

# **KNOWLEDGE TRANSFER WITHIN SUPPLY CHAIN PARTNERSHIPS**

## **An Empirical Study Of A Chinese Steel Producer**

**A thesis submitted to Middlesex University  
in *partial* fulfilment of the requirements for  
the degree of  
Doctor of Philosophy**

**Qile He**

**Business School,  
Middlesex University, London, U.K.**

**April 2009**

## **ABSTRACT**

Over the last decade, increasing attention by practitioners has been matched by an increasing interest and focus by academics on issues surrounding knowledge creation and knowledge deployment in organizations. There is also increasing recognition that knowledge generated solely within the firm is likely to have a limited impact on performance improvement. Knowledge from external sources is an important contributor to firms' efforts to gain sustainable competitive advantage. Schools of organizational learning and inter-organizational relationship argue that interfirm relationship is an important conduit for valuable know-how and capabilities, which are difficult to generate efficiently within the firm. Among various types of partnership - for example, franchise, R&D partnership, joint venture, and licensing agreement - supply chain partnership as a conduit of interfirm knowledge transfer has attracted increasing attention from practitioners and academics. Despite numerous attempts to examine knowledge transfer in supply chains, previous researchers appear to provide limited clarification on particular characteristics of knowledge transfer in supply chain partnerships. As a result, influential factors unique to the process of supply chain knowledge transfer and the patterns of influence also require examination.

The current study sought to explore the nature of interfirm knowledge transfer between supply chain partners and of relationship factors that influence the effectiveness of that knowledge transfer. It also sought to develop a model capable of explaining the process of knowledge transfer in supply chain partnerships and the influence of knowledge transfer processes on partner firms' supply chain performance and market performance. A large-scale questionnaire survey was executed using snowball sampling in the supply chain network of a large Chinese steel producer. The measurement model was examined before structural equation modelling was carried out to ensure reliability and validity of input data. Moreover, multiple structural equation models were constructed with sub-samples according to partnership characteristics of duration, contract status, and

location in the supply chain. Results of model testing provided varied evidence to support the original model and generally demonstrated the positive role of interfirm knowledge transfer in the context of supply network to firms' performance. Although not all relationship factors showed consistent support for the process of knowledge transfer, commitment, interdependence, and restraint in use of power appeared to be more significant facilitators.

This research widens the existing literature in a number of ways. Theoretically, it highlights the unique characteristics of the supply chain partnership compared with those of other interfirm partnerships. It extracts the relationship factors that have a more significant influence on the knowledge transfer processes. It also examines the multi-stage process of interfirm knowledge transfer, which has previously been regarded as a "black box". Given that existing literature was largely developed in the Western countries, this research extends the knowledge transfer theories to a Chinese industrial context. Empirically, this research fills gaps in previous studies and examines interfirm knowledge transfer in the context of a large supply chain network. Methodologically, snowball sampling has proved to be an effective approach to collecting data from a network of firms. The systematic approach of construct development, validation, cross-validation and model testing could also serve as a guideline for future empirical researchers in the area.

There are several limitations in this research. This research may suffer from common method bias. Moreover, key informant bias may be an issue as a single respondent from each organization was asked to return the questionnaire. Although snowball sampling is an effective data collection method, it may end up including more favourable or mature partnerships in the sample. However, given that this research sought to study partnerships rather than arms-length relationships, closer relationships were preferred. Because this research was carried out in the supply network of one large firm, the findings could be contextual. This, however, remains an issue to be addressed by future researchers.

## **ACKNOWLEDGEMENTS**

I am very glad to take this opportunity to express my gratitude to all the people who have supported this research. Special thanks are due to my advisors Professor Abby Ghobadian, Dr. David Gallear, Dr. Jeff Evans, and Professor Nicholas O'Regan for their tireless guidance and encouragement. I also wish to thank Dr. David Jarrett for his advice on statistical analysis. My thanks also go to the external examiners, Dr. Peter Burcher and Dr. David Bamford, for their valuable comments on improving this thesis.

Special thanks are also due to the chairman of Baogang Group, Mr Chen Cui, and the group headquarters secretary, Mr Hui Zhao, for their assistance in completing the survey. This research also owes gratitude to many other anonymous respondents to the survey.

Thanks also to my wife and my parents for their selfless and continuous support. Finally, may I thank all those, too numerous to mention individually, who have given me their help.

# TABLE OF CONTENTS

ABSTRACT .....	i
ACKNOWLEDGEMENTS .....	iii
TABLE OF CONTENTS .....	iv
LIST OF TABLES.....	xi
LIST OF FIGURES.....	xvi
LIST OF APPENDICES .....	xviii
CHAPTER 1 INTRODUCTION .....	1
1.1 Background.....	1
1.2 Critique of the Literature .....	3
1.2.1 An Insufficient Focus on Supply Chain Partnership .....	5
1.2.2 An Insufficient Understanding of the Influence of Partnership Characteristics.....	6
1.2.3 An Insufficient Understanding of the Knowledge Transfer Process .....	7
1.2.4 A Lack of a Comprehensive Theoretical Model.....	8
1.2.5 Inadequate Research Design .....	9
1.2.6 Issues in Method of Analysis .....	12
1.2.7 Issues to be addressed by the Current Study .....	13
1.3 Research Questions .....	15
1.4 Aims and Objectives of the Research .....	16
1.5 Outline of Research Methodology.....	16
1.6 Contributions of the Study.....	18
1.7 Structure of the Thesis .....	19
CHAPTER 2 OVERVIEW OF SUPPLY CHAIN MANAGEMENT AND KNOWLEDGE TRANSFER IN THE SUPPLY CHAIN.....	21
2.1 Preamble .....	21
2.2 Concept of the Supply Chain.....	21
2.2.1 The Value Chain Concept.....	22
2.2.2 The Supply Chain Defined.....	24

2.2.3 Characteristics of the Supply Chain Concept.....	26
2.3 Supply Chain Management .....	29
2.3.1 Supply Chain Management Defined .....	29
2.3.2 Scope of Supply Chain Management .....	30
2.4 General View of Knowledge Transfer in Supply Chain Partnerships .....	36
2.4.1 Supply Chain Performance .....	36
2.4.2 Supply Chain Partnerships .....	37
2.4.3 Interfirm Knowledge Transfer in the Supply Chain.....	39
2.5 Summary.....	46
<b>CHAPTER 3 SUPPLY CHAIN PARTNERSHIP .....</b>	<b>48</b>
3.1 Preamble .....	48
3.2 Critical Role of Supply Chain Partnership .....	48
3.3 Supply Chain Partnership Defined .....	49
3.4 Supply Chain Partnership as a Type of Interfirm Relationship .....	51
3.5 Uniqueness of Supply Chain Partnerships.....	54
3.5.1 Cooperative Interface .....	54
3.5.2 Nature of Contractual Agreement .....	57
3.5.3 Potential Benefits of Partnership.....	60
3.5.4 Partnership Structure.....	63
3.5.5 Summary of Characteristics of Supply Chain Partnership.....	65
3.6 Determinants of the Characteristics of Supply Chain Partnership .....	66
3.6.1 Magnitude of Supply Chain Partnership .....	66
3.6.2 Attributes of Supply Chain Partnership Magnitude .....	67
3.6.3 Power Relationship .....	78
3.6.4 Partnership Duration .....	83
3.6.5 A Three-dimensional Representation of the Determinants of Supply Chain Partnership Characteristics.....	84
3.7 Summary.....	86
<b>CHAPTER 4 KNOWLEDGE AND KNOWLEDGE TRANSFER IN SUPPLY CHAIN PARTNERSHIP .....</b>	<b>87</b>
4.1 Preamble .....	87
4.2 The Knowledge-based Theory of the Firm and Interfirm Knowledge Transfer.....	87
4.2.1 The Resource-based View and Knowledge-based View of the Firm .....	88
4.2.2 Implications for Interfirm Knowledge Transfer .....	91
4.3 Concept of Knowledge .....	94

4.3.1 Information vs. Knowledge.....	94
4.3.2 Explicit vs. Tacit Knowledge .....	96
4.3.3 Forms of Supply Chain Knowledge.....	98
4.4 Knowledge Transfer in Supply Chain Partnership .....	101
4.4.1 Unique Characteristics of Knowledge Transfer in Supply Chain Partnership .....	104
4.4.2 Multi-stage View of Interfirm Knowledge Transfer .....	110
4.4.3 Knowledge Acquisition.....	116
4.4.4 Knowledge Internalization.....	122
4.4.5 Knowledge Utilization.....	125
4.4.6 Obstacles to Effective Supply Chain Knowledge Transfer.....	128
4.4.7 Contributions of Interfirm Knowledge Transfer to Firm Performance.....	133
4.5 Summary.....	137
 CHAPTER 5 THEORETICAL FRAMEWORK OF KNOWLEDGE TRANSFER IN THE SUPPLY CHAIN .....	 138
5.1 Preamble.....	138
5.2 Review of Previous Interfirm Knowledge Transfer Studies and Models.....	138
5.2.1 Interfirm Relationship Focus .....	145
5.2.2 Process of Knowledge Transfer .....	146
5.2.3 Factors Influencing Interfirm Knowledge Transfer .....	147
5.3 Theoretical Framework of Knowledge Transfer in Supply Chain Partnership ....	160
5.4 Relationship Strength and Knowledge Transfer .....	171
5.4.1 Partnership Strength Influence on Knowledge Acquisition .....	171
5.4.2 Partnership Strength Influence on Knowledge Internalization .....	175
5.5 Balanced Power and Knowledge Transfer.....	177
5.5.1 Influence of Balanced Power on Knowledge Acquisition .....	178
5.5.2 Influence of Balanced Power on Knowledge Utilization.....	179
5.6 Interrelationship between the Knowledge Transfer Stages .....	180
5.7 Knowledge Transfer and Performance Improvement.....	182
5.7.1 Knowledge Acquisition and Performance Improvement .....	182
5.7.2 Knowledge Internalization and Performance Improvement .....	183
5.7.3 Knowledge Utilization and Performance Improvement.....	184
5.7.4 Relationship between Supply Chain Performance and Market Performance .....	185
5.8 Moderating Effects of Partnership Duration .....	186
5.9 Summary.....	189
 CHAPTER 6 RESEARCH METHODOLOGY .....	 191
6.1 Preamble.....	191

6.2 Methodological Approach .....	191
6.2.1 Positivism vs. Post-positivism .....	191
6.2.2 Adopting Post-positivism as the Methodology .....	193
6.3 Research Design .....	195
6.3.1 Research Purpose .....	195
6.3.2 Fixed Design Strategy .....	196
6.3.3 Fitting Research Methods to Research Questions.....	197
6.3.4 Questionnaire Survey as Data Collection Method .....	199
6.4 Design of Fieldwork .....	200
6.4.1 Highlights from an Influential Previous Study .....	201
6.4.2 Sampling Strategy .....	203
6.5 Issues in Research Design .....	205
6.5.1 General Research Design .....	205
6.5.2 Validity and Reliability .....	207
6.6 Potential Ethical Issues .....	209
6.7 Summary of the Research Process .....	209
6.8 Summary.....	210
<b>CHAPTER 7 SURVEY CONSTRUCTION AND EXECUTION.....</b>	<b>212</b>
7.1 Preamble .....	212
7.2 The Total Design Method .....	212
7.3 Target Research Sample .....	214
7.3.1 Getting Access to the Research Sample .....	214
7.3.2 Assistance and Sponsorship Gained from the Target Organization .....	215
7.3.3 Introduction to the Target Supply Chain Network .....	216
7.4 Rationale of Constructs Operationalization.....	220
7.5 Operationalization of Supply Chain Partnership Characteristics .....	221
7.5.1 Level of Trust.....	222
7.5.2 Level of Commitment .....	223
7.5.3 Level of Interdependence.....	224
7.5.4 Level of Shared Meaning.....	226
7.5.5 Level of Availability of Alternatives .....	227
7.5.6 Level of Restraint in Use of Power .....	228
7.5.7 Level of Partnership Duration.....	229
7.6 Operationalization of Knowledge Transfer Activities .....	229
7.6.1 Measures of Knowledge Acquisition .....	230
7.6.2 Measures of Knowledge Internalization .....	231
7.6.3 Measures of Knowledge Utilization .....	232



7.7 Operationalization of Performance Measures .....	235
7.7.1 Market Performance Measurement.....	235
7.7.2 Review of Supply Chain Performance Measurement .....	238
7.7.3 Operationalization of Supply Chain Performance .....	246
7.8 Control Variables.....	247
7.8.1 Contract Status .....	247
7.8.2 Upstream or Downstream .....	248
7.9 Questionnaire Layout .....	248
7.9.1 Screening Questions.....	248
7.9.2 Main Body of Questionnaire.....	250
7.10 Translation-back-translation .....	251
7.11 Instrument Refinement and Survey Execution .....	254
7.12 Summary.....	256
<b>CHAPTER 8 DEMOGRAPHIC ANALYSIS .....</b>	<b>257</b>
8.1 Preamble .....	257
8.2 Status of Respondents.....	257
8.3 About the Responding Firms .....	259
8.4 Partnership Location in the Supply Chain.....	260
8.5 Status of the Supply Chain Partnerships.....	266
8.6 Summary.....	269
<b>CHAPTER 9 ANALYSIS STRATEGY AND MEASUREMENT MODEL</b>	
<b>EVALUATION .....</b>	<b>271</b>
9.1 Preamble .....	271
9.2 Analytical Method and Analysis Strategy .....	271
9.2.1 Structural Equation Modeling and LISREL.....	273
9.2.2 The Two Stage Analysis.....	274
9.3 Data Preparation .....	279
9.3.1 Recoding and Missing Values Imputation.....	279
9.3.2 Test of Normality .....	284
9.4 Measurement Model Evaluation.....	289
9.4.1 CFA and Validity Assessment .....	290
9.4.2 Measurement Model Improvement and Scale Refinement .....	292
9.5 Indicators of Supply Chain Partnership Characteristics .....	295

9.5.1 Confirmatory Factor Analysis.....	295
9.5.2 Cross-validation of Supply Chain Relationship Scale .....	298
9.5.3 Convergent Validity and Discriminant Validity of Refined Relationship Scale.....	301
9.5.4 Second-order CFA of Partnership Strength Indicators .....	305
9.6 Indicators of Knowledge Transfer Activities.....	307
9.6.1 Second-order CFA of Knowledge Utilization Scale with Calibration Sample .....	307
9.6.2 Cross-validation of Knowledge Utilization Scale.....	310
9.6.3 Validity and Reliability of Knowledge Utilization Scale .....	312
9.6.4 CFA Analysis of Knowledge Transfer Scale with Calibration Sample .....	315
9.6.5 Cross-validation of Knowledge Transfer Scales.....	316
9.6.6 Reliability and Validity of Knowledge Transfer Scales .....	317
9.7 Summary.....	319
<b>CHAPTER 10 STRUCTURAL EQUATION MODELING.....</b>	<b>321</b>
10.1 Preamble .....	321
10.2 Strategy of Structural Equation Modeling.....	321
10.2.1 Competing Model Strategy .....	321
10.2.2 Model Trimming Approach.....	322
10.2.3 Issues of Cross-validation .....	324
10.3 SEM Part One: Partnership Characteristics and Knowledge Transfer Activities.....	325
10.3.1 Submodel 1: Entire Sample.....	325
10.3.2 Submodel 1a: Controlling Duration.....	332
10.3.3 Submodel 1b: Controlling Contract Status .....	339
10.3.4 Submodel 1c: Controlling Upstream and Downstream in the Supply Chain.....	344
10.4 SEM Part Two: Knowledge Transfer Activities and Supply Chain Performance.....	348
10.4.1 Submodel 2: Entire Sample.....	349
10.4.2 Submodel 2a: Controlling Duration.....	352
10.4.3 Submodel 2b: Controlling Contract Status .....	356
10.4.4 Submodel 2c: Controlling Upstream and Downstream in the Supply Chain.....	360
10.5 Summary.....	364
<b>CHAPTER 11 DISCUSSION .....</b>	<b>366</b>
11.1 Preamble .....	366
11.2 Influences of Partnership Magnitude on Supply Chain Knowledge Transfer ....	371
11.2.1 Trust and Commitment.....	371
11.2.2 Shared Meaning .....	374
11.2.3 Interdependence .....	375
11.3 Influence of Balanced Power on Supply Chain Knowledge Transfer .....	376
11.3.1 Availability of Alternatives.....	377

11.3.2 Restraint in Use of Power .....	378
11.4 Stages of Knowledge Transfer and Firm Performance.....	379
11.4.1 Stages of Knowledge Transfer .....	379
11.4.2 Impact on Firm Performance .....	380
11.5 Short Partnership vs. Long Partnership .....	382
11.6 Contracted Partnership vs. Non-contracted Partnership.....	387
11.7 Upstream in the Supply Chain vs. Downstream in the Supply Chain .....	392
11.8 Comparing Results with Previous Literature.....	397
11.9 Summary.....	402
CHAPTER 12 CONCLUSIONS.....	403
12.1 Preamble .....	403
12.2 Summary to the Study .....	403
12.3 Summary of Key Research Findings .....	405
12.4 Implications for Practitioners .....	408
12.4.1 Management of Knowledge Transfer.....	408
12.4.2 Management of Supply Chain Partnerships.....	412
12.5 Contributions of the Study.....	415
12.6 Implications for Researchers .....	418
12.7 Limitations.....	419
12.8 Directions for Future Research.....	422
REFERENCES.....	424
FURTHER READINGS.....	458
APPENDICES.....	468

## **LIST OF TABLES**

Table 2-1 Definitions of Supply Chain.....	25
Table 2-2 Examples of Studies on Different Types of Interfirm Knowledge Transfer.	41
Table 3-1 Definitions of Supply Chain Partnership.....	50
Table 3-2 Selection of Classification of Inter-firm Relationship Types .....	52
Table 3-3 Comparisons of Supply Chain Partnership and Other Types of Interfirm Partnership .....	65
Table 3-4 Sample of Interfirm Relationship Magnitude Attributes .....	68
Table 3-5 Dimensions of Trust and Explanations.....	70
Table 4-1 Explicit Knowledge vs. Tacit Knowledge .....	97
Table 4-2 Summary of Characteristics of Knowledge Transfer in Supply Chain Partnership .....	102
Table 4-3 Knowledge Transfer Process in Prior Studies .....	113
Table 4-4 Interfirm Knowledge Acquisition Mechanisms .....	118
Table 4-5 Possible Barriers to Knowledge Transfer in Supply Chain Partnership.....	131
Table 5-1 A Synthesis of Empirical Studies of Interfirm Knowledge Transfer.....	140
Table 5-2 Research Hypotheses and Supporting Literature .....	163
Table 7-1 Characteristics of Firms in Baogang's Supply Chain Network.....	219
Table 7-2 Measures of Trust .....	222
Table 7-3 Measures of Commitment .....	224
Table 7-4 Measures of Interdependence .....	225
Table 7-5 Measures of Shared Meaning.....	226
Table 7-6 Measures of Availability of Alternatives .....	227
Table 7-7 Measures of Restraint in Use of Power .....	228
Table 7-8 Measures of Knowledge Acquisition.....	230
Table 7-9 Measures of Knowledge Internalization.....	231
Table 7-10 Measures of Instrumental Use of Knowledge .....	233
Table 7-11 Measures of Conceptual Use of Knowledge .....	234

Table 7-12 Measures of Symbolic Use of Knowledge .....	235
Table 7-13 Measures of Market Performance .....	237
Table 7-14 Different Aspects of Supply Chain Performance .....	239
Table 7-15 A Supply Chain Balanced Scorecard Framework .....	241
Table 7-16 Combined Balanced Scorecard Supply Chain Performance Indicators ...	242
Table 7-17 Supply-focused vs. Demand-focused Supply Chain Performance.....	243
Table 7-18 Performance measures by Management Level and Supply Chain Processes.....	245
Table 7-19 Adopted Measures of Supply Chain Performance .....	247
Table 7-20 Number of Usable Questionnaires .....	255
Table 8-1 Position of Respondent .....	257
Table 8-2 Working Area of Respondent .....	258
Table 8-3 Duration at Position of Respondent .....	258
Table 8-4 Industrial Sector of Responding Firms .....	259
Table 8-5 Numbers of Employees of Responding Firms .....	260
Table 8-6 Type of Responding Partnership with Respect to Position in Supply Chain	261
Table 8-7 Sectors of Responding firms Upstream in the Supply Chain.....	263
Table 8-8 Sectors of Responding firms Downstream in the Supply Chain.....	264
Table 8-9 Sectors of Responding Firms Involved in Direct Partnerships .....	265
Table 8-10 Sectors of Responding Firms Involved in Indirect Partnerships.....	266
Table 8-11 Supply Chain Partnership Contract Status .....	267
Table 8-12 Supply Chain Partnership Duration .....	267
Table 8-13 Cross-tabulation of Contract Status and Partnership Duration .....	268
Table 8-14 Cross-tabulation of Contract Status and Partnership Location .....	269
Table 8-15 Cross-tabulation of Partnership Location and Partnership Duration .....	269
Table 9-1 Coding of Types of Supply Chain Partnership .....	279
Table 9-2 Summary of Missing Value for Each Indicator .....	281
Table 9-3 Univariate Summary Statistics for Continuous Variables .....	285
Table 9-4 Test of Univariate Normality for Continuous Variables.....	287
Table 9-5 CFA Analysis of Indicators of Partnership Characteristics from Calibration	

Sample .....	296
Table 9-6 Comparison of Parameters Estimates of Refined Relationship Scales .....	299
Table 9-7 Test of Invariance of Refined Relationship Scales .....	301
Table 9-8 CFA Analysis of Refined Supply Chain Relationship Scale (n=413) .....	302
Table 9-9 Second-order CFA analysis of Knowledge Unitization Scales with Calibration Sample .....	307
Table 9-10 Comparison of Parameters Estimates of Refined Knowledge Utilization Scales .....	311
Table 9-11 Test of Invariance of Refined Knowledge Utilization Scales .....	312
Table 9-12 CFA Analysis of Refined Knowledge Utilization Constructs with Entire Sample .....	313
Table 9-13 Principal Component Analysis of Knowledge Utilization Dimensions ...	315
Table 9-14 CFA Analysis of Knowledge Transfer Constructs with Calibration Sample .....	316
Table 9-15 Comparison of Parameters Estimates of Refined Knowledge Transfer Scales .....	317
Table 9-16 Test of Invariance of Refined Knowledge Transfer Scales .....	317
Table 9-17 Confirmatory Factor Analysis of Refined Knowledge Transfer Constructs (n=413) .....	319
Table 10-1 Structural Equation Model Comparing Nested Models .....	328
Table 10-2 Path Coefficient Estimates based on the Entire Sample .....	330
Table 10-3 Comparing Nested Models for Short Duration Sample .....	334
Table 10-4 Path Coefficient Estimates based on Short Duration Sample .....	334
Table 10-5 Comparing Nested Models for Long Duration Sample .....	336
Table 10-6 Path Coefficient Estimates based on Long Duration Sample .....	336
Table 10-7 Test of Invariance of Relationship Scales on Short and Long Duration Samples .....	338
Table 10-8 Test of Invariance of Knowledge Transfer Scales on Short and Long Duration Samples .....	338
Table 10-9 Supply Chain Partnership Contract Status .....	339

Table 10-10 Comparing Nested Models for Contracted Sample.....	340
Table 10-11 Path Coefficient Estimates based on Contracted Sample.....	340
Table 10-12 Comparing Nested Models for Non-contracted Sample .....	342
Table 10-13 Path Coefficient Estimates Based on Non-contracted Sample.....	343
Table 10-14 Upstream or Downstream in the Supply Chain .....	344
Table 10-15 Comparing Nested Models for Upstream Sample.....	345
Table 10-16 Path Coefficient Estimates based on Upstream Sample.....	345
Table 10-17 Comparing Nested Models for Downstream Sample.....	347
Table 10-18 Path Coefficient Estimates based on Downstream Sample.....	347
Table 10-19 Comparing Nested Models Entire Sample for Model Part 2.....	350
Table 10-20 Path Coefficient Estimates of Model Part Two based on Entire Sample	351
Table 10-21 Comparing Nested Models of Short Duration Sample for Model Part 2	352
Table 10-22 Path Coefficient Estimates of Model Part Two based on Short Duration Sample .....	353
Table 10-23 Comparing Nested Models of Long Duration Sample for Model Part 2	355
Table 10-24 Path Coefficient Estimates of Model Part Two based on Long Duration Sample .....	355
Table 10-25 Comparing Nested Models of Contracted Sample for Model Part 2 .....	357
Table 10-26 Path Coefficient Estimates of Model Part Two based on Contracted Sample .....	358
Table 10-27 Comparing Nested Models of Non-contracted Sample for Model Part 2	359
Table 10-28 Path Coefficient Estimates of Model Part Two based on Non-contracted Sample .....	359
Table 10-29 Comparing Nested Models of Upstream Sample for Model Part 2 .....	361
Table 10-30 Path Coefficient Estimates of Model Part Two based on Upstream Sample .....	361
Table 10-31 Comparing Nested Models of Downstream Sample for Model Part 2...	363
Table 10-32 Path Coefficient Estimates of Model Part Two based on Downstream Sample .....	363
Table 11-1 Summary of Tested Hypothesis .....	369

Table 11-2 Comparing Current Research Findings and Findings from Previous Literature .....	399
--	-----



## LIST OF FIGURES

Figure 1-1 Research Process and Main Chapters .....	20
Figure 2-1 The Value Chain Model .....	23
Figure 2-2 Generalized Supply Chain Model .....	27
Figure 3-1 Supply Chain Relationship Continuum .....	53
Figure 3-2 Supply Chain Partnership Structures .....	63
Figure 3-3 Supply Chain Partnership 3-D Representation .....	85
Figure 4-1 Four Stages of Knowledge Transition from Source to Use .....	112
Figure 4-2 Supply Chain Interfirm Knowledge Transfer Process Model.....	115
Figure 5-1 Emerging Influential Factors to Interfirm Knowledge Transfer .....	149
Figure 5-2 Theoretical Model of Knowledge Transfer in Supply Chain Partnership	161
Figure 6-1 Summary of Research Process and Methods.....	211
Figure 7-1 An Illustration of Extended Supply Chain Network of Baogang Group ..	218
Figure 7-2 Measurement Metric at Four Basic Links in a supply chain .....	245
Figure 7-3 Translation-back-translation Process .....	253
Figure 8-1 Map of Responding Supply Chain Partnerships and Number of Respondents.....	262
Figure 9-1 Divided Conceptual Model Part One.....	272
Figure 9-2 Divided Conceptual Model Part Two .....	273
Figure 9-3 Stage One of the Structural Equation Modeling Process.....	277
Figure 9-4 Stage Two of the Structural Equation Modeling Process .....	278
Figure 9-5 CFA of Refined Supply Chain Relationship Scale Based on Calibration Sample, Model R7 .....	298
Figure 9-6 CFA of Supply Chain Relationship Scale Based on Entire Sample, Model R7 .....	304
Figure 9-7 Second-order CFA of Partnership Strength.....	306
Figure 9-8 Second-order CFA of Knowledge Utilization Constructs, Model U1 .....	309
Figure 9-9 First-order CFA of Knowledge Utilization Constructs with Entire Sample,	

Model U5 .....	314
Figure 9-10 CFA of Refined Scale of Knowledge Transfer based on Entire Sample, Model KT2 .....	318
Figure 10-1 Path Diagram of SEM Model Part 1, Model P1M11, Entire Sample .....	329
Figure 10-2 Significant Relationships in Model Part One, Entire Sample.....	331
Figure 10-3 Significant Relationships in Model Part One, Short Duration Sample...	335
Figure 10-4 Significant Relationships in Model Part One, Long Duration Sample...	337
Figure 10-5 Significant Relationships in Model Part One, Contracted Sample.....	341
Figure 10-6 Significant Relationships in Model Part One, Non-contracted Sample..	343
Figure 10-7 Significant Relationships in Model Part One, Upstream Sample.....	346
Figure 10-8 Significant Relationships in Model Part One, Downstream Sample.....	348
Figure 10-9 Path Diagram of SEM Model Part 2, Entire Sample .....	350
Figure 10-10 Significant Relationships in Model Part Two, Entire Sample .....	351
Figure 10-11 Significant Relationships in Model Part Two, Short Duration Sample	353
Figure 10-12 Significant Relationships in Model Part Two, Long Duration Sample	356
Figure 10-13 Significant Relationships in Model Part Two, Contracted Sample.....	358
Figure 10-14 Significant Relationships in Model Part Two, Non-contracted Sample	360
Figure 10-15 Significant Relationships in Model Part Two, Upstream Sample.....	362
Figure 10-16 Significant Relationships in Model Part Two, Downstream Sample....	364
Figure 11-1 Significant Relationships in the Whole Model, Entire Sample .....	368
Figure 11-2 Significant Relationships in the Whole Model, Short Duration Sample	383
Figure 11-3 Significant Relationships in the Whole Model, Long Duration Sample.	384
Figure 11-4 Significant Relationships in the Whole Model, Contracted Sample.....	388
Figure 11-5 Significant Relationships in the Whole Model, Non-contracted Sample	389
Figure 11-6 Significant Relationships in the Whole Model, Upstream Sample.....	395
Figure 11-7 Significant Relationships in the Whole Model, Downstream Sample....	396

## **LIST OF APPENDICES**

APPENDIX 1 ENGLISH VERSION OF SURVEY (NON-RANDOMIZED)	468
APPENDIX 2 TYPICAL EXAMPLES OF LISREL PROGRAM INPUTS	482
Stage One: Measurement Model Evaluation .....	482
Part One: Partnership Nature Scale.....	482
Part Two: Knowledge Transfer Process Scale.....	484
Stage Two: Structural Equation Modeling.....	488
Part One: Relationship between Partnership Nature and Knowledge Transfer Process .	488
Part Two: Relationship between Knowledge Transfer Process and Firms Performance	491
APPENDIX 3 A REVIEW PAPER OF REARCH METHODOLOGIES IN INTERFIRM KNOWLEDGE TRANSFER .....	495

# CHAPTER 1 INTRODUCTION

## 1.1 Background

Over the last two decades, the intensity of market competition has significantly increased. To secure sustainable competitive advantage practitioners and academics are seeking various ways to improve efficiency and effectiveness. The search extends beyond the individual firm's boundaries. Instead, the supply chain is considered as an alternative source of creating operations advantage. One of the consequences of this trend has been the acceptance of supply chain management as a new philosophy of improving a firm's performance. The successful stories of Toyota, Wal-Mart, and Dell, for example, have stimulated many firms to reevaluate their traditional operations, and explore the possibility of supply chain integration. Nowadays, the realization that the basis of competition has moved beyond individual firms is widespread. It is now the competition between supply chains that is dominating the contemporary business world (Christopher, 1998, p.16; Maqsood et al., 2007).

Recognizing the trend, practitioners and researchers increasingly highlight the cooperation and collaboration of participants from upstream to downstream of the production and distribution process (e.g. Macbeth and Ferguson, 1994; Mentzer et al., 2000; Chopra and Meindl, 2001; Lamming, 2005; Cousins et al., 2006). Supply chain partnership becomes an important strategy that enables businesses to improve performance and generate competitive advantage (e.g. Harland, 1996; Christopher, 1998; Monczka et al., 1998; Cousins and Spekman, 2003; Harland et al., 2004; Lamming, 2005). Importantly, the performance improvement of an individual firm is no longer recognized as the key to success. Instead, the performance and productivity of the whole supply chain becomes the factor determining the success of the supply chain and the participant firms (Christopher, 1998; Lamming et al., 2000; Maqsood et al., 2007).

Among various integrative strategies that firms in a supply chain could benefit from, knowledge transfer and interfirm learning have been increasingly highlighted. It is believed that supply chain partnership, acting as the conduit for the flow of know-how and best practices, will become an engine of continuous development (Beecham and Cordey-Hayes, 1998; Dyer and Nobeoka, 2000; Crone and Roper, 2001; Love et al., 2002; Hult et al., 2004; Hult et al., 2007; Maqsood et al., 2007; Modi and Mabert, 2007; Lawson et al., 2009). Compared to other tangible business resources, knowledge is regarded as an important resource for sustainable competitive advantage (Conner and Prahalad, 1996; Grant, 1996b; Argote et al., 2003a). Accordingly, interfirm knowledge transfer is considered to be an important means for firms to gain competitive advantage (Crossan and Inkpen, 1995; Grant, 1996b; Cousins and Spekman, 2003; Maqsood et al., 2007). The continuous transactions between supply chain partners provide the platform for supplier and purchaser firms to exchange new ideas and learn best practices from each other. For example, the successful knowledge transfer between Toyota and its suppliers, which significantly improved their productivity and reduced inventory, has provided good evidence for the importance of interfirm knowledge transfer (Dyer and Nobeoka, 2000). However, whether firms are aware of and are capable of taking the opportunity of interfirm learning is a different matter.

To many businesses, knowledge transfer is still a brand new concept. Firms' managers may not be aware of the potential of effective interfirm learning. The traditional principle of guarding important information is still at the forefront of most managers' minds. Thus, even though there are success stories of effective knowledge transfer, many firms still refuse to give their supply chain partners access to their knowledge. For this reason, the capability and the effectiveness of suppliers and purchasers to learn from each other are still a bottleneck facing practitioners and researchers, despite the fact that they are increasingly emphasized (e.g. Love and Gunasekaran, 1999; Bender and Fish, 2000; Levin, 2002; Cousins and Spekman, 2003; Desouza et al., 2003; Modi and Mabert, 2007; Cousins et al., 2008).

The barrier to greater levels of knowledge transfer could be technological, in that firms do not have adequate facilities or mechanisms to facilitate knowledge transfer.

Arguably, the greater barrier is managerial, and most of the time it is to do with interfirm relationships. Partner firms hesitate to share knowledge, because of the status of their relationship and the traditional perceptions of competitiveness that are still dominating their relationship (Dyer and Nobeoka, 2000; Knight, 2000; Crone and Roper, 2001; Kotabe et al., 2003). As Love and Gunasekaran (1999) pointed out, a “psychological barrier” may exist between alliance partners, caused by the fear that their partner(s) may out-learn or deskill them. Fear of knowledge spillover tends to dominate firms’ inter-firm strategy, which may limit the level of interfirm knowledge transfer. In this sense, the reasons for ineffective knowledge transfer, and the relationship factors that influence knowledge transfer are important foci for clarification.

Given the potential practical value of knowledge transfer among supply chain partners, it is necessary to have a more in-depth understanding of the nature of knowledge transfer between supply chain partners. Issues such as mechanisms of knowledge transfer and organizational factors that affect the knowledge transfer need to be examined. In particular, the influence of the characteristics of supply chain partnerships on the interfirm knowledge transfer needs to be explored. A more in-depth and systematic understanding of the determinants of supply chain partnership, as well as how they influence the process of knowledge transfer, will help supply chain partners to practise better knowledge transfer and to benefit more from interfirm knowledge transfer.

## **1.2 Critique of the Literature**

There is no doubt that issues of interfirm knowledge transfer are attracting more and more attention from the academic world. An examination of the literature indicates that

researchers are particularly interested in issues such as the benefits of knowledge transfer, mechanisms of interfirm knowledge transfer, retaining and protecting knowledge, and factors that affect interfirm knowledge transfer (e.g. Cohen and Levinthal, 1990; Mowery et al., 1996; Simonin, 1999b; Cummings and Teng, 2003; Santos-Vijande et al., 2005; Wu and Cavusgil, 2006; Krause et al., 2007; Lawson et al., 2009). In order to develop a full picture of the existing literature in the area of interfirm knowledge transfer and knowledge transfer in supply chain partnership, a content analysis of existing literature was conducted (see also He et al., 2006). Specifically, more than eighty empirical papers recently published in peer-reviewed journals (such as Decision Sciences, Organization Science, Management Science, Strategic Management Journal, Academy of Management Journal, Omega, Journal of Management Studies, and Journal of Operations Management) were reviewed based on a set of dimensions developed by Podsakoff and Dalton (1987). The original dimensions were extended to suit the nature of interfirm knowledge transfer studies:

- (1) Main Setting of Data Collection
- (2) Unit of Analysis
- (3) Sample Size
- (4) Type of Sample
- (5) Occupation of Subjects
- (6) Primary Means of Data Collection
- (7) Type of Dependent Variable
- (8) Number of Dependent Variables
- (9) Type of Analysis
- (10) Time Frame of Study
- (11) Nature of Construct Validation Procedure
- (12) Nature of Results Verification
- (13) Geographic Location of the Study (new dimension)
- (14) Range of Analysis (new dimension)
- (15) Type of Interfirm Knowledge Transfer (new dimension)
- (16) Nature of Interfirm Relationship (new dimension)
- (17) Process of Knowledge Transfer (new dimension)

These dimensions were used to address questions concerning the range of methodologies deployed. For example, do these studies rely on a broad or narrow range of methodologies; what are the commonalities between the research methods; what are the general limitations of the interfirm knowledge transfer research? Answers

to these questions underpin the rationale for the development of the current research. The following sections provide a summary of the findings of this review that are relevant to the current study (See Appendix 3 for the original paper which details the literature review).

### **1.2.1 An Insufficient Focus on Supply Chain Partnership**

Consensus in the literature exists on the view that interfirm partnership is generally regarded as the intermediate form of interfirm relationship in the relationship spectrum, that ranges from arms-length to vertical integration (e.g. Gardner et al., 1994; Lambert et al., 1999; Golicic et al., 2003). Researchers generally agree that partnerships between firms can take place through a variety of different arrangements, including relationships with suppliers, intermediaries, customers and even with potential or current competitors (Mohr and Sengupta, 2002; Sornn-Friese and Sorensen, 2005), so that when studying interfirm knowledge transfer, various forms of interfirm relationship could be the focus.

Nevertheless, it was found that previous scholars were particularly interested in knowledge transfer in strategic alliances, which could cover a wide range of interfirm partnerships (e.g. Mowery et al., 1996; Powell et al., 1996; Simonin, 1997, 1999b; Cummings and Teng, 2003). Although some researchers have paid attention to a particular type of strategic alliance, such as joint ventures (e.g. Ritcher and Vettel, 1995; Makhija and Ganesh, 1997; Tiemessen et al., 1997; Inkpen and Dinur, 1998; Buckley et al., 2006) many researchers have not specified the strategic alliance or type of interfirm partnership within which the study of knowledge transfer has taken place (e.g. Cavusgil et al., 2003; Nieto and Quevedo, 2005; Ramasamy et al., 2006).

Furthermore, research efforts to help clarify issues surrounding interfirm knowledge transfer in the supply chain have emerged over the last decade or so (e.g. Beecham and Cordey-Hayes, 1998; Dyer and Nobeoka, 2000; Kotabe et al., 2003; Hult et al., 2004;



Dyer and Hatch, 2006; Hult et al., 2006; Hult et al., 2007; Modi and Mabert, 2007; Lawson et al., 2009). However, most of the studies were developed based on the general theorization of interfirm partnerships without giving much attention to the particular characteristics of supply chain operations and supply chain partnerships. Given that the learning practices involved in knowledge transfer are likely to depend on the different interfirm relationship arrangements (e.g. Koka and Prescott, 2002; Hardy et al., 2003; Uzzi and Lancaster, 2003; Harland et al., 2004), the results generated from many studies are open to criticism in terms of feasibility and applicability. It is particularly evident that little previous research has focused on developing a holistic understanding of knowledge transfer between supply chain partners.

### **1.2.2 An Insufficient Understanding of the Influence of Partnership**

#### **Characteristics**

The previous studies have highlighted a number of organizational factors that influence effective interfirm knowledge transfer. Typically, researchers have been interested in absorptive capacity (Cohen and Levinthal, 1990; Mowery et al., 1996; Wang et al., 2004; Nieto and Quevedo, 2005), knowledge ambiguity (Simonin, 1999b), collaborative know-how (Simonin, 1997), and learning intention (Mowery et al., 1996; Calantone et al., 2002; Wang et al., 2004). Relatively few studies, however, have paid attention to the characteristics of the interfirm interfaces that tend to affect interfirm knowledge transfer. In particular, in the study of knowledge transfer in supply chains, very few scholars have provided a comprehensive view of the characteristics of supply chain partnership.

Prior studies have been limited in providing a comprehensive view regarding the determinants of the supply chain partnership status, and, as such, limited understanding has been provided on how the characteristics of supply chain partnerships could affect the knowledge transfer process. For instance, Kotabe et al. (2003) concentrated on the

influence of link duration between buyer and supplier on knowledge transfer. Cavusgil et al. (2003) examined the effect of relationship strength between partnering firms on knowledge transfer. Dyer and Nobeoka (2000) addressed the role of network identity and network strength in knowledge transfer in their case study of Toyota and its suppliers. Hult et al. (2004) explored the role of shared meaning and achieved memory in the process of knowledge sharing. Dyer and Hatch (2006) addressed the organizational routines as barriers to interfirm knowledge transfer between suppliers and buyers in the auto industry. However, the characteristics of the relationship between supply chain partners tend to be specified by a collection of indicators. Looking at one or the other indicator in isolation is not enough to give a sufficient understanding of the impact of the characteristics of supply chain partnership on effective knowledge transfer. A more systematic analysis of supply chain partnerships to understand the facilitators as well as the barriers to successful knowledge transfer in supply chain partnership is called for.

### **1.2.3 An Insufficient Understanding of the Knowledge Transfer Process**

To clearly understand the concept of interfirm knowledge transfer, it is also necessary to have a clear view of the knowledge transfer process. However, the majority of studies reviewed have treated the learning process as a “black box” between inputs and outputs (e.g. Cohen and Levinthal, 1990; Mowery et al., 1996; Powell et al., 1996; Cavusgil et al., 2003; Kotabe et al., 2003; Buckley et al., 2006; Modi and Mabert, 2007). Some scholars have simply regarded knowledge transfer as a single stage phenomenon or a black box, so that they tested the factors that could affect the whole process of knowledge transfer (e.g. Simonin, 1999b; Cavusgil et al., 2003; Kotabe et al., 2003). For instance, Kotabe et al. (2003) empirically examined the influence of relationship duration on the effective transfer of technical and technological knowledge. However, only very limited information on the mechanism of knowledge transfer was provided. Minbaeva (2007) differentiated the disseminative capacity of the knowledge sender and the absorptive capacity of the knowledge receiver, but did not examine the

actual process of interfirm knowledge transfer.

It seems that many empirical studies were built upon the assumption that the interfirm learning process is unlikely to vary and lead to different outcomes. One possible explanation is that researchers have employed research methods with limited capability to deal with the complexity involved in the dynamic process of knowledge transfer, although some have realized the importance of those processes (Lane et al., 2001; Cummings and Teng, 2003; Johnson and Sohi, 2003; Hult et al., 2004; Minbaeva, 2007; Molina et al., 2007). Without disclosing the actual process of knowledge transfer, discussions on the characteristics of knowledge transfer and the factors that influence it can be regarded as somewhat arbitrary.

#### **1.2.4 A Lack of a Comprehensive Theoretical Model**

There is generally a lack of a comprehensive theoretical framework that could explain the interfirm knowledge transfer process. In particular, there is a lack of a comprehensive theoretical model dealing with knowledge transfer between supply chain partners. Although researchers have constructed models to explain interfirm knowledge transfer, most of those models were found to be limited in clarity and comprehensiveness with respect to issues such as the characteristics of interfirm relationship, mechanisms of knowledge transfer and potential benefits to performance. Specifically, researchers have tended to be selective on the organizational factors that affect knowledge transfer (e.g. Simonin, 1999b; Cavusgil et al., 2003; Kotabe et al., 2003; Hult et al., 2004; Santos-Vijande et al., 2005), and insights into the knowledge transfer process have tended to be omitted (e.g. Mowery et al., 1996; Simonin, 1999b; Cavusgil et al., 2003; Cummings and Teng, 2003; Kotabe et al., 2003; Modi and Mabert, 2007; Mason and Leek, 2008; Squire et al., 2008). Moreover, the mechanisms of knowledge transfer practices are not clearly identified (Beecham and Cordey-Hayes, 1998; Calantone et al., 2002; Becerra et al., 2008).

The researchers that have studied the performance improvement in firms due to knowledge transfer tended to deploy a few performance measures, such as supplier performance improvement (Kotabe et al., 2003), cycle time performance (Hult et al., 2004), organizational performance (Santos-Vijande et al., 2005), and alliance performance (Wu and Cavusgil, 2006). However, the rationales for selecting the measures were generally unclear and appeared to be rather arbitrary.

### **1.2.5 Inadequate Research Design**

Given that two or more parties are normally involved in the process of interfirm knowledge transfer, ideally researchers might be expected to examine all the parties involved in the knowledge transfer process in order to generate a comprehensive view of the subject. To help to classify the studies focused on different kinds of interfirm relationship, the idea of “range of analysis” was introduced. This comprised three different ranges of analysis, unilateral, dyadic, and network. A unilateral range of analysis means that researchers focus only on one party in the context of interfirm knowledge transfer (even if they intend to study the knowledge transfer taking place between two parties). Studies with a dyadic range of analysis are those that look at both counterparts in an interfirm dyad.<sup>1</sup> For example, the studies of Heide and Miner (1992) and Muthusamy and White (2005) collected data from both sides of the dyadic relationship in a survey based study. A network range of analysis is found in those studies, which simultaneously examine more than two firms involved in an interfirm relationship. As an example of a network range of analysis, Hult et al. (2004) examined the supply chains of a Fortune 500 firm. The authors examined the corporate buyer, the internal user, and the external suppliers at the same time in order to explore the interfirm learning effects on company performance.

The benefit of examining both sides of the partnership is widely advocated (e.g. Heide and Miner, 1992; Lam, 1997; Muller et al., 2003). What is apparent in the literature is

---

<sup>1</sup> Examining joint ventures is not treated as a dyadic range of analysis, unless the study explores both parent firms at the same time.

that there is a paucity of studies incorporating a dyadic or network range of analysis perspective. Although researchers may be limited by the research methods or resources available to them, many researchers have failed to give sufficient justification as to why only unilateral studies were carried out (e.g. Mowery et al., 1996; Simonin, 1999b; Anand and Khanna, 2000). This has largely limited the capacity of prior studies to give a more balanced view of the interfirm relationship. Especially in the case of supply chain partnerships, where relationships could be extended into large networks (see more in Section 3.3), perceptions of only one party are far from enough to represent all the parties involved.

Additionally, many researchers have omitted to give explanations about why a certain unit of analysis is chosen as appropriate to answer the research question (e.g. Hult et al., 2000a; Hult et al., 2002a; Wu and Cavusgil, 2006). For instance, in Hult et al.'s (2000a) study of interfirm learning between supply chain partners, SBUs (Strategic Business Units) were chosen as the main unit of analysis. However, the authors did not explain why SBUs rather than firms are legitimate to represent the participants in the supply chain. Moreover, some researchers were unable to link the unit of analysis to the actual research subject (e.g. Kale et al., 2000; Chen, 2004; Muthusamy and White, 2005). Some researchers have even claimed that their unit of analysis is a dyadic relationship, but they actually collected the information from only one side of the relationship. Other researchers have asked respondents to choose one of the most significant partners to answer the questionnaire (e.g. Chen, 2004), but the unilateral information collected may not be justifiable to represent the dyadic relationship. Therefore, there seems to be a misconception in using a unilateral entity with a dyadic relationship as the unit of analysis. It is reasonable to propose that if the dyadic relationship is the unit of analysis, it is important to collect information from both sides of the relationship. Such information is necessary to generate a balanced understanding with findings applicable to the dyadic interfirm units.

Moreover, many studies omitted to clarify the nature of industry sectors which could

be highly differentiated (e.g. Calantone et al., 2002; Spekman et al., 2002; Belderbos, 2003; Bessant et al., 2003). The industry sectors are usually not specified or are only broadly defined. Since the nature of industry determines the organizational structure and the operations process, it is also likely to influence the mechanisms of knowledge transfer. Without clearer identification of the industry sectors studied, research findings tend to be vague and limited in practical value and generalizability.

The scope of studies focusing on examining the knowledge transfer between supply chain partners was generally limited. For instance, Beecham and Cordey-Hayes (1998) examined the knowledge transfer in technology partnering through a longitudinal study. The sample contained only 27 component suppliers in the U.K. motor industry, hence, the outcome is limited in generalizability. Dyer and Nobeoka (2000) studied the knowledge transfer practices of Toyota and its suppliers. Although the result of their study has provided important information for the understanding of effective knowledge transfer in the supply chain, given that the study was based on a single firm, the result may not be applicable to other circumstances. It is worth noting that Hult et al. (2004) explored knowledge sharing within the strategic supply chains of a large organization. Despite the rigorous methodology, a lack of clarification of the characteristics of the supply chain still limited the generalizability of the study.

It is also worth noting that most of the studies collected data from western countries, such as the U.S. and U.K. A small proportion of studies collected data from Asian countries or regions. Nevertheless, most of these studies were based on the data collected from Japan, Hong Kong and Taiwan, which are more technologically developed. This seems to reflect the fact that the concept of interfirm knowledge transfer is much less adopted in other countries. However, given that emerging economies - for example, China, India, and Brazil - are playing increasingly more important roles in global supply chains, a clearer view on these countries will contribute significantly to the understanding of knowledge transfer theories and practices. As most of the studies have been conducted in western countries, the

suitability of research findings being applied in wider geographical contexts could be an issue.

### **1.2.6 Issues in Method of Analysis**

Central to the scientific approach is a degree of scepticism about the findings and their meaning (Robson, 1993, p. 67). The value of any research result largely depends on the adequacy of the construct, which should be both reliable and valid. Validity is concerned with whether the findings are really about what they appear to be about (Robson, 2002, p. 93). Different names have been given to the concept of validity, but its main concern is about whether the measurement is consistent or repeatable (reliability) and whether the measurement is measuring what it intends to measure (construct validity). According to Podsakoff and Dalton (1987), although different validation methods exist, using any individual method is not enough to establish the validity of a construct. It was found that there was a lack of adequate validation practices in past interfirm knowledge transfer studies, especially for those disseminated through the European journal articles. The reason for this could be the absence of ‘standard’ means of assuring reliability and validity in field-based studies (Robson, 2002), or the objective of gaining “analytical generalization” rather than “statistical generalization” (Yin, 2003), or simply the ignorance of researchers when carrying out the study (Didow and Franke, 1984).

As Podsakoff and Dalton (1987) pointed out, when studying multiple dependent variables, it is preferable to use analytical methods capable of handling multiple dependent variables simultaneously, such as canonical correlation, MANOVA, MANOCOVA, and Structural Equation Modeling. However, it was found that there was generally a paucity of studies which employed comprehensive analytical methods to examine the multiple dependent variables. Many of the studies used methods which analyze multiple dependent variables separately or simply used interpretative methods. This indicates that many researchers have relied heavily on the qualitative capability of

the interpretative method to handle more complicated research questions. Treating multiple dependent variables in a statistical model simultaneously has advantages recognized by various researchers (Bray and Maxwell, 1985; Podsakoff and Dalton, 1987; Hair et al., 1995). When multiple dependent variables are examined separately, the potential relationship between concepts is very likely to be overlooked.

Podsakoff and Dalton (1987) also emphasized the importance of conducting various result verification methods (e.g. cross-validation, multi-method validation, and subgroup analysis) to ensure that results are robust and generalizable. Generalizability refers to the extent to which the findings of the enquiry are more generally applicable outside the specifics of the situation studied (Robson, 2002, p. 93). The review of literature suggested that many of the interfirm knowledge transfer studies did not report the use of result verification methods, especially for field-based studies ("Field-based studies" refer to those conducted by researchers who actually enter or access the research subject organisation in person and collect primary data through various data collection techniques, such as interview, observation, or action research). Given that most of the data collected by field-based methods was qualitative, it is hard to find comprehensive verification practices in many studies. One of the main reasons is the lack of standard verification procedures and the complexity involved in the verification of qualitative findings.

### **1.2.7 Issues to be addressed by the Current Study**

Despite substantial research efforts to explore the concept of interfirm knowledge transfer, there is still a gap in the literature in terms of theory building in the context of supply chain partnerships. Researchers could do more to conceptualize the knowledge transfer process and test the concepts empirically, and hence enrich the understanding of interfirm knowledge transfer. In addition, more attention should be paid to the conceptualization of the interfirm relationship when conducting empirical research. Because the characteristics of the interfirm relationship could substantially affect the



mechanisms and process of knowledge transfer (Koka and Prescott, 2002; Hardy et al., 2003; Harland et al., 2004), research findings could be highly context-specific.

Researchers should clearly define the interfirm relationship within which knowledge transfer is taking place before conducting empirical research, to avoid misleading the potential users of research findings. This is especially important for the current research, since few studies have disclosed the particular characteristics of the supply chain partnership and the characteristics of knowledge transfer in the supply chain. More efforts are needed to clarify the characteristics of supply chain partnerships before interfirm knowledge transfer issues are examined. Furthermore, more effort is also needed to examine the particular factors that determine the characteristics of supply chain partnerships, as well as how those factors affect the process of knowledge transfer.

The initial review of literature revealed some common weaknesses in prior interfirm knowledge transfer studies. Some of these weaknesses are also commonly criticized in business and management research areas. Researchers appear to have found difficulty selecting and applying a methodological approach which is able to avoid all the weaknesses but at the same time handle the complex social issues involved. The argument also applies to the interfirm knowledge transfer studies. For example, field-based study allows a researcher to collect richer information based on more means of data collection, from more respondents, for a longer period of time. This type of study is more likely to generate realistic information. However, the limited sample size and the lack of adequate result verification and validation procedures have largely limited its generalizability, which is central to the value of social science studies. This calls for the researchers' capabilities to balance the advantages of various methodologies and the actual objectives of the studies.

At the research design stage, particular attention needs to be paid to the choice of research sample and the unit of analysis. Given that interfirm knowledge transfer normally involves more than one party, the complexity of the study increases

correspondingly. When conducting empirical studies, clear definitions of the unit of analysis should be reached, and sufficient theoretical justifications should be provided, before deciding whether to collect information from one party or more parties in the interfirm relationship, and whether the chosen unit of analysis is appropriate to generate adequate information to answer the research questions. It is believed that sound research design and sufficient justification will not only enhance the empirical power of the research but also make the study more replicable to other researchers.

### **1.3 Research Questions**

This research attempts to fill the gap in the existing literature discussed in the previous sections and provide more insights into the issues of knowledge transfer in supply chain partnerships. This research intends to explore the current practice of knowledge transfer between supply chain partners, and to find out the underlying mechanisms of knowledge transfer in the supply chain. It also seeks to indicate the relationship factors that influence knowledge transfer in the supply chain partnership, which will lead to the potential measures that could improve the knowledge transfer practice of supply chain partners. Specifically, this research attempts to answer the following questions:

- *What* are the particular characteristics of knowledge transfer in supply chain partnerships?
- *To what extent* are suppliers and purchasers practising knowledge transfer in supply chain partnerships?
- *What kind of* knowledge is being transferred among suppliers and purchasers in supply chain partnerships?
- *How* is knowledge being transferred/*How* do suppliers and purchasers in supply chain partnerships learn best practices from each other?
- *What benefits* could knowledge transfer bring to suppliers and purchasers in supply chain partnerships?
- *What* are the relationship factors that affect knowledge transfer in the supply chain?

- *How* do those relationship factors affect the transfer of knowledge between supply chain partners?
- *How* can interfirm relationships be improved to enhance knowledge transfer in supply chain partnerships?

## 1.4 Aims and Objectives of the Research

The overall aim of this research is to investigate the nature of knowledge transfer between supply chain partners and the benefits that the interfirm knowledge transfer could bring to the participants. It also intends to identify the main organizational factors that affect the effectiveness of interfirm knowledge transfer in supply chain partnership. Especially, this research seeks to identify the influence of supply chain partnership characteristics on the knowledge transfer process. Hence, this research aims to develop a model capable of improving the knowledge transfer between supply chain partners. Specifically, the objectives of this research are as follows:

- (1) To *identify* the mechanisms of knowledge transfer in supply chain partnerships;
- (2) To *identify* what are the relationship factors and how those factors influence the transfer of knowledge in the supply chain;
- (3) To identify the possible ways in which interfirm knowledge transfer could benefit supply chain partners;
- (4) To *model* the interfirm knowledge transfer between supply chain partners;
- (5) To *test* the model of knowledge transfer in supply chain partnership empirically;
- (6) To *generate* practical guidelines for practitioners to improve knowledge transfer in supply chain partnerships.

## 1.5 Outline of Research Methodology

This section provides a brief overview of the research methodology used in the current research, while more detailed discussions are provided in Chapter 6. To answer the research questions and fulfill the research objectives, this research has followed

post-positivism as the main research methodology (Robson, 2002). This methodological approach highlights the theory-laden nature of observations and allows contextual factors to be considered in the interpretation of results, so that a more holistic view to the issues of knowledge transfer in the supply chain was generated (see more in Chapter 6). This research employed a fixed design approach (Robson, 2002), in which the theoretical model developed, based on the previous literature, would be tested.

This research has both exploratory and explanatory purposes (Saunders et al., 2000), in that it explored the nature and process of knowledge transfer in supply chain partnership, and it also tested the theoretical model developed in the literature review stage of the study. To test the theoretical model of knowledge transfer in the supply chain, the author sought to collect primary data from the supply chain network of a large Chinese steel producing firm and looked at knowledge transfer practices of participating companies within this supply chain network. The research sample was chosen because in the steel industry, the supply chain structure and operations tend to be more typical. Supply chain partnerships in the steel industry could more easily be identified than in other industries. Collecting data from the same supply chain network also ensures consistency of data (more details will be explained in Chapter 6). Moreover, since Chinese firms are playing increasingly more important roles in the world supply chains, examination of Chinese firms is expected to generate valuable new insights into the theory of knowledge transfer in the supply chain.

Due to the limitation of time and resources, this research mainly relied on a cross-sectional survey to collect the data. A questionnaire instrument was constructed based on the theoretical model developed in the research. After a small-scale pilot testing, a questionnaire survey was executed to collect the data from the chosen steel producer and its supply chain partners. The data was cross-validated and verified in terms of reliability and validity, and was subjected to a series of statistical analyses (such as Cross-tabulation, Structural Equation Modeling, Multi-group Analysis) to

reach the final results.

## **1.6 Contributions of the Study**

The expected theoretical and methodological contributions of this thesis include the following:

- (1) This research will provide more insights into the particular characteristics of supply chain partnership and the characteristics of interfirm knowledge transfer in the context of supply chain partnerships;
- (2) This research will provide more understandings of mechanisms that are employed and could be employed by supply chain partners to transfer knowledge effectively;
- (3) The process of knowledge transfer will be unpacked, so that practitioners and future researchers can have a clearer insight into how knowledge is transferred from one organization to another and what the possible barriers are;
- (4) Some important relationship characteristics, which could influence the effectiveness of knowledge transfer in supply chain partnerships, will be identified and analyzed in terms of significance and the nature of influence;
- (5) This research will also give a more holistic evaluation of the benefits that interfirm knowledge transfer could bring to the supply chain partners;
- (6) A theoretical model of knowledge transfer between supply chain partners will be developed, which could be followed by practitioners and future researchers to assess knowledge transfer practices and to introduce remedies to improve knowledge transfer in supply chain partnerships.
- (7) On the grounds that existing literature was largely developed in the Western countries, this research will apply the knowledge transfer theories to a different geographical area.

In terms of research methodology, this research intends to follow a systematic approach to research development, from literature review, to theoretical framework, to

sample selection, to instrument design, to data verification and validation, and finally to model testing and result interpretation. This systematic approach could serve as a guideline of how systematic development of research could help the author to develop sound and thus more robust results. The current research applies the approaches to fieldwork design and instrument development employed by prior researchers, thus it not only verifies the feasibility of those approaches but also paves the way for future researchers to follow similar methods. A detailed record of the research process is kept, which will enable later researchers to verify the results or to carry out similar studies.

## **1.7 Structure of the Thesis**

Figure 1-1 shows a flow chart of the research process and the main content of chapters in this thesis. Specifically, Chapter 2 provides a general view on issues of supply chain and supply chain management. It will also define the research boundaries by looking at issues of supply chain performance and knowledge transfer between supply chain partners. Chapter 3 specifically reviews literature on interfirm relationships and examines the characteristics and determinants of the supply chain partnership. Chapter 4 looks at the characteristics of knowledge transfer in supply chain partnerships. Chapter 5 reviews the previous models of interfirm knowledge transfer constructed by other researchers and develops the theoretical framework of this research. This theoretical framework will help to develop the main research hypotheses. Chapter 6 discusses the methodological approaches to be followed in the research. Chapter 7 details the development of survey instruments and the conduct of fieldwork. Chapter 8 briefly discusses the characteristics of the respondents. Chapters 9 and 10 detail the complete process of data verification and data analysis, respectively. Chapter 11 interprets the results with the support of literature. Finally, Chapter 12 concludes this thesis by providing recommendations to practitioners as well as researchers, and by pointing out the contributions and limitations of the research. It also provides some directions for future research.

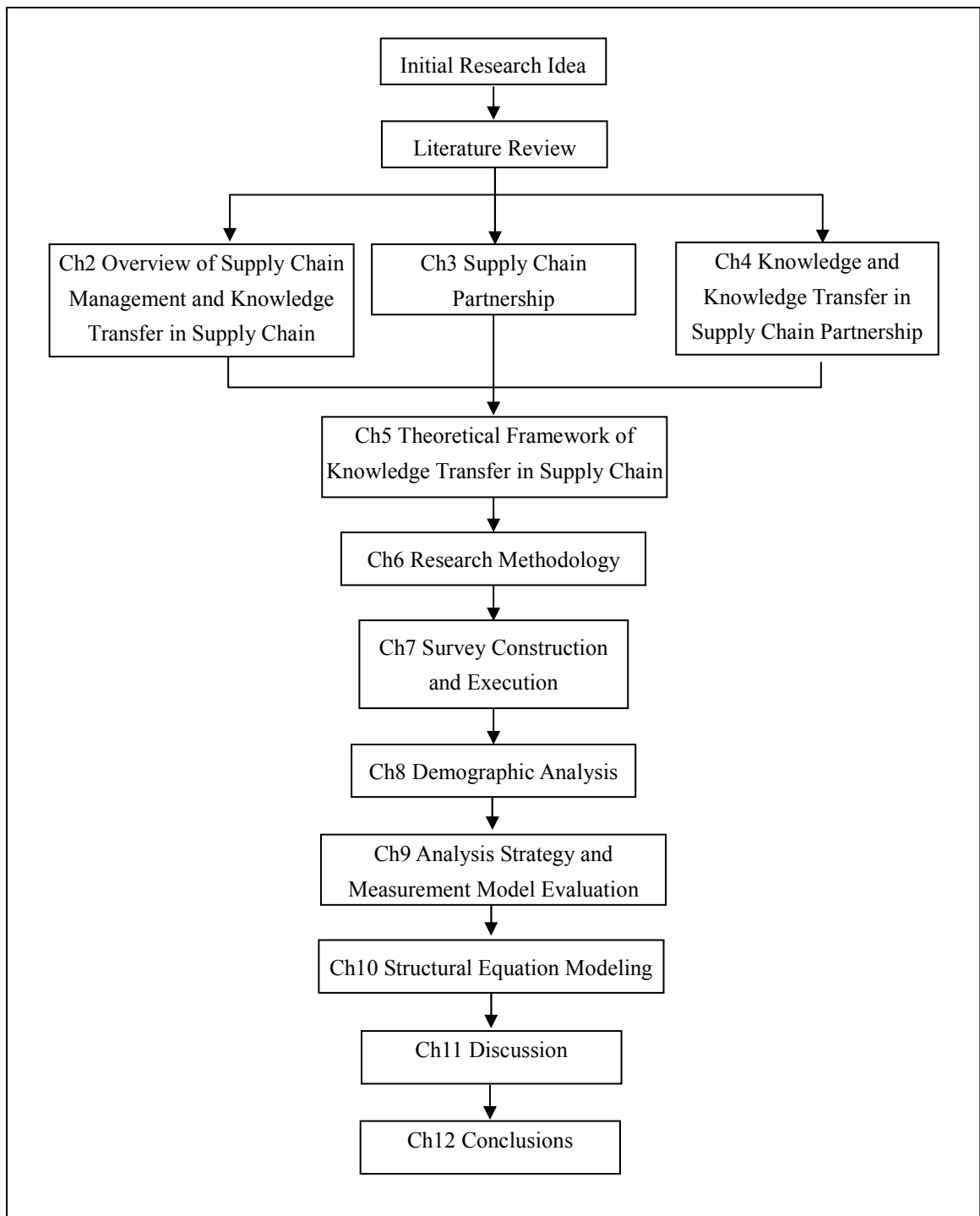


Figure 1-1 Research Process and Main Chapters

# **CHAPTER 2 OVERVIEW OF SUPPLY CHAIN MANAGEMENT AND KNOWLEDGE TRANSFER IN THE SUPPLY CHAIN**

## **2.1 Preamble**

The aim of this chapter is to define the research boundary and the main context of the research. The main focus of this research is knowledge transfer in supply chain partnerships and performance improvement of firms due to knowledge transfer. Supply chain partnership is regarded as one of the most important strategies for improving firms' performance. One of the most important ways firms could benefit from supply chain partnerships is knowledge transfer. Effective knowledge transfer between buyer and supplier firms is a measure of improving competitive advantage among the individual firms and the whole supply chain. This chapter briefly introduces the concept of supply chain, supply chain management, and what determines supply chain performance. Based on these considerations, some general ideas of supply chain partnership and interfirm knowledge transfer will also be discussed.

## **2.2 Concept of the Supply Chain**

The traditional approaches to gaining competitive advantage are no longer considered adequate because of severe market competition and higher customer expectations. Business organizations traditionally tended to regard themselves as independent entities (Christopher, 1998). The intense global competition in the last twenty years has forced business organizations to offer high quality products at low cost while simultaneously increasing design flexibility (Tan et al., 1999). Moreover, according to Macbeth and Ferguson (1994), customers are expecting higher levels of quality, reliability, variety and response, which forces business organizations to employ new statistically capable processes and to cope with more rapid changes of product mix.



Therefore, new organizational principles underpinning the satisfaction of market needs have emerged. According to Macbeth and Ferguson (1994, p.30), those principles include absolute process control and waste elimination processes driven by people involvement in a highly visible way. This new way of working highlights the integrated process control and the linkage of buyer and supplier of a certain product, which share the common destiny in the whole production and distribution process. Similar thoughts are also echoed in Christopher's (1998, pp.31-33) 3Rs principle, namely responsiveness (ability to respond to customer requirements in a time efficient way), reliability (improving reliability and quality through process control), and relationship (achieving partnership between buyer and supplier). These three principles demonstrate the challenges firms are facing in the changing competitive environment. Consequently, the concept of the supply chain was introduced to replace the traditional non-integrated way of considering the business process and the relationship between upstream and downstream organizations.

### **2.2.1 The Value Chain Concept**

The supply chain concept draws on the idea of the value chain, which describes the general value-adding process of a business organization (Macbeth and Ferguson, 1994). According to the value chain model presented by Porter (1980), the typical business organization adds value, as conceived by the customer, to goods or services through certain primary activities and supporting activities (see Figure 2-1). The primary activities include Inbound Sourcing (activities ensure a reliable source of supply of input materials), Operations (the transformation of the good or service), Outbound Sourcing (delivering of the good or service to the customer), Marketing and Sales, and after sale Customer Services. The conduct of these primary activities is made possible by other supporting activities, which include Procurement of input resources; Technology Development, which can be of product, transformation process, or of management process; Human Resource Management; Organizational Infrastructures,

such as legal, financial, internal planning, and external liaison.

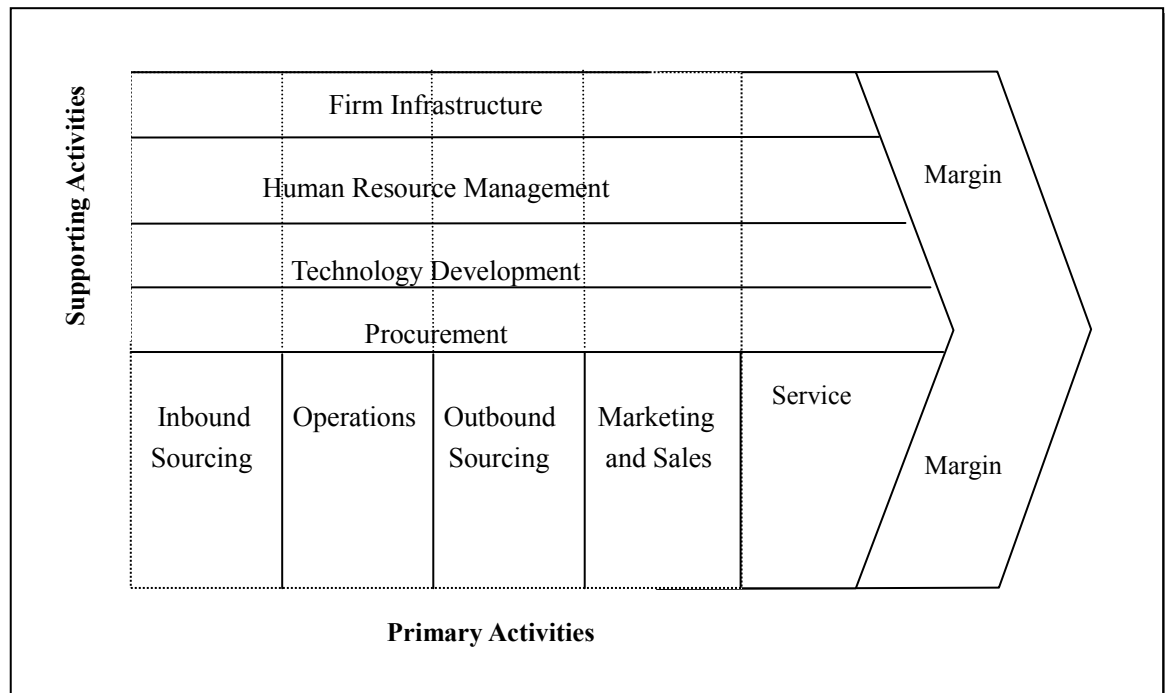


Figure 2-1 The Value Chain Model

*Source: Porter, M. E., 1980*

The value chain model generally demonstrates the production flow from supply side to the customer in a single business entity. It illustrates the process through which a firm adds value to the good or service. According to Christopher (1998, p.11), the competitive advantage of the firm is derived from the way in which firms organize and perform those activities within the value chain. To gain competitive advantage, a firm must generate value to its customer through performing those primary and supporting activities more efficiently or performing those activities in a unique way that creates greater differentiation. This implies that, in order to survive severe market competition, a firm needs to deliver a high level of value-added good or service to the customer through a low cost method of production.

Obviously, no firm is isolated from other business organizations. A firm has to interact with upstream suppliers for input materials and services or with downstream buyers to deliver products and services to end customers. Consequently, the collection of a firm

and its buyers and suppliers form a network of value chains. This network of value chains eventually forms a supply chain from raw materials suppliers to the end consumers. The supply chain might be significantly complex, due to the number of organizations involved, the operational practice of individual organizations, the nature of the relationship between organizations, and the environment under which organizations interact with each other. However, the supply chain concept emphasizes the business process as a whole, rather than focusing on the operation of individual organizations, so that it will enable the management to improve the entire production and distribution process to satisfy the requirement of end-consumers and gain more competitive advantage.

### **2.2.2 The Supply Chain Defined**

As an emerging management concept, the term “supply chain” has been given various definitions. Table 2-1 presents a list of definitions of the supply chain given by different authors. All these definitions of the supply chain are very similar with respect to the focus of the definition. The main concepts implied by those definitions are organization network, supply chain activities, value creation, physical and non-physical flow, and fulfilling consumer requirements.

Among all the definition of the supply chain, the one provided by Rogers and Tibben-Lembke (1998) is found to be the most comprehensive. This is because:

- (1) This definition highlights the importance of organizational networks, which opposes the traditional loosely linked associations of discrete businesses.
- (2) This definition encompasses the idea of linkages, which implies the coordination of processes and relationship from raw material to customers.
- (3) According to this definition, the supply chain is made up of processes, in that it involves a broad range of activities including sourcing, manufacturing, transporting, and selling products. Here product refers to both goods and services.

- (4) This definition incorporates the idea of upstream and downstream, which represent the vertical relationship between supplier, buyers, and customers.
- (5) This definition also emphasizes that the ultimate goal of a supply chain is to generate value that is perceived by the customer.

Thus, this definition will be adopted as the working definition of a supply chain in this study (see table 2-1).

Table 2-1 Definitions of Supply Chain

Author(s)	SC Definition	Focus
Christopher (1998)	SC is the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer.	Organization network; Value production; Customer focus.
Rogers and Tibben-Lembke (1998)	A supply chain is that network or organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer or consumer.	Organization network; Upstream and downstream; Process; Value production; Customer focus
Lummus and Vokurka (1999)	All the activities involved in delivering a product from raw material through to the customer including sourcing raw material and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channel, delivery to the customer and the information systems necessary to monitor all of these activities.	Production flow; Activities based.
Chopra and Meindl (2001)	SC consists of all stages (and functions) involved, directly or indirectly, in fulfilling a customer request.	Customer focus; Production stages.
Kasarda (2001)	Life cycle processes comprising physical, information, financial, and knowledge flows whose purpose is to satisfy end-user requirements with products and services from multiple linked	Life cycle processes; Physical and non-physical flow; Customer focus;

	suppliers.	Organization network.
Mentzer et al. (2001)	A set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer.	Organization network; Physical and non-physical flow.
Ballou (2004)	SC encompasses all activities associated with the flow and transformation of goods from the raw materials stage, through to the end user, as well as the associated information flows.	Activity based; Physical and non-physical flow and transformation.

### 2.2.3 Characteristics of the Supply Chain Concept

Bowersox et al. (2002, p.6) adopted a generalized supply chain model to demonstrate the typical structure of a supply chain (See figure 2-2). In this model, the integrated supply chain is the center of multi-firm relationship management which is bounded by capacity limitations, information, core competencies, capital, and human resource constraints (Bowersox et al., 2002, p.6). Raw materials are transformed into final products and delivered to end customers through three main entities: the supplier network, integrated enterprise, and distribution network. The supplier network consists of a group of component or material supplier organizations, which purchase production materials and transform those materials into forms of products that will be used as the input of the downstream enterprise. The integrated enterprise has three main functions, namely procurement, manufacturing, and market distribution. It also carries out the main production functions. It purchases the components or materials from the suppliers and transforms them into final products, which will be delivered to the downstream distribution network. The distribution network will then sell the products to the final customer. In this integrated process of business operations, there are bi-directional flows of information, product, service, fund, and knowledge between all the firms in the supply chain. Noticeably, knowledge flow is highlighted in the supply chain structure. Moreover, logistics, that is, “the work required to move and position inventory throughout a supply chain”, serves as the main conduit of product and service flow within the supply chain arrangement (Bowersox et al., 2002, p. 6).

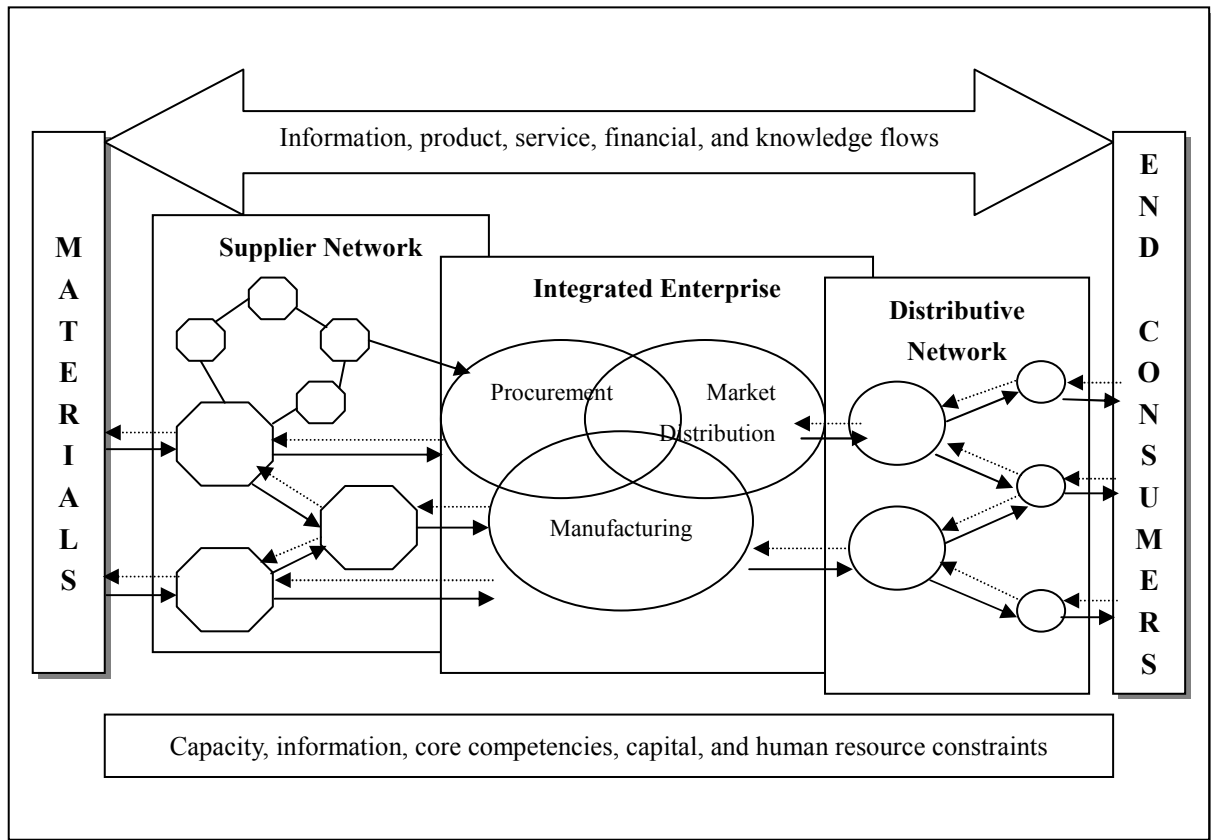


Figure 2-2 Generalized Supply Chain Model

Source: Bowersox, D. J., Closs, D. J., and Cooper, M. B. , 2002

Obviously, this is just a simplified model, since the actual supply chain may involve more organizations and longer chains of linkages. For instance, in practice there could be more enterprises in the middle of the chain, which manufacture not only the products to be purchased by ultimate consumers, but also the components to be purchased by other enterprises. This results in a network of middle stream enterprises, which makes the supply chain much bigger. On the other hand, the actual supply chain could also be shorter. For example, Dell Computer does not deliver the final products to the consumer through a downstream distribution network, rather it delivers the product to the consumer directly. As a result, the supply chain is greatly shortened.

According to this generalized supply chain model, there are several main characteristics of the supply chain concept, which make the supply chain concept

different from traditional management concepts:

- (1) Typically, the supply chain includes all the parties involved in the business process, such as suppliers, manufacturers, transporters, warehouses, retailers, and even customers themselves (Chopra and Meindl, 2001, p.3). Therefore, the supply chain concept is not about a single organization, but a domain of organizations and entities.
- (2) Buyer and supplier firms are dependent upon each other due to the material requirements, product delivery, information needs, and the common purpose of customer value creation, and as such the supply chain concept emphasizes the network structure of upstream suppliers and downstream buyers in the whole business process (Macbeth and Ferguson, 1994; Bowersox et al., 2002; Tan et al., 2002).
- (3) The supply chain is dynamic in nature in that it involves the constant flow of information, product, funds, and very importantly knowledge between different stages of the value creation process (Chopra and Meindl, 2001; Kasarda, 2001).
- (4) The supply chain has a high degree of mobility, in that firms may enter and exit the supply chain arrangement without any apparent loss of essential connectivity (Bowersox et al., 2002).
- (5) The supply chain concept highlights the importance of the cooperation and integration between organizations involved in the value creation process, although the ideal form of collaborative relationship is yet to be realized (Christopher, 1998). The collaboration of participants from upstream to downstream in the supply chain is believed to improve the overall efficiency and competitiveness of the whole supply chain.
- (6) The concept of supply chain is different from “vertical integration”, which implies ownership of upstream suppliers and downstream customers (Christopher, 1998, p.15). Supply chain integration is more about the coordination of the operations between supply chain organizations. The supply chain concept embraces the idea that business organizations in the supply chain are relying on other organizations

for material, components, and information. Individual organizations typically procure materials or components from other organizations, so that they will be able to focus on their “core business” to enhance their competitive advantage.

- (7) Since all products have market life cycle and/or usage life cycle (Kasarda, 2001), this implies that the supply chain should include all the tasks involved before sale and after sale of the product.
- (8) Finally, end-consumer satisfaction is seen as an essential objective of the supply chain. The supply chain concept highlights the consumer-based view and the importance of consumer value creation.

## **2.3 Supply Chain Management**

Supply Chain Management (SCM) is an emerging management approach based on the concept of the supply chain. It is viewed by many as a new management philosophy, which helps businesses to enhance competitive advantage and overall performance (Tan et al., 2002; Petersen et al., 2005). It also extends traditional internal activities conducted within the organization, by embracing an inter-enterprise scope, bringing trading partners together with the common goal of optimization and efficiency (Harwick, 1997; Cousins et al., 2006).

### **2.3.1 Supply Chain Management Defined**

Supply Chain Management (SCM), put simply, is the management of the supply chain. Nevertheless, the novelty of this management approach has led to debate among researchers as to its definition. After consulting the literature, it is found that Ho et al. (2002) have provided a more generalized definition of SCM based on a systematic review of prior SCM research:

SCM is a philosophy of management that involves the management and integration of a set of selected key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders through the collaborative efforts of supply chain members.



This definition embraces the core elements of SCM, which are integration of key business processes, collaborative relationship, and value creation. It will be remembered that the main objective of this research is to investigate knowledge transfer in the supply chain. The research focus will be on the knowledge transfer between the supply chain partners, which is conducted through the operation processes and partnership relationships. Therefore, the generalized definition of Ho et al. (2002) fits the objectives of this research and will be adopted as the working definition of SCM.

### **2.3.2 Scope of Supply Chain Management**

A supply chain exists wherever there are flows of goods and services between upstream and downstream elements of the value production process. As a result, SCM could be applied to coordinate and improve the value production and distribution processes. Originated and developed in the manufacturing industry, SCM has now been applied in many other sectors, such as construction, military, service industries, and environment management (Vrijhoel and Koskela, 2000; Ballou, 2004).

Differing from the traditional management approach of independence, the main objective of supply chain management is to maximize customer value and entire supply chain profitability (Christopher, 1998; Chopra and Meindl, 2001), and thus it implies that SCM aims to control waste and non-value-adding activities and simultaneously improve efficiency and achieve optimization of the whole supply chain. As many researchers have recognized, SCM has adopted management techniques from Just-In-Time and TQM (Total Quality Management) (Wong and Fung, 1999; Vrijhoel and Koskela, 2000). However, SCM has evolved to include much broader issues of production and distribution management than Just-In-Time and TQM, in order to reach the goal of supply chain optimization and customer value maximization. Generally, the main areas of SCM include logistics management, manufacturing operations

management, service management, information systems management, financial management, customer management, and relationship management. Due to the limit on space and the research focus, a simplified discussion of these main areas of SCM is presented in the following sections.

#### ***2.3.2.1 Logistics Management***

One of the most important components of SCM is Logistics Management. Although Logistic Management has been used interchangeably with SCM by some researchers, they are actually different concepts. The Council of Logistics Management (CLM) has defined logistics as: "...part of the supply chain process that plans, implements, and controls the efficient flow and storage of goods, services, and related information from the point of origin to the point of consumption in order to meet customers' requirements" (1998). This definition implies that logistics is concerned with the flow of goods, services, and information. More importantly, logistics is just part of the entire supply chain process. A similar argument is provided by Christopher (1998, p.17):

Logistics is essentially a planning orientation and framework that seeks to create a single plan for the flow of product and information through a business. Supply chain management builds upon this framework and seeks to achieve linkage and co-ordination between processes of other entities in the pipeline, i.e. suppliers and customers, and the organization itself.

It is implied that logistics is more about the management of flows of material, service, and information through a business, which is one function of the whole supply chain management. On the other hand, SCM emphasizes the integration of the logistics activities throughout the supply chain to realize optimization of the whole supply chain. In this sense SCM encompasses a much broader concept. Typically, logistics management includes tasks such as inventory, warehousing, transportation, and distribution management (Bowersox et al., 2002; Tan et al., 2002). The main purpose of logistics management under SCM is to ensure the precise, time efficient and cost effective flow of product, service, and related information throughout the supply chain.

### ***2.3.2.2 Manufacturing Operations Management***

As has been shown in figure 2-2, the integrated enterprise, which consists of functions of procurement, manufacturing, and market distribution, forms an important part of a supply chain. Manufacturing firms purchase materials, perform manufacturing, and distribute products to the end customer or the manufacturer in the next stage. Through performing these activities, they conduct the value creation process. A substantial number of firms in the supply chain are manufacturing firms. How to manage this value creation process to realize supply chain optimization is an essential task of SCM.

Three important tasks are involved in manufacturing operations management, namely procurement management, manufacturing management, and market distribution management. Procurement management is mainly concerned with how to acquire high quality, reliable, and continuous input materials at the right time and in the right amount, so as to minimize the ‘total cost of ownership’ rather than the purchase price of acquired resources (Bowersox et al., 2002, p.136). Manufacturing management is concerned with how to produce high quality products with the lowest lead time and at lowest ‘total cost of manufacturing’ (Bowersox et al., 2002, p.155). Market distribution management is mainly to do with how to select and design appropriate distribution channels or networks to lower the cost and satisfy customer requirement. These three tasks are interdependent upon each other, and they together form the main functions of manufacturing operations management of supply chain firms. To realize maximized customer value creation not only requires the firm to produce quality products on time, it also requires the firm to ensure high performance in procurement and distribution. Together with logistics management, manufacturing operations management forms the core of supply chain management.

### ***2.3.2.3 Information Systems Management***

As recognized by many, information is the key to the success of the supply chain (Macbeth and Ferguson, 1994; Chopra and Meindl, 2001; Bowersox et al., 2002; Lamming et al., 2006). An effective supply chain relies on timely, accurate, and

efficient information flow between its members. It is reasonable to argue that information is actually the backbone for the entire supply chain operation. Information sharing is highlighted by prior researchers as the key to optimal flexible supply chain and successful collaboration (Towill, 1996; McCullen and Towill, 2002; Webster, 2002; Lamming et al., 2006). As a result, the management of information is an essential part of SCM. This involves two main tasks. The first is the setting up of information systems. This requires the supply chain entities to employ adequate technological means to establish the infrastructure to enable the acquisition, storage, processing, and sharing of information across the supply chain, to be realized on a timely, adequate and efficient basis. For instance, firms and organizations have developed information systems like EDI (Electronic Data Interchange), ERP (Enterprise Resource Planning), and CRM (Customer Relationship Management), and also information sharing standards to improve information sharing and flow within the supply chain (Chopra and Meindl, 2001). The second task is the management of information. This requires the supply chain entities to introduce and apply appropriate means to manage and facilitate the efficient flow of information throughout the supply chain. However, this task is considered more difficult than setting up the information system, due to human, organizational, and traditional constraints (Macbeth and Ferguson, 1994; Lamming et al., 2006).

#### ***2.3.2.4 Financial Management***

Financial management is also an important part of SCM. The constant transactions between supply chain entities require a holistic financial management system to ensure timely, adequate, and reliable flows of funds (Delk, 2000). Successful SCM also requires the supply chain organizations to have effective budgeting, costing and financial performance assessment systems to fit the requirements of supply chain operation (Bowersox et al., 2002). Moreover, to achieve supply chain optimization, one organization may need to make a decision that is less optimized at local level (Macbeth and Ferguson, 1994). Therefore, a reward system is needed to compensate the organization that makes less optimal decisions. This requires an integrated financial

system, which enables the supply chain to measure the contribution of supply chain entities adequately and provide proper rewards to all members of the supply chain.

#### ***2.3.2.5 Customer Management***

How to satisfy customer requirements is also an essential job of SCM. Here the customer is not just the end consumer, the concept also includes ‘organizational end user’ and ‘intermediate customers’, who purchase products from supply chain firms for production needs or just for reselling purposes (Bowersox et al., 2002, pp.66-67).

Effective customer management not only requires the supply chain firm to have good marketing arrangements, but also requires the supply chain firm to have adequate means to process customer orders, service customers, monitor and understand customer expectations, respond to customer requirements, and feedback customer requirements to responsible organizations in the supply chain. According to Macbeth and Ferguson (1994) it makes logical sense that effective customer management is likely to increase customer satisfaction and customer retention, and as such it also enhances supply chain firms’ competitive advantage.

#### ***2.3.2.6 Relationship Management***

The collaborative relationship is one of the main elements of SCM, and hence the relationship management of supply chain entities engaged in the customer value creation is a key issue of SCM. It is argued that most aspects of SCM, such as integrated logistics, effective information management and lean operation, all depend on the establishment of collaborative relationships between supply chain entities (Macbeth and Ferguson, 1994; Cousins, 2002; Handfield and Lawson, 2007).

Relationship management is mainly concerned with initiating, implementing, and maintaining collaborative relationships between supply chain entities (Bowersox et al., 2002). Moreover, issues of power, leadership, conflict, cooperation, risk and reward are to be covered by relationship management. Relationship management also forms an important context under which the issue of supply chain knowledge transfer is examined. Relationship management will be discussed in more detail in Chapter 3 of

the thesis.

### ***2.3.2.7 Summary***

Overall, compared to traditional management approaches which concentrate on the activities of individual organizations, supply chain management represents a much more holistic view. Since the traditional management approach focuses only on the profitability and performance of the individual business organization, transactions between firms are regarded as “zero-sum games”, so that one firm will try to make extra profit at the expense of other firms. However, when firms are in the same supply chain, this “zero-sum game” approach is very likely to harm the profitability of the whole supply chain (Macbeth and Ferguson, 1994).

In contrast, the SCM approach views the supply chain as a whole, so that it relies on management practices to enhance the performance of the entire supply chain. SCM considers related firms as an integrated group, so it emphasizes the success of the entire supply chain. Sometimes, in order for the bigger system to obtain an optimum solution, it may be necessary for the individual firms to make decisions which produce less optimized results for themselves (Macbeth and Ferguson, 1994).

Moreover, traditional management approaches tend to isolate functional areas from each other by evaluating the performance of individual functions. On the other hand, SCM views all the functions in the supply chain process as a whole, since isolated optimization of any specific functional area without considering cross-functional impact is not likely to result in maximum performance (Bowersox et al., 2002).

It is commonly acknowledged that SCM is a very sophisticated issue, in that effective SCM depends on a huge number of social, economic, and organizational factors. Moreover, as Macbeth and Ferguson (1994) argued, managing the supply chain in an integrated way will not guarantee success, but it can provide an opportunity to compete more effectively with other supply chains in the particular market place.

## **2.4 General View of Knowledge Transfer in Supply Chain**

### **Partnerships**

It will be remembered that this research intends to explore the strategic role of interfirm knowledge transfer in supply chain partnership. The Resource-based View (RBV) of the firm (Wernerfelt, 1984; Barney, 1991; Peteraf, 1993) and related Knowledge-based View (KBV) of the firm (1996) both regard knowledge as an important source of competitive advantage. In particular, KBV highlights the role of interfirm alliances in facilitating the flow of best practices and valuable knowledge between partner firms (Grant and Baden-Fuller, 1995). Within the supply chain, collaborative supply chain partnership is considered to be an important means to improve the performance of the individual firm as well as the performance of the supply chain as a whole (Christopher, 1998; Cousins et al., 2008). One of the most important ways that supply chain firms could benefit from the partnership is acquiring and absorbing best practices and knowledge from each other to optimize the supply chain operations (Love et al., 2002; Hult et al., 2004; Squire et al., 2008; Lawson et al., 2009). A direct implication is that interfirm knowledge transfer can be a source of performance improvement and competitive advantages for supply chain partners. This section briefly examines interfirm knowledge transfer among supply chain partners and its role in improving firm and supply chain performance, in order to define the boundary of this study. More detailed discussion of supply chain partnership and interfirm knowledge transfer will be presented in Chapters 3 and 4, respectively.

#### **2.4.1 Supply Chain Performance**

Since market competition is now between supply chains rather than between individual firms (Christopher, 1998; Maqsood et al., 2007), improving performance of the supply chain is actually the essential goal of SCM. According to the literature, researchers have developed various approaches to define and measure supply chain performance.

However, the notions of productivity, cost effectiveness, time efficiency, profitability, quality, customer satisfaction, and competitive advantage are the terms commonly emphasized (Spekman et al., 1998a; Tan et al., 1999; Brewer and Speh, 2000; Ramdas and Spekman, 2000; Dasgupta, 2003). More details of indicators of supply chain performance are introduced in section 7.7.

Multiple perspectives and strategies that affect supply chain performance have been identified. Webster (2002) has classified the main factors that influence supply chain performance into four variables, namely inventory, information, relationship, and technology. These variables were considered to have both independent and joint influence on supply chain performance. Tan et al. (1999) indicated that SCM practices, including competitive environment analysis, TQM practice, supply base management, and customer relations practice all have a positive influence on firms' performance. Moreover, Morash (2001) examined the relationship between customer closeness strategies and operational excellence strategies of supply chain firms and supply chain performance. The results indicated positive relationships between various supply chain strategies and performance level. In summary, evidence has been provided that various SCM strategies have the potential to improve supply chain performance, given that supply chain performance is not determined by a single set of factors.

#### **2.4.2 Supply Chain Partnerships**

Within multiple means of supply chain performance improvement, "partnership" is frequently highlighted as an essential factor affecting supply chain performance. Webster (2002) highlighted the importance of the relationship variable on supply chain performance. The relationship variable is referred to as the relationship between organizations that form links in the supply chain. However, Webster (2002) did not provide sufficient analysis on the type of the relationship and how that relationship actually enhances supply chain performance. Morash (2001) indicated that strategies focused on collaborative relationships are positively related to firms' performance.



Ittner and Larcher (1997) carried out an exploratory study of the impact of a number of process management techniques and supply chain practices on firms' overall profitability. The authors indicated that establishing long-term partnerships with suppliers and customers does improve profitability. The work of Tan et al. (1999) supported such a view, and indicated the important role of supply chain firm integration (mainly characterized by supply chain partnership) on performance improvement. Ramdas and Spekman (2000) examined the relationship between supply chain performance and a number of supply chain practices and thinking. Results of their study further confirmed the positive impact of supply chain partnerships on competitive advantage. Overall, there is consensus in the literature that collaborative supply chain relationships or supply chain partnerships are one of the most important means to improve supply chain performance.

As has been mentioned previously, the concept of the supply chain embraces multiple entities throughout the value creation process, for example upstream suppliers, downstream buyers, third party logistics providers, and ultimate customers. This implies that numerous supply chain partnerships between different parties could be formed. Since the main objective of the current research was to investigate the knowledge transfer among supply chain partners, the interaction between business organizations was more focused. Thus, supply chain partnership between buyer firm and supplier firm was the main relationship focus in the current research.

The literature review suggested that some previous researchers were particularly interested in how partnerships are formed and maintained (Gardner et al., 1994; Ellram, 1995; Bagchi and Virum, 1996; Lambert et al., 1999; Mentzer et al., 2000; Handfield and Lawson, 2007). Although the characteristics and history of the supply chain partnership are relevant to the issue of supply chain knowledge transfer, partnership formation and maintenance were beyond the coverage of this research. Again, considering the main objective of this research, the following chapters focus more on the characteristics and status of supply chain partnerships that have already been

established.

### **2.4.3 Interfirm Knowledge Transfer in the Supply Chain**

Given that knowledge transfer appeared to be a complex issue covered by previous researchers, it is very important for the current researcher to identify what is the main focus of the research presented in this thesis. According to Hult (2003), the transferability of knowledge is a critical determinant of an organization's capacity to create a sustainable competitive advantage, which is paramount in both intra and inter organizational settings. Prior researchers have been interested in knowledge transfer activities either within organizations or across organizational boundaries. Areas such as knowledge creation (e.g. Kogut and Zander, 1992; Nonaka, 1994), innovation (e.g. Cooper, 1984; Cohen and Levinthal, 1990; Powell et al., 1996), knowledge transfer within the firm (e.g. Argote and Ingram, 2000; Gupta and Govindarajan, 2000; Boland et al., 2001; Argote et al., 2003b) and knowledge transfer between firms (e.g. Mowery et al., 1996; Simonin, 1999a; Cavusgil et al., 2003; Ramasamy et al., 2006; Lawson et al., 2009) have been studied. The current research mainly concentrates on knowledge transfer activities between different business organizations.

Prior researchers have suggested that interfirm alliances, of which partnership is one type, are effective platforms for learning and knowledge transfer. It is recognized that prior studies tend to focus on interfirm knowledge transfer practices under different circumstances or with various purposes. Inkpen and Tsang (2005) examined the interfirm knowledge transfer from four perspectives. These four perspectives disclose the main types of interfirm knowledge transfer that may attract the interests of researchers. First, firms *learn from* an alliance partner when acquiring knowledge from the partner by gaining access to the skills and competencies the partner brings to the alliance. Second, firms *learn with* an alliance partner when the partners jointly enter a new business area and develop new capabilities. Third, firms *learn to manage alliances* when acquiring knowledge useful in the design and management of current

or future alliances. Fourth, firms may *learn about* an alliance partner, which supports the firms' ability to manage the collaborative task. Table 2-2 provides a sample of studies in each category of interfirm knowledge transfer put forward by Inkpen and Tsang (2005). Noticeably, although "learn about" was regarded as an important type of knowledge transfer, no empirical studies have been identified from the literature review. This suggested that relatively less research has been conducted to examine the "learn about" type of knowledge transfer.

Table 2-2 Examples of Studies on Different Types of Interfirm Knowledge Transfer

Type of knowledge transfer	Author(s)	Relationship context	Main setting of data collection	Main findings
<b>Learn from</b>	(Johnson and Sohi, 2003)	Buyer-supplier relationship	Survey	The firm must provide the appropriate platform, as manifest in the firm's culture in terms of learning intent, receptivity, and transparency, for learning activities to occur. The higher the levels of those factors are, the more the firm will engage in learning activities for interfirm partnering competence. The firm's learning activities in interfirm partnering competence would influence its IFRs in a positive way, in terms of relationship effectiveness/efficiency and commitment.
	(Lamming et al., 2005)	Supply chain partnership	Field based <sup>a</sup>	Whereas one-way open-book approaches appear static and concerned with the treatment (or management) of existing knowledge, working 'on' knowledge, transparency revolves around reflexivity and is concerned with dynamics and potentials that are working 'with' knowledge. Benefits of transparency may lay in the questions it forces organizations to address, rather than in the immediate answers themselves.
	(Santos-Vijande et al., 2005)	Strategic alliance	Survey	The firm's learning orientation stimulates the market-oriented behaviour and it also positively affects the establishment of long-term relationships with strategic clients (indicated by trust, affective commitment, and willingness to continue relationship). Contrary to prior research a significant and positive effect on business performance is only found in the case of market orientation, but not of learning orientation.
	(Squire et al., 2008)	Buyer-supplier relationship	Survey	The results indicate that knowledge transfer is positively influenced by the extent of cooperation, but that this relationship is moderated by the level of trust and the performance of the supplier firm.
<b>Learn with</b>	(Bates and Slack,	Buyer-supplier	Field based	Small companies should capitalize on any unique specialist knowledge that is core

1998)	relationship		to their business, to give some leverage with their suppliers. Small companies should consider exchanging information with suppliers in order to initiate the process of developing trustful relationships to the benefit of both parties. Small companies may well be able to improve the relationship with their supplier by identifying and sharing critical technical knowledge.
(Capello, 1999)	Regional interfirm network	Survey	The element of club externality is the main distinguishing feature of collective learning. The transfer of creative and cumulative knowledge takes place independently of the will of the first inventor, and the use made of collective learning by local agents depends on their private interests and their structural features. Collective learning mechanisms are present in those firms, which are very small and very dynamic in terms of radical product innovation. Collective learning enhances the innovative capability of small firms.
(Wu and Cavusgil, 2006)	Strategic alliance	Survey	Learning intention, partner sensing, and relationship initiation are positively associated with organizational commitment. Organizational commitment is positively associated with both alliance performance and a firm's market performance. Organizational commitment is a key to aligning common interests with private interests and to generating value for both firms. Under high market uncertainty, the effect of commitment is more salient in generating higher rents for the alliance than for the firm. Organizational commitment may not be an effective strategy for large firms in generating firm specific rents.
(Modi and Mabert, 2007)	Buyer-supplier relationship	Survey	Evaluation and certification efforts are the most important supplier development prerequisites before undertaking operational knowledge transfer activities such as site visits and supplier training. Furthermore, collaborative inter-organizational communication is identified as an important supporting factor in transforming an organization's efforts to improve supplier performance.

---

<b>Learn to manage alliance</b>	(Kale et al., 2001)	Strategic alliance	Survey	Companies which invest in alliance structures to co-ordinate alliance activity and systems to capture, codify, communicate and coach alliance-related know-how, definitely reap benefit in a number of ways (higher and positive abnormal stock market gains; higher long-term alliance success; improvements in companies' alliance management practices).
	(Ethiraj et al., 2005)	Buyer-supplier relationship	Archival based <sup>b</sup>	Client-specific capabilities are a function of repeated interactions with clients over time and across different projects. This learning from repeated interactions with a given client reduces project execution costs and helps improve project contribution. Project management capabilities are acquired through deliberate and persistent investments in infrastructure and systems to improve the firm's software development process. Marginal returns to acquiring different capabilities may be different.
	(Sampson, 2005)	R&D alliance	Archival based	Prior alliance experience does increase collaborative benefits. However, collaborative benefits are most improved with some experience, but firms do not seem to benefit further with extensive experience. This lack of cumulative benefits from prior alliance experience appears to be partly due to the depreciation of knowledge over time, since only recent experience has a positive impact on collaborative returns. Prior experience matters more for those alliances characterized by greater complexity or with more uncertain outcomes. Managerial experience is a firm's capacity that has important implications for performance.
	(Mason and Leek, 2008)	Supply network	Field based	Dynamic business models help organizations identify and link key actors with each other (at the firm and individual level), and aid the identification and specification of appropriate knowledge types and knowledge transfer mechanisms for different actors, in different contexts.

---

---

<b>Learn about</b>	Not found	N.A.	N.A.	N.A.
--------------------	-----------	------	------	------

---

Note: a. Field based refers to studies that collect data by researchers actually going into the research subject organisation and collecting primary data through various data collection techniques, such as interview, observation, and action research.

b. Archival based refers to studies which are mainly based on the data collected from secondary sources, such as documentation, organization archives or published databases.

---

Given the importance of knowledge transfer across firms' boundaries, this study was mainly focused on "learning from" as the main type of interfirm knowledge transfer. One of the main incentives of firms to form partnership is to learn from others, which enhances their competitive advantages (Crossan and Inkpen, 1995; Beecham and Cordey-Hayes, 1998; Love and Gunasekaran, 1999; Hult et al., 2007), and constant knowledge flow between supply chain entities is one of the important characteristics of the supply chain cooperation. Interfirm knowledge transfer between supply chain partners is also found to be an important means to improve supply chain firms' performance (Dyer and Nobeoka, 2000; Kotabe et al., 2003; Hult et al., 2007). Firms could benefit from acquiring and applying knowledge and best practices from supply chain partners, which could be used to enhance core competence, innovative capability, product performance, and overall firm performance (Helleloid and Simonin, 1994; Calantone et al., 2002; Cavusgil et al., 2003; Hult et al., 2007). Therefore, how to manage the flow of knowledge and ensure efficient and effective knowledge transfer between supply chain firms becomes an important issue. Thus, the current research examined the mechanisms and process of knowledge transfer between supply chain partners.

Prior research has provided evidence that successful knowledge transfer between firms tends to be determined by the characteristics of interfirm relationships (Dyer and Nobeoka, 2000; Cummings and Teng, 2003; Kotabe et al., 2003; Wijk et al., 2008) in addition to other factors that also affect knowledge transfer practices, such as culture (Mowery et al., 1996; Cummings and Teng, 2003), absorptive capacity (Cohen and Levinthal, 1990; Mowery et al., 1996; Wang et al., 2004; Dyer and Hatch, 2006), and knowledge ambiguity (Simonin, 1999a; Becerra et al., 2008). Nevertheless, given that supply chain partnership is one particular type of interfirm partnership it has some unique characteristics. The research presented in this thesis concentrated on the characteristics and status of supply chain partnerships that affect the transfer of knowledge. This was for two reasons: (1) stable and healthy supply chain partnerships are arguably a precondition to successful supply chain knowledge transfer (Kotabe et al., 2003; Hult et al., 2004); (2)



little research has been conducted to identify the particular characteristics of supply chain partnerships and their role in interfirm knowledge transfer.

Furthermore, this research examined not only knowledge transfer activities that take place within formal arrangements but also knowledge transfer activities that take place in more informal settings or unintentionally during the cooperation between supply chain partners. As indicated by prior researchers, learning need not be conscious or intentional (Huber, 1991), knowledge transfer can also take place unintentionally (Kogut and Zander, 1992). When firms transact with each other, knowledge can be exchanged between firms without the interference of external control. Mintzberg et al. (1996) argue that joint learning may occur through interaction without partners conceptualizing it as such, and without a collaborative agreement in place. Research focused on organized and intentional knowledge transfer practice has the potential to result in the generation of direct implications to help practitioners to improve existing knowledge transfer practices. On the other hand, the examination of unintentional knowledge transfer would also be valuable in the understanding of knowledge transfer and hence in helping to raise the awareness of managers.

## **2.5 Summary**

This chapter briefly introduced and defined the concept of supply chain and supply chain management. Moreover, the relationship between knowledge transfer in supply chain partnerships and firms' performance improvement were discussed. The boundaries of the present research were identified, in that the research presented in this thesis mainly focused on the issue of interfirm knowledge transfer between the buyer and supplier firms in existing supply chain partnerships. In particular, the present research was concerned with how a firm intentionally or unintentionally "learns from" its supply chain partner. The research examined the impact of the characteristics of partnership on effective knowledge transfer, and the way successful knowledge transfer could benefit supply chain participants. The next two chapters (Chapters 3 and 4) discuss the

characteristics of supply chain partnership and the characteristics of supply chain knowledge transfer in more depth.

## **CHAPTER 3 SUPPLY CHAIN PARTNERSHIP**

### **3.1 Preamble**

According to the general discussion in the previous chapter, a supply chain partnership is thought to be an important conduit of interfirm knowledge transfer. Moreover, knowledge transfer is an essential means to help partner firms to benefit from supply chain partnership. This chapter will provide a detailed discussion of supply chain partnership. This chapter defines and classifies supply chain partnerships, and analyzes the characteristics of supply chain partnerships vis-à-vis other interfirm partnerships. The understanding of transaction cost theory, the resource-based view of the firm, and schools of relationship marketing supported the review of supply chain partnerships. The intention of this chapter is to clarify the characteristics of supply chain partnerships and form the basis for the clarification of characteristics of knowledge transfer in supply chain partnerships, as will be discussed in Chapter 4.

### **3.2 Critical Role of Supply Chain Partnership**

Within the 3Rs principle of Christopher (1998) (i.e. responsiveness, reliability, and relationship), the relationship factor has been given greater emphasis when analyzing successful supply chain management. In Christopher's words "the new competitive paradigm is that supply chain competes with supply chain and the success of any one company will depend upon how well it manages its supply chain relations" (1998, p.245). Moreover, the severe market competition and increasing customer requirements are also moving the power in the distribution channel from supplier to buyer, resulting in firms seeking to reduce their supplier base (Christopher, 1998; Harland et al., 1999; Bowersox et al., 2002). This implies that buyers need to transact with fewer suppliers and on a longer-term basis to improve their overall performance.

According to Spekman et al. (1998b) effective SCM suggests seeking close and long-term working relationships with suppliers and buyers. In Copacino's (1996) words "although it is challenging to develop true partnership relationship, the fact is that without strategic partnerships, it is impossible to manage the supply chain as a single entity". Similarly, Lambert et al. (2004, p. 38) argue that "although supply chain management offers many internal opportunities for improvement, the real opportunities will come from reaching out to other members of the supply chain and forming efficient and effective relationships". This implies that whether the firm can effectively manage the relationship between supply chain partners could determine the success of the whole supply chain management strategy. This belief also encourages the firm to develop long-term partnerships with other supply chain members (Gentry, 1996; Golicic et al., 2003; Hult et al., 2004; Cousins et al., 2006). The expected outcomes of higher stability, enhanced synchronization, better coordination, more innovativeness, and more effective information flow and learning, stimulate the firm to form stable partnerships with other supply chain members (Hult et al., 2004). The available evidence therefore, strongly advocates that supply chain partnership is a critical factor that determines the success of any supply chain.

### **3.3 Supply Chain Partnership Defined**

Since supply chain partnership research is still at an early stage, there is lack of a commonly agreed theoretically derived definition for it (Lemke et al., 2003). Table 3-1 provides some typical definitions of supply chain partnership. Some of these definitions generally define the partnership relationship between firms (Mohr and Spekman, 1994), whilst others more particularly define the partnership between buyer and supplier firms (Ellram, 1995; Lambert et al., 1999; Mentzer et al., 2000; Kotabe et al., 2003), given that supply chain partnerships are a subset of business relationships (Lemke et al., 2003). Nevertheless, the key notions of independence, shared risk and reward, information sharing, and mutual dependence are constantly quoted.

Table 3-1 Definitions of Supply Chain Partnership

Reference	Definitions
(Mohr and Spekman, 1994)*	Purposive strategic relationships between independent firms who share compatible goals, strive for mutual benefit, and acknowledge a high level of mutual interdependence.
(Ellram, 1995)	An agreement between a buyer and a supplier that involves a commitment over an extended time period, and includes the sharing of information along with a sharing of the risks and rewards of the relationship
(Burnes and Steve, 1996)	Relationships where customers and suppliers work together in a close, long-term relationship
(Gulati and Lawrence, 1999)	Vertical links between independent firms operating at successive stages in the production chain. The vertical link has the ability to provide high levels of differentiation and integration simultaneously.
(Lambert et al., 1999)	A tailored business relationship based upon mutual trust, openness, shared risk and shared rewards that yields a competitive advantage, resulting in business performance greater than would be achieved by the firms individually
(Mentzer et al., 2000)	An inter-organizational entity developed between two independent organizations in a vertical relationship within a supply chain
(Yu et al., 2001)	A relationship formed between two independent members in supply channels through increased levels of information sharing to achieve specific objectives and benefits in terms of reductions in total costs and inventories.
(Kotabe et al., 2003)	Buyer-supplier relationship or partnership is a set of practices and routines that support economic exchanges between the two firms
(Hult et al., 2004)	Members of the chain are strategically, operationally, and technologically integrated.
* The definition is applicable not just to supply chain partnership.	

Therefore, based on prior definitions, the definition of a supply chain partnership adopted in this research is “an *enduring relationship* between *independent firms* in the *successive stages of the industry chain* based on *vertical complementarities*, and which yields a competitive advantage resulting in *greater business performance* than would be achieved by the single firm alone”. This definition is considered favourable because: (1) it embraces the key characteristics of supply chain partnerships highlighted by prior studies; (2) it provides a clearer view of the unique characteristics of the supply chain partnership which differentiate it from other interfirm partnerships. Section 3.5 examines the unique characteristics of supply chain partnerships.

### **3.4 Supply Chain Partnership as a Type of Interfirm Relationship**

Although the literature is abundant on discussion of the nature of interfirm relationships, little consensus exists on the classification of different types of relationships. For instance, Heide (1994) use the typology of market governance, bilateral nonmarket, and hierarchical nonmarket governance to describe the different types of interfirm relationship. Lambert et al. (1996) classified the interfirm relationship from arms-length to joint venture and vertical integration. In the middle authors have classified three distinct type of partnership relationship, which range from weak to strong partnerships. Golicic (2003) simplified the relationship continuum by combining the intermediate relationship types as one cooperative relationship.

Although different terminologies have been used, the extensive literature alludes to a continuum of interfirm relationships (see table 3-2). Arms-length and integration are the two opposite ends of the spectrum, with partnership in the middle (e.g. Gardner et al., 1994; Lambert et al., 1999; Golicic et al., 2003). Here arms-length relationship refers to short-term discrete transaction relationship. Partnership, sometime also referred to as alliance by researchers, is the longer-term, cooperative form of relationship. Integration refers to where one firm, or several firms acting as one, perform all channel functions (Golicic et al., 2003).

Table 3-2 Selection of Classification of Inter-firm Relationship Types

Authors	Arms-length	Partnership	Integration
Webster (1992)	Transactions; Repeated transactions	Long-term relationships; Partnerships; Strategic alliances; Network organizations	Vertical integration
Heide (1994)	Market governance	Bilateral nonmarket governance	Hierarchical nonmarket governance
Gardner et al. (1994)	Arms-length	Partnership	Vertical integration
Harland (1996)	Transaction	Short-term contract; Long-term contract	Joint venture; Equity interest; Acquisition
Lambert et al. (1996)	Arms-length	(Partnership) Type I; Type II; Type III	Joint venture; Vertical integration
Golicic et al. (2003)	Arms-length	Cooperative relationship	Integration

Moreover, it is generally commented that partnerships between firms can take place through a variety of different arrangements, including relationships with suppliers, intermediaries, and customers, and even with potential or current competitors (Mohr and Sengupta, 2002; Sornn-Friese and Sorensen, 2005). Typically, interfirm partnerships encompass a wide range of equity or non-equity arrangements, such as joint ventures, collaborative advertising, R&D partnerships, lease service agreements, shared-distribution, cross-manufacturing, and cross-licensing (for list and examples of each type of strategic alliances see Pekar and Allio, 1994). Thus, interfirm partnership may take various forms and characteristics (Golicic et al., 2003). Supply chain partnership is therefore one particular form of interfirm partnership.

When depicting supply chain relationships, previous researchers show consensus over the view that there are different levels of relationships between supply chain firms (Macbeth and Ferguson, 1994; Spekman et al., 1998b; Mentzer et al., 2000; Knemeyer et al., 2003; Moberg and Speh, 2003). As Spekman et al. (1998b) argued, co-operation is the starting point for supply chain management and has become a *necessary* but not sufficient condition. In another word, a cooperative relationship is needed to implement

supply chain management strategies. As illustrated in figure 3-1, while the literature alludes to the range of supply chain relationships from arms-length to vertical integration, partnership is most frequently assumed to be the main type of relationship under supply chain management (Macbeth and Ferguson, 1994; Lambert et al., 1996; Spekman et al., 1998b). Given the prevalence and perceived importance of partnerships, this research concentrated only on the partnership between supplier and buyer firms as the main relationship type in supply chains. First, it is more meaningful to analyze the knowledge transfer issue between buyer-supplier partner firms, rather than between those who have only spot exchange relationships, given that the objective of the research was to investigate the issue of knowledge transfer under the supply chain management scenario. Second, vertical integration goes beyond the coverage of interfirm cooperation, so it represented a different concept from supply chain partnership. Its inclusion would have broadened the scope of the research too far, and consequently it is not covered in the examination of supply chain knowledge transfer.

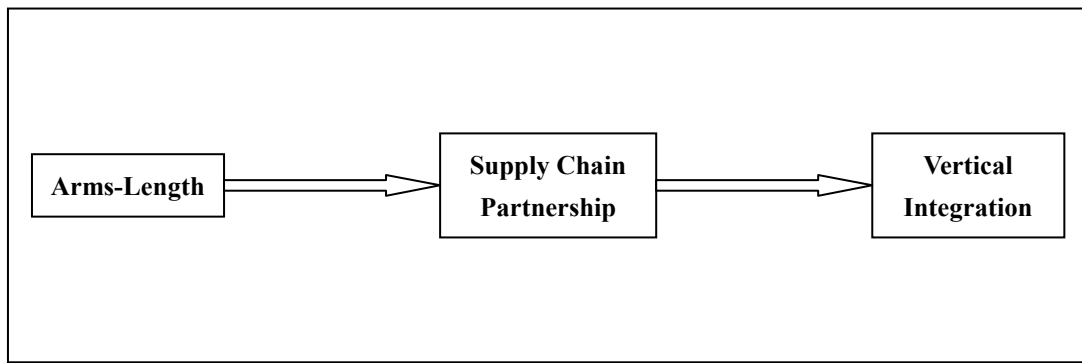


Figure 3-1 Supply Chain Relationship Continuum

It is worth noting that not all supply chain partnerships are the same. The characteristics of each supply chain partnership are different. The exact status and characteristics of the supply chain partnership can be determined by a series of factors, such as partnership strength, power relationship, and duration (e.g. Gadde and Snehota, 2000; Maloni and Benton, 2000; Golobic et al., 2003; Squire et al., 2008). Therefore, when studying the influence of supply chain partnership characteristics on knowledge transfer, researchers



need to clarify what the determinants of supply chain partnerships are. Section 3.6 examines the determinants of the characteristics of supply chain partnerships in detail.

### **3.5 Uniqueness of Supply Chain Partnerships**

Based on the previous discussion, it is reasonable to argue that a supply chain partnership is just one of the various types of interfirm partnership that firms could establish.

Although most types of partnership share certain elements, supply chain partnerships are deemed to be different from other types of interfirm partnership due to their unique characteristics. Based on this review of the literature, it is reasonable to propose that a supply chain partnership could be distinguished from its counterparts through the following four characteristics, namely: cooperative interface, potential benefits of partnership, nature of contract, and partnership structure. Each is discussed in the following four sections.

#### **3.5.1 Cooperative Interface**

Porter (1985) suggested that complementarities might arise between successive stages of the industry chain. Although most interfirm partnerships are formed because of each counterpart's complementarities, a supply chain partnership is typically formed on the basis of vertical complementarities of partner firms along the supply chain. The cooperation between partners is vertical as opposed to horizontal, because in a supply chain partnership, one firm normally uses other firms' output as input to its own value-added process (Christopher, 1998). Gulati and Lawrence (1999) used the notion of value chain alliances (VCAs) to describe the links between independent firms operating at successive stages in the production chain. For example, Boeing established supply chain partnerships with its engine manufacturer, its landing gear supplier, and the host of firms who supply components, expertise, and knowledge that ultimately are incorporated in the 7X7 airplanes to compete for global market share (Spekman et al., 1998b). Through supply chain partnerships the individual functions of each partner firm are

integrated into the whole value-added process from initial material to end customer (Bowersox et al., 2002). In contrast, other types of interfirm partnership are not necessarily formed on the basis of vertical functions of partner firms. For instance, Cytel and Sumitomo Chemicals established an R&D partnership to develop a next generation of bio-technology drugs (Pekar and Allio, 1994). In this case, the partnership was formed based on the R&D functions of two firms.

The literature suggests that firms are seeking supply chain partnerships both upstream and downstream in the value chain. Harland (1996), for example, pointed out the “go slim” trend in industries, in which vertical disintegration, supplier-base reduction, focusing of operations, outsourcing, Just-in-Time, and partnership sourcing are the major strategic options of firms. All of these strategic moves give much emphasis to the importance of supply chain partnerships, especially with firms providing stable vertical complementary functions. Murray (2001) advocated that companies can readily achieve strategic flexibility and effectiveness by partnering with suppliers with complementary strengths. Likewise, Mills et al. (2004) pointed out that instead of producing components or generating functions within the firms’ boundary, more and more firms are turning to outsourcing certain functions to external product or service suppliers.

Meanwhile, firms are also seeking partnerships downstream in the value chain. For instance, Aulakh and Kotabe (1997) pointed out the trend of firms forming strategic alliances among manufacturing and distribution firms for downstream value-added activities. Mills et al. (2004) evidenced the emergence of the ECR (efficient customer response) strategy in the early 1990s, which aims to provide consumers with high quality products or services more quickly with lower costs. This is accomplished mainly by forming more collaborative relationship between manufactures, distributors, and retailers to increase efficiency in the supply chain. There are also many examples of firms outsourcing transportation or distribution functions to third party logistic providers (e.g. Gentry, 1996; Bowersox et al., 2002).

Overall, a supply chain partnership is normally established across vertical boundaries of firms. Through forming partnerships with firms that provide vertical complementary functions, firms are able to reduce redundant operations and concentrate on their core competencies. This allows them to save cost from those less efficient or less important functional areas. As a result, they can be more specialized and be more agile to fluctuating market demand (Sornn-Friese and Sorensen, 2005).

Two implications can be drawn from the previous discussion. Firstly, mutual dependence is the basis of supply chain partnership (although the level may vary due to the actual structure of the supply chain and product types and external market competition). The Industrial Marketing and Purchasing Research Group (IMP) regards both buyer and seller as active participants in the market with complementarities of need and a recognition of inter-dependence (Bates and Slack, 1998). Moreover, according to the resource-based view of the firm, resource bundles and capabilities underlying production are heterogeneous across firms (Peteraf, 1993). By applying and combining unique resources, such as assets, capabilities and organizational processes, firms' attributes, information, and knowledge, firms can enjoy sustainable competitive advantage (Barney, 1991). In this sense, by entering into partnerships, firms can gain complementary skills by tapping into the partners' know-how, sharing risks and gaining synergy (Powell, 1987). Based on this view, the firms on both sides of the supply chain partnership, which possess vertically complementary functions and capabilities, tend to regard each other as important sources of competitive advantage. Given interdependence results from a relationship in which both firms perceive mutual benefits from interacting and in which any loss of autonomy will be equitably compensated through the expected gains (Walton, 1996), supply chain partners develop mutual interdependence as they rely on each other to get access to resources and capabilities which otherwise are unable to be reached to complete the entire value-added process.

Secondly, unlike horizontal interfirm partnerships, firms in a supply chain partnership do not compete directly with each other over supply chain resources, or, if competition

exists due to certain business overlaps, it may not be the major concern of partner firms. Many leading-edge companies have realized that competition is now mainly between supply chains rather than firms in the same value-added process (Christopher, 1998; Maqsood et al., 2007). Nevertheless, the competition that does exist is based on the vertical power struggle over the appropriation of value between buyers and suppliers at each point of the chain (Cox, 1999). Consequently, firms in supply chain partnerships tend to have higher incentives to cooperate with each other to compete with other supply chains, given that they possess different competencies and expertise in the same value-added chain. They tend to realize the potential of competitive advantage improvement they could achieve by accessing resources and expertise that cannot be generated internally. This, in the long-term, rules out the possibility of opportunistic behaviour and strengthens the cooperative relationship between firms (Murray, 2001). However, where supply chain partners may compete is over the fair share of benefits generated from the collaborative supply chain operations.

### **3.5.2 Nature of Contractual Agreement**

Transaction cost theory advocates that an implicit or explicit safeguard mechanism is necessary to safeguard against the hazard of opportunistic behaviour between parties, when there is presence of transaction specific investment and parties have bounded rationality (Williams, 1985). The purpose of the safeguard is to provide control and promote commitment to the exchange at minimum cost. The safeguard or governance structure could take various forms, such as a legal contract (for example, classical and contingency contract) and self-enforcing agreement (for example, informal relational or goodwill trust and reputation, and formal financial hostages) (Dyer, 1997). Unlike other types of interfirm partnerships, such as joint ventures, R&D partnership, and cross-licensing, supply chain partnership is generally loosely organized in terms of non-targeted and less-specified contractual agreements (e.g. Wilson, 1995; Frankel et al., 1996; Lambert et al., 1996). Lambert et al. (1996) advocated that the strongest supply chain partnerships generally have the shortest and least specific agreements, or even no

written agreement at all. For instance, McDonald's and Coca-Cola's partnership for supply of beverages to McDonald's restaurants has no written contract. The partnership is purely based on trust and handshakes (Lambert et al., 1996). When contracts are negotiated in some supply chain partnerships, responsibilities of the partners are usually less specified or are operationally based (Handfield et al., 1999). In many cases, a specified contract is unnecessary because of a social network of prior partnerships or anticipated future cooperation (Heide and Miner, 1992; Kogut et al., 1993). The governance of the partnership relies not on the detailed contract or joint equity investment, but on the trust and commitment that arises from mutual dependence.

The issue of the process of partnership formation is beyond the coverage of this review and implies another research agenda. Nevertheless, it is important to note that previous research suggests that the establishment of a supply chain partnership is likely to go through a prolonged process, which involves phases of spot exchange, awareness, exploration, expansion, and commitment (Dwyer et al., 1987). Such a process is accompanied by activities of continuous interaction, partnership readjustment and conflict handling (Dwyer et al., 1987; Parkhe, 1993; Andersen and Kumar, 2006). Sometimes a relationship may break up before the partnership matures or is officially recognized. Given that mutual dependence is the basis of cooperation, partnerships which last for a longer time period are more likely to develop trust and commitment (Parkhe, 1993). Moreover, transaction specific investments (i.e. physical assets specificity, site specificity, human resource specificity) are more likely to be committed as the cooperative relationship continues (Williams, 1985). Thus partners become more reluctant to act opportunistically which could in all probability result in the termination of the partnership and loss of the value of non-recoverable investments (Parkhe, 1993). Unlike other types of interfirm partnerships, implicit safeguarding mechanisms are cultivated before a partnership is officially formed. Trust between partners in turn reduces further any perception of opportunistic behaviour, and thus eliminates the need for formal contractual structures (Parkhe, 1993; Zaheer et al., 1998; Dyer and Chu, 2003). Opportunistic behaviours of partner firms are outweighed by the concentrated effort to

jointly improve quality and productivity and to reduce overall costs (Landeros and Monczka, 1989) and the concerns over reputation maintenance (Houston and Johnson, 2000). Consequently, supply chain partnerships are more likely to form on the basis of implicit safeguarding mechanisms (e.g. trust, commitment, shared meaning and interdependence) rather than explicit written contractual agreements.

Wilson (1995) pointed out that unlike joint ventures, buyer-supplier partnerships seldom have legal structures that define the boundaries of the partnership. In the author's opinion, a supply chain partnership should be considered as an informal organization developing a governance structure drawing on, but not governed by, the structure of the parent organization. According to Frankel et al. (1996), a formal contract may sometimes hinder alliance practice, since the experimental nature of an alliance may preclude documentation of every conceivable contingency. A formal contract may limit the conduct of the cooperation given that changes in circumstances may raise the ex ante cost of negotiating and rule out the benefit of contractual agreement. Even if a contract is required to guide the implementation of an alliance, it would be difficult for the partners to achieve the full benefits of individual creativity and joint synergy (Frankel et al., 1996).

In contrast, other types of interfirm partnership, such as R&D partnership and joint venture, are usually governed by much more formal and specified contracts, which clarify the duties and responsibilities of each partner firm, define the partnership boundaries and duration to avoid opportunistic behaviours of each party when a partnership is established (Kogut, 1988; Ingham and Mothe, 1998). Moreover, the contract often reasonably specifies the objectives to be achieved through the partnering activities to ensure each party has a mutual understanding on the fair share of benefits and the adequate monitoring of partnership performance. For instance, a joint venture creates superior monitoring mechanisms and rules of sharing costs and/or profits, and the mutual investment in dedicated assets (Kogut, 1988). Likewise, R&D partnership is also governed by specified contract, which confines the activities of each firm and presets the

objectives of the cooperation (Ingham and Mothe, 1998).

In addition, supply chain management researchers generally regard supply chain partnership as non-equity based. According to Stuart (1997), although different definitions of supply chain partnership exist, strategic buyer-supplier partnerships are generally considered as being long-term relationships between buying and supplying firms that involve mutual collaboration and benefit in the absence of any direct equity investment. Such non-equity based arrangements also imply that supply chain partnership is based on influence, trust, and mutual values as opposed to the use of formal authority (Stuart, 1997). Likewise, Lambert et al. (1996) suggested that although certain levels of financial resource sharing may strengthen the partnership, a joint equity arrangement is neither a sufficient nor a necessary condition for a supply chain partnership.

Overall, it is implied that supply chain partnership is not determined by formal contract or hierarchical control mechanisms. In the absence of formal contract or joint equity investment, firms could still form effective partnerships based on informal safeguarding mechanisms, such as trust, commitment, shared meaning, and interdependence (e.g. Frankel et al., 1996; Lambert et al., 1996). Informal mechanisms consider the historical and social context of a relationship as well as specifically acknowledging that the performance and enforcement of obligations are an outcome of mutual interest between parties (Frankel et al., 1996). Supply chain firms may form long-term partnerships solely based on the strategic concerns of the participating firms and mutual benefits to be achieved from the partnership.

### **3.5.3 Potential Benefits of Partnership**

The lack of a well-specified contractual agreement in a supply chain partnership implies that the partnership is usually non-targeted in nature. This means that supply chain firms may not have specific requirements in terms of benefits and returns from the partnership.

Nevertheless, according to Lambert et al. (1996), firms have to have certain drivers or compelling reasons to partner before they form any interfirm partnerships. Consistently, prior research reveals that the most common benefits of supply chain partnership are quality enhancement, time efficiency improvement, inventory reduction, and innovation (e.g. Ellram, 1992; Wilson, 1995; Christopher, 1998; Monczka et al., 1998; Fiala, 2005; Hult et al., 2007). Compared with other types of interfirm partnerships, supply chain partners concentrate more on enhancing operational efficiencies, which does not necessarily lead to immediate financial or economical returns (Li et al., 2006). For instance, quality improvement in the value-added process could enhance customer satisfaction, which in turn improves the market performance of the firm. However, quality improvement alone does not guarantee a firm's growth, for example, in market share. Moreover, innovativeness tends to enhance the overall competitive advantage of the firm, but it does not lead to a direct improvement in financial performance. Operational benefits are actually means to achieve ultimate performance improvement, such as cost reduction, profit enhancement, and market occupation (Wilson, 1995).

On the other hand, other types of interfirm partnership aim to achieve benefits that are more immediate, tangible, predictable, or reasonably quantifiable. Lambe and Spekman (1997), for example, illustrated how firms may form partnerships driven by various explicit motivations, such as gaining access to new markets, acquiring market share, reaching economies of scale, acquiring external technology, reducing cost, or enhancing profit. Even if the expected returns are intangible, partners can reasonably predict the outcome of the relationship most of the time. Overall, compared to other types of interfirm partnership, supply chain partner firms recognize that the potential benefits of the partnership are often indirect and long-term oriented rather than based on direct and specific short-term gains.

Implications for the characteristics of supply chain partnerships are threefold. Firstly, benefits and returns need to be shared among firms keen to improve performance through a supply chain partnership (Christopher, 1998). This implies that the maintenance of the



partnership is largely dependent on the mutual understanding of the potential benefits of the partnership.

Secondly, since the benefit of supply chain partnering is hard to predict or measure, there is a high level of performance ambiguity. According to Heide and Miner (1992), performance ambiguity occurs when it is hard for a player to evaluate the outcomes or products gained from another party. The occurrence of performance ambiguity may largely decrease the chances for cooperation. However, when cooperation is the outcome of structural dependency or commitment, performance ambiguity may not hinder the cooperative relationship between the firms (Heide and Miner, 1992). Moreover, as was discussed above, because of the lack of a strictly defined contract in a supply chain partnership, it is reasonable to argue that commitment and interdependence between supply chain partners may affect the fair share of benefits among partners.

Thirdly, since the benefit is not immediate to partners, in situations where there is a considerable power imbalance between supply chain partners, the relative power of a partner firm could determine the nature of supply chain cooperation, which in turn influences the fair share of benefits between partners and the maintenance of cooperation. According to Ramsay (1996) a relatively powerful party in the buyer-supplier relationship may convert its potential power into actual power to produce intended changes in the counterpart's operations in favour of itself. Asymmetrical dependence in an exchange situation makes one party susceptible to the power and influence of the other party (Ganesan, 1994). The more powerful party is in a position to create more favourable terms of trade and divert the profit from the less powerful party. Cox et al. (2001) also suggested that the power regime or the extended networks of dyadic power relationship largely affect the value appropriation among suppliers and buyers in the supply chain.

### 3.5.4 Partnership Structure

The concept of 'supply network' is newly developed from the research of internal value chains and external supply chains (Lamming et al., 2000; Mills et al., 2004; Harland et al., 2006). According to Christopher (1998) a supply chain is a network of organizations that are involved through upstream and downstream linkages in the value production process. The network view of supply chain relationships emphasizes the firms' role as nodes of a larger supply network. It is the supply network which allows strategic consideration of the whole value production process (Mills et al., 2004). Dyadic relationships (i.e. relationships between two firms) are regarded as the building blocks of a chain and network of supply chain firms (Harland, 1996; Harland et al., 2006).

Therefore, supply chain partnership goes beyond dyadic interfirm partnership into chains and networks of interfirm partnerships. According to Lamming et al. (2000, p. 675), "the articulation of supply network, as an extension of supply chain, seeks to accommodate and explain the commercial complexity associated with the creation and delivery of goods and services from the source of raw materials to their destination in end-customer markets." Therefore, the supply network is defined as sets of supply chains, describing the flow of goods and services from original sources to end customers (Lamming et al., 2000).

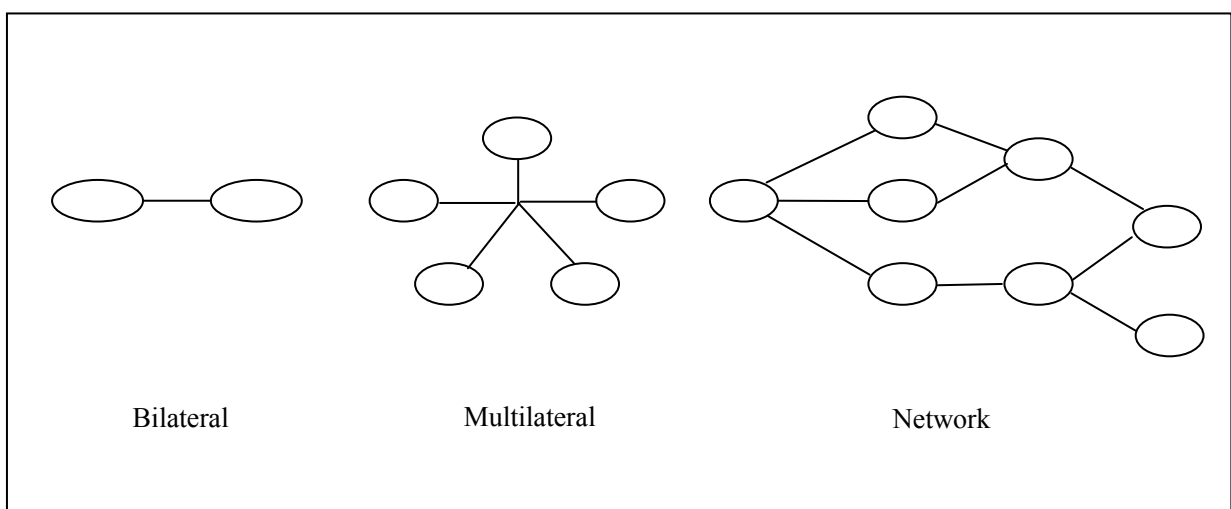


Figure 3-2 Supply Chain Partnership Structures

Linking the concept of the supply network to supply chain partnership, figure 3-2 depicts the possible structures of supply chain partnerships. The partnership could be bilateral, i.e., a partnership based on a one-to-one relationship. It could also be multilateral, where a group of firms serving the same value added process join the same partnership to optimize the value production process (e.g. Dyer and Nobeoka, 2000). Finally, the partnership could be extended into networks of partners. Although a firm may not have partnership with every firm in the network, it may form indirect relationship with other firms through its immediate partners.

The network view of supply chain structure has three major implications for the understanding of supply chain partnership. First, although a supply chain partnership could be a dyadic partnership in nature, it is the network view which provides the most comprehensive understanding of the supply chain relationship (Harland et al., 2006).

Second, dyadic partnership is not the only form of interfirm partnership existing in the supply network. A supply chain partnership could also be multilateral, i.e. involving more than two firms in the same supply chain, and formed by a group of partner firms, which contribute to the same value-added process. For example, Toyota as a focal firm organized its suppliers into hierarchies and formed *Keiretsu* with groups of suppliers, so that first tier or primary suppliers provided systems rather than components to Toyota, which resulted in the reduction in the supply base and overall cost (Nishiguchi, 1994).

Third, even a bilateral or a multilateral supply chain partnership is part of a larger supply relationship network. One single supply chain partnership may be largely affected or determined by other firms or interfirm partnerships in the value chain, and the change of one partnership could also trigger the change of the whole supply network. Petrovic et al. (1998) pointed out that procurement, production and distribution are three subsystems of the supply chain, and these three subsystems are interrelated in a way such that decisions made at one of the subsystems affect the performance of the supply chain as a whole. Gentry (1996) also suggests that a supply chain may consist of multiple partnerships.

One supply chain partnership may not be isolated from the rest of the supply network. Multiple partnerships are likely to be interrelated and together determine the nature of the supply network.

### 3.5.5 Summary of Characteristics of Supply Chain Partnership

Based on the above discussion, table 3-3 was developed to provide a summary of the differences between a supply chain partnership and other types of interfirm partnership. Overall, a supply chain partnership is different from other types of interfirm relationship in terms of relationship interface, expected benefits of participants, contracting arrangement, and structure of interfirm partnership. Accordingly, it is reasonable to argue that the management of the supply chain partnership is different from that of other types of interfirm partnership. Therefore, it is also reasonable to argue that the knowledge management practices in the supply chain will also have some unique characteristics which will be discussed in detail in the next chapter.

Table 3-3 Comparisons of Supply Chain Partnership and Other Types of Interfirm Partnership

Characteristics	Other Interfirm Partnerships	Supply Chain Partnership	Sources
Cooperative Interface	Partnership is typically based on horizontal complementarities.	Partnership is typically based on vertical complementarities.	(Porter, 1985); (Harland, 1996); (Aulakh and Kotabe, 1997); (Christopher, 1998); (Bowersox et al., 1999)
Potential Benefits of Partnership	Attempts to achieve tangible benefits directly; Benefits tend to be realized in shorter term; Benefits are more predictable; Benefits are more quantifiable.	Attempts to achieve operational efficiency which indirectly enhance tangible performance; Benefits tend to be realized in longer term; Benefits are less predictable; Benefits are less quantifiable.	(Wilson, 1995); (Lambe and Spekman, 1997); (Maloni and Benton, 2000); (Graham et al., 1994); (Kalwani and Narayandas, 1995)
Nature of Contract	Contract is more targeted and the goals of partnership are well-specified; Relationship boundaries are clearly specified;	Contract is non-targeted and the goals of partnership are less specified; Relationship boundaries are less specified;	(Kogut, 1988); (Landeros and Monczka, 1989); (Wilson, 1995); (Frankel et al., 1996); (Lambert et al., 1996); (Stuart, 1997); (Anand and Khanna,

	Partnering activities are clearly defined; Terms and responsibilities are clearly specified; May involve shared equity.	Partnering activities are loosely defined; Terms and responsibilities are loosely defined; Does not involve shared equity.	2000)
Partnership Structure	Partnership is bilateral; Relationship is dyadic and isolated from other partnerships.	Partnership could be bilateral or multilateral; Relationship is network based and interrelated with other partnerships.	(Gentry, 1996); (Harland, 1996); (Turnbull and Ford, 1996); (Petrovic et al., 1998); (Lamming et al., 2000); (Mills et al., 2004); (Harland et al., 2006)

Note: other types of interfirm partnership include joint venture, R&D partnership, licensing agreement, collaborative advertising, lease service agreements, shared-distribution, and cross-manufacturing.

### 3.6 Determinants of the Characteristics of Supply Chain Partnership

As previously discussed, one of the main objectives of the present research is to investigate the influence of supply chain relationship characteristics on knowledge transfer between supply chain partners. Thus, it was necessary to clarify the determinants of the characteristics of supply chain partnerships. As highlighted in the previous section, supply chain partnership has certain unique characteristics, which also give rise to relationship factors such as trust, commitment, interdependence, shared meaning, and balanced power. These factors are given special attention here, because they have particular relevance to the study of supply chain partnerships. In the following sections these factors will be examined based on the review of previous literature. Review of interfirm partnership and relationship marketing literature suggested that these relationship factors could be grouped into three main categories, namely partnership magnitude/strength (see section 3.6.1 and 3.6.2), power relationship (see section 3.6.3), and partnership duration (see section 3.6.4).

#### 3.6.1 Magnitude of Supply Chain Partnership

When talking about supply chain partnership, different researchers use different relationship categories to describe the extent to which buyer and supplier firms are

involved in partnerships. For instance, Speckman et al. (1998a) described partnership as ranging from cooperation, through co-ordination, to collaboration, as partner firms engage in an increasing level of information sharing, long-term outlook, more trust and commitment. Mentzer et al. (2000), distinguished between operational and strategic supply chain partnerships, where operational partnering refers to an as-needed, shorter-term relationship for obtaining parity with competitors, whilst strategic partnering refers to an on-going, long-term inter-firm relationship for achieving strategic goals. Moreover, Lambert et al. (1999) classified three levels of partnership, namely type I, type II and type III which exhibit increasingly higher levels of coordination and integration and longer-term orientation.

Although expressed in different terminologies, researchers are consistent on the idea that supply chain partnerships can and should be differentiated by the strength and magnitude of the partnership and by the level of collaboration between partners. According to Golicic et al. (2003), different relationships could have different magnitude, which is antecedent to the type of relationship. In other words, the magnitude of the relationship between organizations helps to determine the nature of the relationship. Here the magnitude is defined as “the extent or degree of closeness or strength of the relationship between or among organizations” (Golicic et al., 2003).

### **3.6.2 Attributes of Supply Chain Partnership Magnitude**

Prior researchers have focused on various factors determining the supply chain partnership magnitude. Various factors have been identified that contribute to the success of partnership (Mohr and Spekman, 1994; Monczka et al., 1998). There is also literature particularly interested in the factors that determine strength or magnitude of the partnership relationship (Stuart, 1993; Lambert et al., 1996; Mentzer et al., 2000; Golicic et al., 2003; Moberg and Speh, 2003). Table 3-4 provides a summary of relationship magnitude attributes highlighted in the prior studies. Although some researchers have used the idea of partnership strength and partnership success interchangeably, they are

actually referring to the same underlying idea. This is because those factors facilitating the success of a partnership are also considered to enhance the partnership's strength. Within these studies the notions of trust, commitment, and interdependence are the commonly agreed supply chain partnership attributes. Each is examined in turn below.

Table 3-4 Sample of Interfirm Relationship Magnitude Attributes

<b>Authors</b> <b>Predictors</b>	(Knemeyer et al., 2003)	(Moberg and Speh, 2003)	(Golicic et al., 2003)	(Mentzer et al., 2000)	(Monczka et al., 1998)	(Lambert et al., 1996)	(Wilson, 1995)	(Mohr and Spekman, 1994)	(Stuart, 1993)
<i>Trust</i>	√	√	√	√	√	√	√	√	
<i>Commitment</i>	√	√	√	√		√	√	√	
<i>Interdependence</i>	√		√	√	√		√	√	
Communication	√				√	√		√	
Investment	√					√	√		√
Shared risks/rewards	√					√	√		√
Conflict resolution					√			√	
Coordination					√			√	
Compatibility				√					
Cooperation							√		
Performance satisfaction							√		
Structural Bonds							√		
Adaptation							√		
Shared technology							√		
Social Bond							√		
Joint problem solving					√				√
Joint planning						√			
Joint operating controls						√			
Development potential									√
Scope						√			
Contract style						√			
Alliance selection process					√				
Conflict				√					

Top management vision of the firm				√					
--	--	--	--	---	--	--	--	--	--

### **3.6.2.1 Trust**

Trust is one of the most commonly agreed factors that determine the relationship magnitude. It is defined as a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviour of another (Rousseau et al., 1998). Trust, however, is also one of the most controversial concepts in the study of interfirm relationships. No commonly agreed conceptualization has yet been reached. Based on the author's review of literature the characteristics of trust could however be explained through the following four facets.

First, trust is not explained as behaviour (e.g. cooperation) or a choice (e.g. taking a risk) but as underlying psychological conditions that can cause or result from such actions (Rousseau et al., 1998). It is positive expectations of the other (Bhattacharya and Devinney, 1998; Das and Teng, 1998; Zaheer et al., 1998). Under the context of market relationship, trust is known as the "willingness to rely on an exchange partner in whom one has confidence" (Moorman et al., 1993, p.82). "Trust is conveyed through faith, reliance, belief, or confidence in the supply partner and is viewed as a willingness to forego opportunistic behavior" (Spekman et al., 1998b, p. 634). It is "one party's confidence that the other party in the exchange relationship will not exploit its vulnerabilities" (Dyer and Chu, 2000, p. 260).

Second, trust is a dynamic concept rather than static. As Rousseau et al. (1998) pointed out the fact that "trust changes over time – developing, building, declining, and even resurfacing in long-standing relationships – is evident from comparative and historical research upon trust". Trust is created, reinforced, or decreased by bilateral relational activities (Suh and Kwon, 2006). Therefore, the maintenance of trust largely depends on the on-going activities of the partners.



Third, trust is a multilevel concept, which could be either individual or inter-organizational. Individual trust refers to the extent of a boundary-spanning agent's trust in her counterpart in the partner organization, i.e. the trust placed by the individual boundary spanner in her individual opposite member (Zaheer et al., 1998). When talking about inter-organizational relationships, trust refers to the extent of trust placed in the partner organization by the members of a focal organization (Doney and Cannon, 1997; Zaheer et al., 1998). The research presented in this thesis has mainly focused on inter-organizational trust rather than individual trust, given that the research objective was to examine the influence of interfirm relationship on knowledge transfer.

Fourth, trust incorporates multiple forms, which highlight the multifaceted nature of trust. Table 3-5 summarises a list of different forms of trust raised by prior researchers. Three general forms of trust emerge from those prior researchers' derivatives of trust: (1) trust based on the balance between benefit and loss of trusting the other, due to the concern of the other party's competence, such as calculative trust, competence trust, calculus-based trust, and risk-based trust; (2) trust derived from continuous relationship with the other, due to improve knowledge or positive experience, such as benevolence, relational-based trust, and good-will trust; (3) trust based on concerns of social norms or bounded by moral or legal systems, such as credibility, institutional-based trust, and contractual trust.

Table 3-5 Dimensions of Trust and Explanations

Reference	Forms of trust	Explanations
(Doney and Cannon, 1997)	Credibility	The expectation that the partner's word or written statement can be relied on.
	Benevolence	The extent to which partner is genuinely interested in the other partner's welfare and motivated to seek joint gain.
(Rousseau et al., 1998)	Calculus-based	Emerges when trustor perceives that the trustee intends to perform an action that is beneficial.
	Relational-based	Derives from repeated interactions over time between trustor and trustee, also known as affective trust or identity-based trust.
	Institutional-based	Supported by institutional means, such as social norms,

---

(Sako, 1992; Miyamoto and Rexha, 2004)	Contractual	legal systems, and social networks. Expectations that an exchange partner keeps its promises.
	Competence	Confidence in exchange partner's competence, professional standard, in carrying out specific tasks.
	Good will	Confidence in exchange partner's open commitment to supporting and continuing a focal exchange relationship.
(Suh and Kwon, 2006)	Calculative	Expected gain from placing oneself at risk to another is positive and the decision to accept such a risk is taken.
	Risk-related	Willingness to take risk.
	Relationship-based	Trust is created, reinforced, or decreased by bilateral relational activities.

---

Bhattacharya & Devinney (1998) suggested that trust is context specific. In this sense, the extent and type of trust that exists between two parties is dependent on the actual relationship nature. In the context of the supply chain, trust has been shown to be one of the most important factors in determining the success of the supply chain partnership (Frankel et al., 1996; Squire et al., 2008). Transaction cost theory suggests that buyers must safeguard themselves against the hazards of opportunism of suppliers and vice versa (Humphreys et al., 2004). A feeling of trust is important in reducing a partner's fear of opportunistic behaviour (Mohr and Spekman, 1994). The existence of trust stimulates favourable attitudes and behaviours among supply chain partners (Schurr and Ozanne, 1985) and it reduces the risk of opportunistic behaviour in a long-term exchange relationship (Ganesan, 1994).

As has been discussed in previous sections, the loosely defined supply chain partnership characterized by the lack of a formalized contract make supply chain partners rely more on trust to maintain the ongoing relationship. Since the behaviours of the partners are less likely to be restricted by written contract or explicit expectations of performance, trust is more emphasized in the supply chain partnership compared with other kinds of interfirm partnership (Moberg and Speh, 2003). In the supply chain partnership, relational-based trust and calculative-based trust play more important roles than institutional-based trust. This is because trust between supply chain partners tends to be built upon continuous

successful transactions, and the awareness that the other party will fulfill supply chain tasks that are unable to be accomplished by the focal firm itself. Although the social network can reinforce the trust between supply chain partners, the frequent lack of a written contract makes the relationship less restricted by other institutional factors, such as legal systems.

### **3.6.2.2 *Commitment***

Commitment is frequently referred to as an important predictor of partnership strength (Golicic et al., 2003). It is also one of the most common variables used in buyer-supplier relationship studies (e.g. Wilson, 1995; Krause et al., 2007). Various definitions of commitment exist. For instance, Moorman et al. (1992) defined the commitment to a relationship as “an enduring desire to maintain a valued relationship”. Dwyer et al. (1987, p 19) defined commitment as “an implicit or explicit pledge of relational continuity between exchange partners”. Similarly, Dion et al. (1992) defined commitment as “the belief that trading partners are willing to devote energy to sustaining this relationship”. All of these definitions convey the idea of partners’ willingness and desire to continue a relationship and enhance the scope of it. According to Mentzer et al. (2000):

“Commitment is a critical success factor for long-term, strategic partnerships because firms sacrifice short-term benefits to realize long-term benefits; it shows an intention to become more deeply involved in the partnership through investments that entail risks; and it implies the importance of the relationship to the partners.”

Commitment refers to the willingness of trading partners to exert effort on behalf of the relationship and suggests a future orientation in which firms attempt to build a relationship that can be sustained in the face of unanticipated problems (Fynes and Voss, 2002). The general consensus of prior studies indicates three facets of commitment: firstly, the subjective willingness of partners; secondly, the basis of commitment is the potential benefits perceived by the partners; and thirdly, commitment results in a prolonged relationship.

In the context of a supply chain partnership, in the absence of a formal written contract, commitment does not arise from the defined length of the relationship (Frankel et al., 1996). Spekman et al. (1998b) argued that, it was through commitment that partners dedicated resources to sustain and further the goals of the supply chain, and hence partners found it more difficult to behave in a way which might harm overall supply chain performance. As a result of commitment, partners become more focused on their value creation process and feel more tied to their overarching goals. This is in comparison with other types of more bounded interfirm partnership. For example, a joint development agreement has the legal terms, which define the length of the partnership, so that during the agreement term the relationship is supposed to be continuous. In supply chain partnerships, commitment between partners is more likely to arise from the interaction of three sources: vertical complementarities, switch costs involved in changing partners, and the influence of social networks.

Under supply chain partnership, one of the most important foundations of partnership development is vertical functional complementarity. The initial establishment of the partnership is usually based on the need of one or more external organisations to complete the value-adding process as well as on assessing and comparing multiple potential partners. Possible criteria used to select the partnership could be price, cycle time, quality, and reputation. At this point, the capabilities and benefits potential partners could bring into the value-adding process are the main factors to be considered during the formation and maintenance of supply chain partnerships.

Once the relationship has been established, it is likely for partners to invest in relationship-specific assets, such as capital improvement, training, and equipment. According to Wilson (1995), such investments are usually non-retrievable, or cannot be recovered if the relationship terminates. Therefore, it becomes quite irrational to indulge in any opportunistic behaviour or to change partners, when the benefit of taking advantage of or ending an existing partnership is lower than the switch cost to a new partner.

The opportunistic or switching decision becomes even more irrational when partners are involved in a healthy partnership, since such a decision will also create a bad impression on a new partner or future potential partners over the credibility of the focal firm, such that future operation opportunities could be largely restricted (Heide and Miner, 1992).

In this research, commitment is mainly referred to as organizational commitment. It should be noted however that organizational commitment is eventually a function of the integrated commitment of individuals. It is the collection of individual members' (e.g. employees', managers') commitment to another organization that leads one organisation to be committed to another. Other things being equal, a partnership is considered to be strongest when commitment is exhibited from all the parties involved in the partnership.

### ***3.6.2.3 Interdependence***

The concept of organizational interdependence incorporates two perspectives. First, interdependence arises from a relationship in which both firms perceive mutual benefits from interacting and in which any loss of autonomy will be equitably compensated through the expected gains (Mohr and Spekman, 1994; Knemeyer et al., 2003). Thus, partner firms are dependent upon each other because they can obtain higher benefits through the relationship. Second, interdependence exists when one actor does not entirely control all of the conditions necessary for achievement of an action or a desired outcome (Monczka et al., 1998). This point, actually, is also reflected in the resource-based view of the firm, in that interdependence arises from the complementarities of need and resources (Barney, 1991). Prior research has suggested that a higher level of interdependence tends to enhance the magnitude of partnership relationship (Wilson, 1995; Spekman et al., 1998b; Golicic et al., 2003; Knemeyer et al., 2003). Firms with higher levels of interdependence tend to rely on each other to generate favourable outcomes, so that they will have greater interest in sustaining the relationship (Anderson and Narus, 1990).

It was previously argued that a supply chain partnership has more flexible and loose structures compared with other types of interfirm partnership. In addition, the performance targets of the partnership are also less clarified and predictable. Moreover, the activities of partners are less likely to be restricted by explicit contract. Nevertheless, given that one of the main foundations for the supply chain partnership is the mutual complementarities in partners' functions, opportunistic behaviour could be ruled out by the recognition of the important roles that each counterpart plays in completing the supply chain tasks. Vertical complementarities therefore are the most important source of interdependence between supply chain partners. In addition, knowing that interdependence does exist leads the partners to believe that they may still carry on the cooperation in the future. This anticipated future interaction or extendedness will reinforce the current cooperation of the partner firms (Heide and Miner, 1992).

#### ***3.6.2.4 Shared Meaning in Supply Chain Partnership***

By assessing the level of trust, commitment and interdependence exhibited in a supply chain partnership, many previous researchers have proposed that the strength of the partnership can be indicated. Given that supply chain partners are more likely to work at different stages of an industrial process, one thing that seems to be missing in many previous researchers' conceptualization of the partnership magnitude is the level of shared meaning.

In section 3.5.2 it was argued that the anticipated future interaction or extendedness results from interdependence could reinforce the cooperation of the partner firms (Heide and Miner, 1992), but that the mere knowledge of mutual reliance is not sufficient for the development of a harmonious relationship between supply chain partners. Unlike those interfirm partnerships with joint organizations or explicit boundaries for cooperation, such as joint ventures or R&D partnership, a supply chain partnership has far fewer opportunities to develop a strong organizational identity or culture (Hult et al., 2004). The supply chain partnership is built upon repeated transactions and reliance on the other party's capability to complete the value chain process, rather than shared

investment and benefits or contracted objectives. The partnership will be solidified only when both parties realize each other's irreplaceable role in completing the value chain process. In most of the cases, when the importance/magnitude of the relationship outcome is still low, the relationship outcome is not significantly better than an alternative relationship, or when alternative trading partners are available (Heide and John, 1988), the partnership will be considered as weak, and the collective action will be largely vulnerable. The identity and culture are even weaker when partner firms are operating at different industrial stages possessing different expertise and specialization. In the absence of strong identity or culture, shared meaning is necessary to harness collective action in the supply chain (Hult et al., 2004).

Shared meaning is defined by prior researchers as the extent to which partner firms share a common understanding and approach to the achievement of tasks and outcomes (Spekman et al., 2002; Hult et al., 2004; Inkpen and Tsang, 2005). It measures the level of partner firms' shared knowledge about the common goals and the approaches to achieve those goals. According to Inkpen and Tsang (2005), the appearance of shared meaning forms the cognitive dimension of the interfirm social capital. The level of shared meaning among supply chain partners determines partner firms' willingness to cooperate with each other and their willingness to take short-term burdens for the future benefits of the supply chain. Unlike an intra-corporate network where headquarters could set the common goals, interfirm partners often have different goals in mind when they enter into a partnership, and negotiation then helps the partners to arrive at goals that are acceptable to most of them (Inkpen and Tsang, 2005). In the case of a supply chain partnership, however, where contract agreement is less explicit or stable, the shared meaning is arguably more difficult to be achieved (Hult et al., 2004).

Prior research generally suggests that a supply chain partnership is most effective when firms have a high level of shared goals or shared meaning in the value-added process (Handfield and Nichols, 2002; Hult et al., 2004). Due to the varied lines of business and the network structure, the tasks and outcomes may vary in clarity and definition (Inkpen

and Tsang, 2005), such that the level of shared meaning may vary from one supply chain partnership to another. Consequently, the magnitude of supply chain partnership also varies from one partnership to another. Apart from trust, commitment, and interdependence, the identification of shared meaning also helps the identification of supply chain partnership magnitude.

#### ***3.6.2.5 Summary of Relationship Magnitude***

The review of the characteristics of supply chain partnerships suggested that supply chain partnership is more likely to be unpredictable and unstable. How a partnership is sustained is unlikely to be bounded by a written contract, and the strength or closeness of a partnership is unlikely to be indicated by objective or ‘quantitative’ criteria. Unlike other interfirm partnerships, it is difficult to identify the legal terms of a supply chain partnership and it is difficult to examine the exact boundary of the partnership. Therefore, in this research, the magnitude of a supply chain partnership is measured by more subjective measures, namely trust, commitment, interdependence, and shared meaning. This is not only because they are more frequently used by other prior researches, but also because of their capabilities to provide tailored measurement to supply chain partnership strength.

Noticeably, other factors, such as communication, shared risk/reward, and investment, have been used to indicate magnitude of the supply chain partnership (Mohr and Spekman, 1994; Morgan and Hunt, 1994; Wilson, 1995; Kraatz, 1998; Monczka et al., 1998; Lambert et al., 1999; Gadde and Snehota, 2000; Cavusgil et al., 2003; Knemeyer et al., 2003; Modi and Mabert, 2007). However, some of these factors are considered intermediate to other magnitude measures such as trust, commitment, interdependence, and shared meaning. It is for this reason these factors are not included in partnership attributes presented in this thesis.

For instance, open communication has been considered as an antecedent to the trust between supply chain partner firms (Selnes, 1998; Knemeyer et al., 2003). Moreover, it



could be argued that shared risk and reward is also reflected in the mutually dependent relationship. It is also suggested that when partner firms engage in higher levels of investment into the relationship, it is more likely that they will be more committed to the partnership and will improve the efficiency of their relationship (Wilson, 1995; Lambert et al., 1999; Gadde and Snehota, 2000; Knemeyer et al., 2003). However, given the loosely formed partnership structure, investment is not necessarily linked to strong supply chain partnership. Therefore, to avoid the overlap between different magnitude indicators, the present research did not include factors such as communication, shared risk/reward, and investment, into the measurement of partnership strength or magnitude.

### **3.6.3 Power Relationship**

The literature of supply chain management highlights the importance of partnership between buyer and supplier firms, which exhibit trust, commitment, mutual dependence, and shared meaning. These factors generally form the basis for the cooperation of supply chain partners. Meanwhile, as suggested by increasingly more scholars, the role of power is also considered an important factor when indicating the relationship structure between supply chain partners (Lascelles and Dale, 1989; New, 1998; Cox, 1999; Cox et al., 2001; Hallikas et al., 2005). Nevertheless, previous empirical studies have tended to overlook the role of power in the study of interfirm knowledge transfer (He et al., 2006). As Maloni and Benton (2000) advocated, supply chain strategy or research that does not account for the influence of power cannot be entirely realistic or implementable. Therefore, this research intends to fill in the gap and give more emphasis to the power relationship between supply chain partners.

#### ***3.6.3.1 Power Relationship in Supply Chain Partnership***

The concept of power has strong roots in social and political sciences, and the topic has since been extended to the marketing channels literature and to the study of supply chain relationships (e.g. Ramsay, 1996; Maloni and Benton, 2000; Cox et al., 2001). Power is defined as the ability of one party (A) to get another party (B) to undertake an activity

that B would not normally do (Cox et al., 2001). In the context of interfirm partnership, power refers to the extent of influence that one party has over the other in terms of influencing decision variables that are significant to achieving the objectives of partnership (Yan and Gray, 1994). The presence of power is sometimes unavoidable. For instance, based on an empirical study, New (1998) found that “even amongst firms who wished to work collaboratively, there seemed little chance of abandoning the sanctions and mechanism of the market”. Although people may try to avoid using the word ‘power’ when managing the relationship with other firms, the power relationship actually penetrates almost every partnership.

In fact, few interfirm partnerships have equal distribution of power (Ramsay, 1996). There is always asymmetric power between partners in one way or another, due to differences in size, business resources, availability of alternatives, and reputation. Asymmetric power in a partnership may even shift from one transaction to another. The resource-based view of the firm advocates the contribution of inimitable resources to a firm’s competitive advantage (Wernerfelt, 1984). It is very likely that the resources one partner possesses will contribute to its influence over the partner in one transaction, but such influence could diminish in another transaction where its resources are no longer considered to be valuable and scarce to the partnership.

In supply chain partnership, power plays an even more important role in managing and maintaining the relationship. Given that supply chain partnership is less restricted by explicit contract, the distribution of power between partners will largely affect the distribution of responsibilities and the fair share of benefits between supply chain partners. Because purchasing and distribution are important exchange interfaces of supply chain players, when discussing the power relationship in the supply chain, researchers have frequently referred to buyer’s and supplier’s exercise of commercial power. According to Ramsay (1996) the purchasing power of supplier or buyer is defined as the potential capacity of supplier or buyer to produce intended changes in the counterpart’s operations in favour of itself, or the potential capacity to resist the effort of

the counterpart to persuade itself to change its own operations, which might result in unfavourable results to itself. Thus, the actual power is a result of the successful conversion of potential power into intended changes in the behaviour of the counterpart.

Prior research shows consensus over the disadvantages that can result from asymmetric power. According to Maloni and Benton (2000) interfirm power has the potential to upset the mutuality of supply chain relationships and subsequently presents a barrier to win-win integration. In an asymmetrical relationship, the dependency may not be reciprocal, so that one partner has power over the other but not vice versa. Under such circumstances, exploitation rather than cooperation might result (Heide and Miner, 1992). Nevertheless, the exercise of power is not always unfavourable. For example, Cox (1999) argued that companies are only successful if they possess power over something or someone, because there are always objective conflicts of interest between vertical participants in supply chains, just as there are between those competing horizontally in the markets that form around specific supply chain resources. Lascelles and Dale (1989) suggest that purchasing power is a major issue in the buyer-supplier relationship, in that a lack of purchasing power of the buyer firm often counts for the unsuccessful quality improvement of the supplier. Moreover, Cox (1999) found that Toyota could create an assembly-based, demand-pull and JIT system because it had a dominant power relationship with its suppliers, which allowed it to force through the innovations it desired from supply chain partners. Therefore, given that integrated supply chain management requires exchange of critical information and the integration of operations, the exercise of power could be used to ensure the congruence in goals and activities of supply chain partners, especially when there is a lack of explicit contracts.

Unlike other attributes of partnership relationships, power cannot be easily indicated by a set of parameters (New, 1998). This is mainly due to the reason that power structures often contain complex social, economical and even emotional factors. As Cox (1999) has argued:

“Analytically, there must be a wide variety of supply chains, each of which will have very different structural configurations of power... This is due to the particular types of resources they own and control (power attributes), and the ways in which they own and control them vis-à-vis other supply chain members.”

Moreover, as Cho and Chu (1994) argued, bargaining power is essentially a subjective and relative concept, since the basis of one's bargaining power is another's belief or expectation of how one will create an impact on the other. Thus, the power relationship is often context specific and difficult to be conceptualized, and the interfirm power is difficult to measure by quantitative scales.

When discussing the power relationship in the supply chain, Cox et al. (2001) used the concept of 'power regime', which refers to the relative dominance of one firm over another, to indicate the power structure between firms. According to Cox et al. (2001), firm A is more powerful than firm B, because firm A tends to be dominant over firm B. Bates and Slack (1998) illustrated that in the supplier-buyer relationship there could be the situation of either strong buyer, weak supplier, or strong supplier, weak buyer. Muthusamy and White (2006) suggested that the power relationship could be either symmetric or asymmetric, which determines the nature of mutual influence of partners. Symmetric power (or balanced) power is where both parties possess the same capability to affect the decisions of the other, whilst the asymmetric (or unbalanced) relationship, is where the stronger party has greater control or influence than the weaker party (Muthusamy and White, 2006).

In this research the main focus is on the knowledge transfer between supply chain partners, which tends to be a two-way process. Thus, it is more relevant to clarify the relative power structure, rather than determine the exact level of power the stronger party has. As will be discussed more in Chapter 5, interfirm knowledge transfer is more likely to be affected by the uneven distribution of power. Based on the discussion of prior literature, rather than indicate exactly the extent of power that one party has over the other, the approach adopted in the present research has been to indicate the relative

power positions of partner firms. Moreover, this study did not make an explicit distinction between the relative power position of the buyer or the supplier in the supply chain partnership (i.e. whether A is more powerful than B or B is more powerful than A), instead this research used the notion of “balanced” or “un-balanced” power to indicate the general power structure of supply chain partnerships.

### ***3.6.3.2 Attributes of Balanced-power***

Based on the extensive review of literature, it is argued that balanced power in the supply chain partnership can be indicated by two factors, namely availability of alternatives and restraint in the use of power. Firstly, balanced power arises from low dependency/available alternatives. Kim et al. (2004) followed the power-dependence argument of Emerson (1962) and pointed out that, although both actors could be mutually dependent in an exchange, it does not mean that they are always equally dependent on each other. The less dependent actor will maintain a power advantage, resulting in a power imbalance. Hardwick and Ford (1986) view dependence, at whatever level, as a poor option since it derives from a lack of choice. As advocated by marketing channel theory (e.g. Ganesan, 1994) and the bargaining theory (e.g. Yan and Gray, 1994), one of the important sources of dependence comes from the lack of alternatives. Although a supply chain partnership is formed on the basis of vertical complementarities, which result in a certain level of mutual dependence, the lack of alternatives for one party will limit the extent of equal say in the partnership. For example, Anderson and Weitz (1989) suggested that the availability of alternative suppliers would contribute to the distributor’s power over the supplier. In the context of supply chain partnership, the lack of an alternative buyer or supplier means that one of the partner firms is more attached to the relationship and is more dependent on the performance of the other party. The partnership becomes vulnerable, especially when there is no explicit contract or the contract is loosely defined, since there is more chance for the more powerful party to exploit the less powerful one.

Second, balanced power arises from restraint in the use of power. As has been mentioned,

few partnerships have equal distribution of influence. However, the relative power may be neutralized given that partners do not have the intention to use the power to take advantage of the counterpart. Muthsam and White (2006) pointed out even if asymmetry arises from differences in dependencies, all potential power is not necessarily enacted. If the long-term interests and future gains of partnership are taken into consideration, partner firms may switch to the restricted use of power as a fundamental policy in managing partnerships (Heide and Miner, 1992; Muthusamy and White, 2005). In the case of Toyota, Dyer and Nobeoka (2000) demonstrated where one partner is stronger than the rest, but the strong partner is not using power to exploit others. Similarly Maloni and Benton (2000) illustrated that automobile manufacturers with objective power may choose to follow a cooperative approach to encouraging communication and sharing of benefits, or a competitive approach to leverage over weaker supply chain partners. In particular, if the boundary-spanning partnership managers are willing to restrain the excessive use of power over their partner and at the same time allow the other party to have a say in the operations, then each partner is more likely to have positive feelings or psychological attachment to the relationship. Therefore, although availability of alternatives determines the objective dependency of supply chain partners, another key to indicate the power relationship is whether the powerful partner is restrained in using its excessive power.

#### **3.6.4 Partnership Duration**

The discussions in section 3.6.1 and 3.6.3 demonstrated that the partnership between buyer and supplier firms in the supply chain could be differentiated by the magnitude of their relationship and the balance of power. A stronger partnership tends to exhibit higher levels of trust, commitment, interdependence, and shared meaning. A symmetric relationship between supply chain firms will exhibit a certain level of mutual influence resulting from availability of alternatives and/or restraint in the use of power. It is worth noting that supply chain partnership matures over time. Different partnerships may have reached different stages of development. In order to more accurately position the

characteristics of a supply chain partnership in which firms are engaged, the duration of the partnership is also considered.

Although prior researches suggested that strength of partnership should increase with the length of prior relationship (Monczka et al., 1995), prior history of the relationship still matters (Heide and Miner, 1992). According to Gadde and Snehota (2000):

“It does not follow automatically that long lasting supplier relationship of a company are always the obvious candidates for increased involvement, nor does it necessarily mean that short-term supplier relationships are to be handled with a low-involvement approach.”

Authors have used the term ‘involvement’ to indicate the strength or closeness of partnership. They suggest that even in a long lasting relationship, the cooperation between partner firms could still be weak. For instance, Dyer et al. (1998) observed the existence of durable arms-length relationships, characterized by less face-to-face communication, less assistance, fewer relation-specific investments and frequent price benchmarking. It could be that the manufacturer has purchased the product from the supplier over several years due to a consistently low price, so that their relationship may not go anywhere beyond the placing of an order and its delivery (Lemke et al., 2003). On the other hand, in a short-term relationship, partner firms could still have intense involvement. As an illustration of this, Gadde and Snehota (2000) demonstrated the examples of equipment and investment goods procurement. In short, when considering the status of a partnership, partnership duration is an important variable to be considered.

### **3.6.5 A Three-dimensional Representation of the Determinants of Supply Chain Partnership Characteristics**

In summary, three main aspects of relationship attributes can indicate the characteristics of partnership between supply chain firms. In another word, supply chain partnerships can vary on their levels of partnership magnitude, power relationship, and partnership

duration. A three-dimensional representation of supply chain partnership is developed (as shown in figure 3-3).

According to this 3-D representation, a supply chain partnership could be placed in any area in the model. The boundaries between one area and another are not distinct, i.e. it is matter of degree as to whether a partnership belongs to one area or another. However, being further from the origin point in this structure suggests that the partnership tends to exhibit stronger relationship, with more balanced power, and with longer duration. To illustrate, a partnership in area 'IA' indicates that this partnership is weak in magnitude, lasts for a short period, and one partner imposes more influence over another. On the contrary, a partnership in area 'IIIC' will indicate that this partnership tends to be stronger, with balanced power between partners, and lasts for a longer time. This 3-D representation demonstrates the possible status of particular supply chain partnerships, and is provided to help guide examination of the influence of supply chain partnership characteristics on interfirm knowledge transfer between supply chain partners.

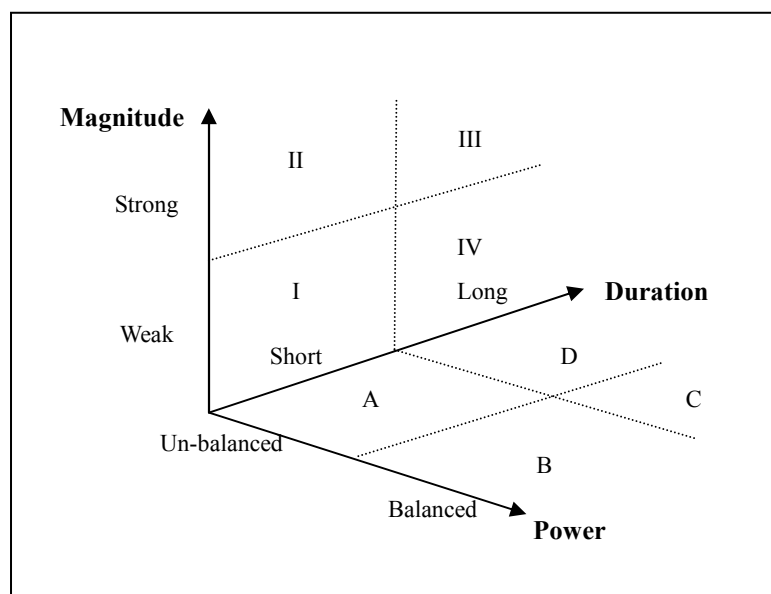


Figure 3-3 Supply Chain Partnership 3-D Representation



### **3.7 Summary**

This chapter disclosed the unique characteristics of the supply chain partnership compared with other types of interfirm partnership based on review of relationship marketing and supply chain management literature. The determinants of the supply chain partnership were introduced, so that a three-dimensional representation of partnerships (consisting of partnership magnitude, balanced-power relationship, and partnership duration) was developed to help explain the relationship characteristics between supply chain partner firms. This formed the basis for the further examination of knowledge transfer between supply chain partner firms. Details of how the characteristics of supply chain partnerships influence interfirm knowledge transfer are discussed in Chapter 5.

## **CHAPTER 4 KNOWLEDGE AND KNOWLEDGE TRANSFER IN SUPPLY CHAIN PARTNERSHIP**

### **4.1 Preamble**

Based on the discussion of supply chain partnership presented in the previous chapter, this chapter attempts to clarify the characteristics of knowledge transfer between supply chain partner firms. One of the key arguments in this chapter is that the characteristics of knowledge transfer in supply chain partnership are determined by the characteristics of supply chain partnerships. The unique characteristics of supply chain partnerships result in the unique characteristics of supply chain knowledge transfer. This chapter takes the knowledge-based view of the firm as a theoretical basis, which suggests that knowledge is one of the most important resources of business organizations. How to acquire and utilize knowledge is viewed as an important means for businesses to gain competitive advantage. This chapter will first introduce the knowledge-based theory of the firm, from which some implications for interfirm knowledge transfer will be generated. After that, the meaning of knowledge and classifications of knowledge to be transferred will be discussed. This chapter develops a dynamic knowledge transfer process model based on the literature. The main stages of the knowledge transfer process, namely knowledge acquisition, knowledge internalization, and knowledge utilization are discussed. Lastly, the potential benefits of supply chain knowledge transfer are introduced.

### **4.2 The Knowledge-based Theory of the Firm and Interfirm Knowledge Transfer**

Multiple theories of the firm have emerged to explain and predict the structure and behaviours of the firm. Well recognized theories of the firm include: the Economics Theory of the firm, which is concerned with predicting the behaviour of firms in

external markets, within which the Neoclassical Theory of the firm predicts the firm's purchase and supply decisions based on partial equilibrium analysis; the Organizational Theory, which analyzes the internal structure of the firms by viewing the firm as a complex organization composed of individuals and departments; the Transaction Cost Theory of the firm, which explains the reason why firm exists by viewing business organizations as entities of transactions (Coase, 1937; Williamson, 1975); the Behavioural Theory of the firm, which provides an important foundation for understanding firm strategy by viewing the firm as a unique and heterogeneous organization (Cyert and March, 1963, 1992); and the Evolutionary Theory of the firm, which contributes to the understanding of firm strategy by considering the dynamic process by which firm behaviour patterns and market outcomes are jointly determined over time. In this sense, firms are determined by the changing environment and at the same time deliberately evolve to improve their position in the environment (Nelson and Winter, 1982). As Grant (1996b) concluded, every theory of the firm is an abstraction of the real-world business enterprise which is designed to address a particular set of its characteristics and behaviours. More recently, the Resource-based View and the related Knowledge-based View of the firm have been developed, and are particularly relevant to the study of interfirm knowledge transfer.

#### **4.2.1 The Resource-based View and Knowledge-based View of the Firm**

Knowledge-based Theory, or more precisely Knowledge-based View (KBV) of the firm is a newly emerging theory of the firm, which explains behaviour, structure, and formation of business organization from a knowledge-based perspective (Nonaka, 1994; Grant and Baden-Fuller, 1995; Grant, 1996b; Kogut and Zander, 1996; Spender, 1996; Spender and Grant, 1996; Grant and Baden-Fuller, 2004; Nickerson and Zenger, 2004). The knowledge-based view of the firm provides an important philosophical approach to understand business behaviours from knowledge-based perspectives. Scholars of the knowledge-based view are mainly interested in providing insights into issues of knowledge creation, organizational learning, knowledge application, and

knowledge transfer.

The Knowledge-based View of the firm originated from the Resource-based View of the firm (RBV) (Wernerfelt, 1984). According to Muller et al. (2003) although the resource-based perspective can be traced back to the 1950s (Penrose, 1959), it did not achieve widespread dissemination until Wernerfelt's (1984) work. The resource-based view of the firm regards the firm as a collection of sticky and difficult to imitate resources, so that a firm could capture rents through protecting and deploying these resources (Wernerfelt, 1984). It advocates that it is the inimitable resources the firm possesses that contribute to the competitive advantages of the firm. Moreover, firms are distinguished from markets because of the authority (employer-employee) relationship existing in firms, as compared to autonomous parties contracting in the market (Conner and Prahalad, 1996). Noticeably, knowledge is considered as a basic source of advantage in competition, so that firms' competitive advantages derive from their preferential access to idiosyncratic resources, especially tacit knowledge-based resources (Penrose, 1959; Wernerfelt, 1984; Conner and Prahalad, 1996). The grasp of favourable know-how will even help the firm to deploy the same resources in a more productive way. Consequently, asymmetric knowledge and competences possessed by different firms result in differentiated performance (Conner and Prahalad, 1996).

The knowledge-based view of the firm develops from the resource-based view and puts more emphasis on knowledge as a corporate resource and the role of the firm in creating, storing and applying knowledge. Similar to the resource-based view, the knowledge-based theory of the firm also views knowledge, which could be in both explicit and tacit forms, as a productive resource of business organizations. It regards the firm as an institution for knowledge integration and application, which forms the basic rationale for the existence of the firm. In the words of Grant (1996b), "firms exist as institutions for producing goods and services because they can create conditions under which multiple individuals can integrate their specialist knowledge...yet markets are unable to undertake this coordination role". According to the knowledge-based

view of the firm, the fundamental task of a business organization is to integrate and coordinate the efforts or knowledge of many specialists, given that knowledge is created, stored and deployed by individual specialists, so that a firm can apply existing knowledge to generate products and services (Grant, 1996b).

Similar to the transaction cost theory of the firm, the knowledge-based theory of the firm recognizes the problem of market failure in order to explain the existence of firms. Nevertheless, the knowledge-based theory of the firm does not consider the firm as an institution for managing transactions, instead it considers the firm as an organization for managing team production (Grant, 1996b). In the market context, explicit knowledge could be easily transferred to additional users at very low marginal cost, since explicit knowledge is codified and communicable, such that potential buyers of knowledge could easily expropriate knowledge without paying, whilst tacit knowledge is unable to be coordinated or transferred through arms-length market relationship, given that tacit knowledge is not capable of articulation (Grant and Baden-Fuller, 1995). In this sense, the firm is more efficient than the market in transferring and integrating the explicit and tacit knowledge of many different individuals to generate products and services.

The knowledge-based view of the firm emphasizes the importance of congruence between product domain and knowledge domain of the firm in efficient knowledge utilization (Grant and Baden-Fuller, 1995; Grant, 1996b; Grant and Baden-Fuller, 2004). According to the knowledge-based view perfect congruence does not exist, i.e. the firm's knowledge is not fully deployed in its products, and the knowledge required by the products it supplies is not entirely available from within the firm (Grant and Baden-Fuller, 1995; Grant, 1996b). This point also serves as a basis to explain the boundary of the firm. Since a firm's knowledge and product are not perfectly congruent, an individual firm's products will represent only a small portion of all the products that result from the knowledge utilization in the whole economy, such that an individual firm is differentiated from other firms horizontally (Grant, 1996b). On the

other hand, as Demsetz (1991) also argued, given that the market is transferring products more efficiently than transferring knowledge, two vertically adjacent stages of production will be conducted more efficiently in two separate firms, when the output of an early stage can be processed in the later stage without the need to access the knowledge utilized at the early stage. In this sense the vertical boundary of the firm is identified.

Contrary to the resource-based view of the firm, the knowledge-based view of the firm does not consider the firm as purely bundles of tangible resources in which managers are rule-makers and employees are rule-followers. Instead, it views firm as enduring alliances between independent knowledge-creating entities including individuals, teams or other organizations (Nonaka, 1994; Grant, 1996b; Spender, 1996). The main function of the firm is to integrate and coordinate the knowledge-creating entities by different mechanisms, such as rules, directives, sequencing, routines, group problem solving, and decision making (Grant, 1996b). Given that the individual is the basic unit of knowledge creation, storing, and application, it is the organization or the firm which integrates individuals to create relevant knowledge (Nonaka, 1994), and to synthesize and apply current and acquired knowledge (Kogut and Zander, 1992).

#### **4.2.2 Implications for Interfirm Knowledge Transfer**

The knowledge-based view of the firm provides a useful theoretical basis to understand the structure, behaviour, and function of the firm. The following two implications can be derived:

- (1) A key role of the firm is in integrating specialized knowledge of individuals into the value creation process. In this sense, individual specialized knowledge is coordinated through rules and mechanisms of the organization, i.e. knowledge is embedded in the organizing principles by which people cooperate within organizations (Kogut and Zander, 1992). Therefore, knowledge can also

be embedded at the level of organization.

- (2) Given that knowledge is the essential resource of the firm, the firm's ability to access, transfer and apply the specialized knowledge will determine the efficiency of the firm to integrate specialized knowledge into the value creation process (Grant and Baden-Fuller, 1995). Thus, the ability of the firm to learn and deploy the knowledge also determines the firm's ability to gain competitive advantage.

Although the knowledge-based view of the firm mainly focuses on the firm level discussion, it also has important implications for interfirm relationship management and knowledge transfer:

- (1) Imperfect congruence between a firm's product and knowledge domains creates opportunities for knowledge trading to achieve fuller utilization of knowledge (Grant and Baden-Fuller, 1995; Grant, 1996b; Grant and Baden-Fuller, 2004). This is because a firm can either access and integrate knowledge which can be more efficiently provided by other firms, or a firm can make the knowledge, which is only partially deployed within the firm, utilized more fully through interfirm collaborative relationships (Grant and Baden-Fuller, 1995).
- (2) Imperfect congruence between a firm's product and knowledge domains also implies that more diversified knowledge resources are available in the interfirm network than within the firm itself (Dyer and Nobeoka, 2000; Kogut, 2000). As Dyer and Nobeoka (2000) argued, knowledge in multiple firms tends to be more diversified than in a single firm, which implies that more knowledge resources could exist in the interfirm network. This means that a firm can create, process and deploy more knowledge resources from an interfirm network than from solely within the firm to enrich its competences and gain competitive advantage. In other words, interfirm learning and knowledge transfer are important sources of gaining competitive advantages (Levinson and Asahi, 1996; Powell et al., 1996; Teece et al., 1997).

- (3) The coordinating role of the firm in integrating knowledge implies the network's role in coordinating multidirectional knowledge flows and knowledge transfer between firms. As noted by Dyer and Nobeoka (2000), "if a network can create a strong identity and coordinating rules, then it will be superior to a firm as an organizational form at creating and recombining knowledge due to the diversity of knowledge that resides within a network". In this sense the coordinating mechanisms in the interfirm relationship is important in determining the efficiency of the knowledge transfer and integration at interfirm level.
- (4) The knowledge-based view of the firm emphasizes the firm's role in integrating specialized knowledge, which is determined by the firm's ability to create, acquire, store, and apply the knowledge. An underlying concept is that knowledge integration is not a single-stage phenomenon, rather it incorporate a series of processes or behaviours. The studies of Grant and Baden-fuller (1995; 2004) have suggested that interfirm knowledge transfer is also a type of knowledge integration, but at the interfirm level. Therefore, the multi-stage view of knowledge integration implies that knowledge transfer under the interfirm scenario is also a multi-stage process, in that the success of the knowledge transfer is determined not only by a firms' ability in acquiring and storing the knowledge, but also by a firm's ability in applying the knowledge.

Overall, according to the knowledge-based view of the firm, effective interfirm knowledge transfer is an important source of competitive advantage. Similar to a firm's role in providing internal knowledge integration mechanisms, interfirm networks can also provide efficient interfirm knowledge transfer and integration mechanisms. Moreover, interfirm knowledge transfer and integration tend to be a multi-stage process in that effective knowledge transfer is determined by a firm's ability in acquiring, storing and applying the knowledge. These implications will be reflected in the following discussion of interfirm knowledge transfer and will pave the way for the formation of the conceptual framework of knowledge transfer in supply chain



partnership which is presented in Chapter 5.

### **4.3 Concept of Knowledge**

Before discussing knowledge transfer in supply chain partnerships, it is important to clarify what the knowledge to be transferred is. Since the concept of knowledge is both abstract and sophisticated, attention needs to be paid to the concept of knowledge. The knowledge-based view of the firm implies that firms could access more valuable knowledge resources through interfirm relationships. Accordingly, a firm could also acquire knowledge through supply chain partnerships. In this sense, what the knowledge to be acquired and transferred between supply chain partner firms is becomes an important issue. The following subsections will address issues of the meaning of knowledge, different types of knowledge, and the nature of knowledge to be transferred in supply chain partnerships.

#### **4.3.1 Information vs. Knowledge**

Although the concept of knowledge has been covered in Michael Polanyi's (1962) work since the early 1960s, more than four decades later, scholars still appear to have difficulty ascertaining the meaning of knowledge. A major confusion is on the difference between knowledge and information, in that these two concepts tend to be used interchangeably. For instance, Kogut and Zander (1992) classified knowledge into two categories of information and know-how, where information is referred to as knowledge which can be transmitted without loss of integrity once the syntactical rules required for deciphering it are known. On the contrary, Grant and Baden-Fuller (1995), included information along with technology, knowledge, and skills into categories of knowledge. When carrying out a case study of interfirm knowledge transfer in Toyota, Dyer and Nobeoka (2000) used explicit knowledge and information interchangeably. Generally, information tends to be confused with the concept of an explicit form of knowledge.

However, according to other literature addressing knowledge management, information and knowledge are actually different concepts. Nonaka (1994) follows the traditional epistemology and defines knowledge as “justified true belief”. Spek and Spijkervet (1997) define knowledge as “a whole set of insights, experiences, and procedures which are considered correct and true and which therefore guide the thoughts, behaviour, and communication of people”. Similarly, according to Liebeskind (1996), knowledge is information whose validity has been established through tests of proof, so that knowledge is distinguished from opinion, speculation, beliefs, or other types of unproven information. All these definitions of knowledge highlight the notion of truthfulness and justification of knowledge, in that knowledge is information that is proved through existing human knowledge and experience.

Moreover, to help understand the meaning of knowledge, Spek and Spijkervet (1997) distinguished knowledge from data and information. The authors argued that data are symbols that have not yet been interpreted. Examples are a set of process data in a factory. Information is data which has been assigned a meaning, for example a graph provides information on the relation between aspects on the horizontal and vertical axis of the graph, and shows there is a certain trend in production. Knowledge is what enables people to assign a meaning to data and thereby generate information. The knowledge will enable people to act and to intelligently deal with all the information sources available (Spek and Spijkervet, 1997). For instance, a manager’s knowledge about production will enable him to make appropriate decisions based on the information provided in a production trend diagram.

As opposed to information, knowledge is action-based, because knowledge is generated from human behaviour or experiences, and people could use knowledge to guide their thought and behaviour. In the words of Nonaka (1994) “information is a flow of messages, while knowledge is created and organized by the very flow of information, anchored on the commitment and beliefs of its holder”. The author also

emphasized human action as the underlying meaning of knowledge. Overall, knowledge is different from information, and when discussing knowledge transfer in the supply chain the author needs to be aware of the differences.

#### **4.3.2 Explicit vs. Tacit Knowledge**

Notions of articulated vs. non-articulated, communicable vs. non-communicable, teachable vs. non-teachable, observable vs. not observable, simple vs. complex, public vs. private have been used by scholars of knowledge management to describe the knowledge spectra. Within these spectra, a commonly accepted classification of knowledge by scholars of knowledge management and business studies is the distinction between explicit and implicit/tacit knowledge (e.g. Kogut and Zander, 1992; Nonaka, 1994; Grant and Baden-Fuller, 1995; Grant, 1996b; Dyer and Nobeoka, 2000; Cavusgil et al., 2003; Modi and Mabert, 2007; Becerra et al., 2008). This distinction is also regarded as the key to understanding organizational knowledge (Inkpen and Dinur, 1998; Cavusgil et al., 2003).

According to Polanyi (1962) explicit knowledge is codified, which is transmittable in formal and systematic language whilst tacit knowledge has a personal quality, which is hard to formalize and communicate, and is rooted in action, commitment, and involvement in a specific context (Polanyi, 1962). Nonaka (1994) argued that explicit knowledge is discrete or “digital” which can be captured in records of the past, such as libraries, archives, and databases, while tacit knowledge is regarded as a continuous activity of knowing.

Explicit knowledge is revealed through its communication (Grant, 1996b). Because it is easily articulated and communicated, it is easier to transfer (Grant and Baden-Fuller, 1995; Grant, 1996b). However, tacit knowledge is revealed through its application, because it is difficult to codify and can only be observed through its application and acquired through practices and experiences (Nelson and Winter, 1982; Nonaka, 1994;

Conner and Prahalad, 1996; Grant, 1996b). Tacit knowledge is more difficult to transfer (Grant, 1996b; Cavusgil et al., 2003).

In contrast to explicit knowledge, tacit knowledge is more “personal” since it is part of an individual’s cognition and is thus difficult to communicate (Grant and Baden-Fuller, 1995). However, the in-person characteristic of tacit knowledge does not mean that tacit knowledge exists only in individuals. Tacit knowledge could also be held collectively, for instance collective tacit knowledge could reside in top management schemes, organizational consensus on past collaborative experiences, firm routines, firm culture and professional culture (Cavusgil et al., 2003). In the words of Kogut and Zander (1992), “organizations know more than what their contracts can say”.

The general difference between explicit and tacit knowledge covered in the above discussion is summarized in table 4-1, in terms of expression, formation, storage, communicability, observability, and transferability. It should be noted that there is no clear distinction between these two types of knowledge, although researchers do distinguish explicit knowledge from tacit knowledge. The notions of explicit and tacit are used to describe the end points of the knowledge type spectrum (Makhija and Ganesh, 1997; Cavusgil et al., 2003). Therefore, it is more appropriate to say that certain knowledge is of explicit character or of tacit character rather than to indicate knowledge in absolute terms of explicit or tacit form.

Table 4-1 Explicit Knowledge vs. Tacit Knowledge

<b>Characteristics</b>	<b>Explicit Knowledge</b>	<b>Tacit Knowledge</b>
Expression	Codified	Context specific
Formation	Discrete	Continuous
Storage	External	Personal (but also collectively)
Communicability	Communicable	Not communicable
Observability	Revealed through communication	Revealed through application
Transferability	Easy to be transferred	Hard to be transferred

Although tacit knowledge is more difficult to articulate, communicate, and transfer, compared with explicit knowledge, tacit knowledge is considered more critical to the competitive advantage of the firm, as is advocated by the resource-based view of the firm (Penrose, 1959; Wernerfelt, 1984; Conner and Prahalad, 1996). Firstly, tacit knowledge is more difficult to imitate, which is referred to as the inertness of the knowledge (Kogut and Zander, 1992). In this sense, tacit knowledge is more likely to result in sustainable advantages (Nonaka, 1994). Secondly, according to Cavusgil (2003), tacit knowledge contributes significantly to the firm's ability to develop more innovation capabilities. This is because tacit knowledge or embedded knowledge is important for a firm's knowledge creation and new product development (Madhavan and Grover, 1998). Innovation capability in turn determines the product performance of the firm (Cooper, 1984; Cavusgil et al., 2003). Therefore, firms tend to be differentiated from each other in performance because of the differences in embedded tacit knowledge, and their capability to deploy the tacit knowledge. Overall, this research was aware of the distinction between explicit and tacit knowledge when examining the issue of knowledge transfer in the supply chain.

#### **4.3.3 Forms of Supply Chain Knowledge**

The review of the interfirm knowledge transfer studies reveals that scholars have been interested in various contents of knowledge to be transferred. Nevertheless, most of the knowledge contents covered could be categorized in terms of explicit or tacit knowledge, individual or organizational knowledge, technical or technological knowledge, success or failure knowledge, and functional areas in which knowledge is covered. In the case of supply chain partnerships, since supply chain firms possess both explicit and tacit knowledge, potential knowledge to be transferred in the supply chain could be either explicit or tacit. For example, Dyer and Nobeoka (2000) carried out a case study of Toyota's successful knowledge transfer practices with its supply chain partners. In their study, tacit knowledge, such as production related know-how,

processes, and philosophies was the focus (Dyer and Nobeoka, 2000). The study by Handfield, et al. (1999) revealed that companies could access the expertise, which could be in both explicit (such as technology roadmaps) or more tacit forms (such as operating processes), from suppliers through supplier involvement in product development.

According to the knowledge-based view of the firm, knowledge can be stored at both individual and organizational levels. A major implication is that knowledge sources of supply chain firms can also be individual or organizational. Cavusgil et al. (2003) examined how tacit knowledge transfer between partner firms impacts on a firm's innovative capabilities. They pointed out that explicit or tacit knowledge could be held individually or collectively. Individual explicit knowledge includes individual skills and know-how, which could be easily written down, while collective explicit knowledge resides in standard operating procedures, documentation, information systems, and rules. Individual tacit knowledge could be found in an employee's schemes, skills, habits, and abstract knowledge, whilst collective tacit knowledge resides in top management schemes, organizational consensus on past collaborative experiences, firm routines, firm culture, and professional culture. Similarly, Cummings and Teng (2003) differentiated levels of knowledge holder, in the sense that knowledge to be transferred may be stored in individual employees or in the firm collectively. In their study of interfirm knowledge transfer, these authors used knowledge embeddedness to measure the extent to which knowledge is held within an organization's routines, systems, and social networks.

Moreover, there are researchers who have emphasized the comprehensiveness of knowledge to be transferred between partner firms by looking at technical skills and technological capabilities (Shan, 1990; Hamel, 1991; Mowery et al., 1996; Kotabe et al., 2003). For instance, Mowery et al. (1996) examined the factors that affect transfer of technological capability between strategic alliances, in which technological capability is frequently based on tacit knowledge of the firm and reflected from the

firm's technology portfolios. Kotabe et al. (2003) extended more and examined the transfer of both technical knowledge and technological knowledge between buyer and suppliers firms. According to the authors, technical knowledge refers to discrete knowledge required to solve a particular operational problem, enhance processes, and improve products. One of the examples of technical knowledge is explicit engineering knowledge (Kotabe et al., 2003). On the other hand, technology is referred to as a broader body of knowledge encompassing a set of related techniques, methods, and designs applicable to an entire class of problems. Transfer of technology will allow one partner firm to access or replicate complete technological capabilities of the other partner (Kotabe et al., 2003). In this sense, knowledge to be transferred in the supply chain could also be grouped into purpose-specific techniques, or more comprehensive technological capabilities.

It is obvious that a firm could learn best practices from its partner's successful stories. Nevertheless, researchers have also pointed out that it is equally important to learn from the failures of other firms, which is often ignored by the practitioner (Crossan and Inkpen, 1995). To learn from others' failures could help the organization to avoid making the same mistakes and improve the existing practices by foreseeing the possible situations. Therefore, experiences of other firms in the supply chain in terms of success and failure in business and operations are also valuable knowledge to be acquired.

Prior researchers also classified the knowledge to be transferred according to functional areas on which knowledge is covered. For instance, Beecham and Cordey-Hayes (1998) examined the knowledge transfer in technology partnering between buyer and supplier in the motor industry. The authors explored the transfer of technological knowledge related to process, product and materials. Cummings and Teng (2003) examined the transferring of R&D knowledge through intra-firm and interfirm relationships. Other researchers explored the transfer of knowledge which relates to various functional areas of the firm, such as production, distribution, and

marketing operations (Hamel, 1991; Tiemessen et al., 1997; Dyer and Nobeoka, 2000).

Overall, although supply chain partnerships have unique characteristics distinguishing them from other interfirm partnerships (see also in section 3.5), at the level of firms, supply chain firms share similar fundamental characteristics with firms in other types of interfirm relationship. What this means is that types of knowledge to be transferred in supply chain partnerships could be classified using similar criteria as in other interfirm relationship contexts. Therefore, potential knowledge to be transferred between supply chain partners could also be classified into various categories in terms of knowledge tacitness, the level of organization knowledge being held, comprehensiveness of knowledge, whether knowledge is about success or failure, and functional areas of knowledge. Although the classification criteria introduced in this research is not exhaustive (i.e., other ways of classifying the knowledge may exist), the extensive review of literature suggests that the above criteria include the most typical classifications of knowledge to be transferred.

It is worth noting, this research did not make an explicit distinction between different types of supply chain knowledge, when empirically examining the process and influential factors of supply chain knowledge transfer. The reasons are threefold: (1) knowledge is a complex concept, it is difficult and controversial to draw the boundary between different forms of knowledge empirically; (2) there is no commonly agreed conceptualizations of different forms of knowledge in prior empirical studies; (3) due to measurement difficulties, it is more applicable to examine the general scenario or activities of firms through which knowledge is transferred or exchanged rather than looking at exactly which types of knowledge have been transferred between supply chain partners.

#### **4.4 Knowledge Transfer in Supply Chain Partnership**

The previous section sought to clarify the nature of knowledge to be transferred in the



supply chain. This section provides more detailed discussion of the characteristics of interfirm knowledge transfer in the context of supply chain partnership. Issues including knowledge transfer processes, mechanisms of knowledge transfer, and potential benefits of knowledge transfer to supply chain partners are covered (see section 4.4.1 to 4.4.7). The literature review suggested that although the broad topic of interfirm knowledge transfer has been covered by much previous research, there is still a lack of insight into the process of knowledge transfer. Moreover, when studying interfirm knowledge transfer, scholars have limited discussions on knowledge transfer mechanisms. The current research, therefore, sought to unfold the interfirm knowledge transfer process, and to provide more understanding of the processes and mechanisms of supply chain knowledge transfer, which then form the basis for exploring the knowledge transfer practices in supply chain partnerships.

Table 4-2 summarizes the characteristics of knowledge transfer in supply chain partnerships:

- Knowledge transfer typically takes place due to vertical complementarities of partners;
- Knowledge transfer is generally non-targeted and less guaranteed;
- Potential network extension of partnership increases the concerns of partners over unwanted knowledge spillover;
- Process of knowledge transfer is better understood as a multi-stage process.

Details of each of these characteristics are discussed in the following sections (section 4.4.1 to 4.4.2).

Table 4-2 Summary of Characteristics of Knowledge Transfer in Supply Chain Partnership

Characteristics of Knowledge Transfer	Facets of Characteristics	Implications	Sources
Knowledge transfer	Knowledge	- Level of knowledge	(Barney, 1991); (Bates

typically takes place due to vertical complementarities of partners	transfer interface	transfer between supply chain partners depends on the level of interdependence between firms - Shared meaning is necessary to harness the knowledge exchange activities	and Slack, 1998); (Dyer and Nobeoka, 2000); (Kotabe et al., 2003); (Hult et al., 2004)
Knowledge transfer is generally non-targeted and less guaranteed	Expected outcome	- Knowledge transfer is more likely to take place informally - Knowledge transfer is less likely to be bounded by written contract - Balanced power influences the nature of knowledge transfer	(Beecham and Cordey-Hayes, 1998); (Heide and Miner, 1992); (Provan and Skinner, 1989); (Maloni and Benton, 2000)
Potential network extension of partnership increases the concerns of partners over unwanted knowledge spillover	Knowledge protection	- Willingness to exchange knowledge depends on level of trust and commitment between partners - Knowledge transfer is more likely to occur when the needs to exchange knowledge outweigh the danger of knowledge spillover	(Beecham and Cordey-Hayes, 1998); (Dyer and Nobeoka, 2000); (Heide and Miner, 1992)
Process of knowledge transfer is better to be understood as multi-stage process	Process of knowledge transfer	- Types and effectiveness of knowledge acquisition depend on the level of complementary contributions of partners - Overlaps of expertise and shared meaning between partners influence the internalization of knowledge - Direct use of knowledge is often rare, and the outcome of particular knowledge use is often less obvious	(Deshpande and Zaltman, 1982); (Menon and Varadarajan, 1992); (Weiss, 1980); (Wiig, 1997)

#### **4.4.1 Unique Characteristics of Knowledge Transfer in Supply Chain Partnership**

An intensive literature review suggested that a substantial number of studies have been conducted to examine interfirm knowledge transfer (He et al., 2006). Drawing upon commonly referred-to theoretical underpinnings (e.g. the resource-based view of the firm, the knowledge-based view of the firm, organizational learning), previous scholars explored the interfirm knowledge transfer issues, which covered various types of interfirm relationships. Multiple interfirm relationships include buyer-supplier relationship, joint ventures, R&D partnerships, franchises, interfirm acquisition, and regional interfirm network. Nevertheless, a good number of studies focused on strategic alliances in general (e.g. Mowery et al., 1996; Simonin, 1999b) or did not specify the interfirm relationship. According to Koka and Prescott (2002), the number and type of alliances, nature of the partners and their alliance structures as well as relationship dynamics determine a firm's access to knowledge spill-over and its ability to leverage information. Thus, the extent and amount of useful knowledge available to firms and the mechanisms of transferring knowledge could be varied under different partnership structures and the relationship arrangement. In this sense, results derived from these studies could be vague if prior researchers did not provide a clear view on the interfirm relationship and the characteristics of knowledge transfer in that particular relationship context.

It is interesting and encouraging to see that more and more researchers are exploring knowledge transfer issues within the context of the supply chain or buyer-supplier relationship (e.g. Heide and Miner, 1992; Beecham and Cordey-Hayes, 1998; Dyer and Chu, 2000; Kotabe et al., 2003; Hult et al., 2004; Modi and Mabert, 2007; Squire et al., 2008). However, most of those empirical studies derived the research hypotheses based on the general interfirm relationship theories. Most of them lacked comprehensive clarification on what makes the knowledge transfer different in the supply chain context from knowledge transfer in other types of interfirm relationships, and how the

characteristics of the supply chain relationship could determine the characteristics of interfirm knowledge transfer. For example, Kotabe et al. (2003) examined the influence of link duration on the technical exchange and technological knowledge transfer and supplier performance. Hult et al. (2004) conducted an empirical study on a large firm's supply chain to examine the effect of knowledge development on cycle time performance. Nevertheless, these authors provided limited discussion on the relationship between the unique nature of supply chain structure and interfirm knowledge transfer. Consequently, the capability of those studies to derive distinguished understanding of knowledge transfer in the supply chain was limited. Due to the above concerns, the current research attempted to depict the particular characteristics of interfirm knowledge transfer in supply chain partnerships based on an understanding of the unique characteristics of supply chain partnership, as discussed in the Chapter 3.

#### ***4.4.1.1 Knowledge Transfer due to Vertical Complementarities***

Despite the general lack of theory development in supply chain knowledge transfer, some of the prior studies have recognized that vertical complementarities exist between supply chain partners. For instance, Kotabe et al. (2003) concluded from their literature review that a firm can benefit from harnessing complementarities with suppliers. Such interfirm relationships could have extensive division of labour, in which suppliers have the abilities not only in manufacturing parts according to the supplier's detailed specification, but also in designing the parts and the corresponding manufacturing and technical processes. Moreover, this division of labour is accompanied by exchanges of knowledge about products and processes to ensure suitable coordination. The division of labour may vary accordingly over time, and varying it requires knowledge transfer between partners (Kotabe et al., 2003). The vertical complementarities between supply chain partners have two implications for the nature of interfirm knowledge transfer.

First, knowledge transfer between supply chain partners depends on the extent of

interdependence between firms. Unlike other types of interfirm partnership, in supply chain partnerships vertical functional complementarities are the primary basis for relationship development and maintenance (See also in section 3.5.1, mutual dependence is an important basis of supply chain partnership). Consequently, knowledge transfer between supply chain partners typically takes place due to the requirement of both parties to contribute differently to the completion of the same industry process (Bates and Slack, 1998). It is hard to imagine how, without exchange of ideas, independent firms could successfully bring different business processes together to serve the downstream clients. In such a way, by entering into partnerships, firms can gain complementary skills by tapping into the partners' know-how, sharing risks and gaining synergy (Powell, 1987). Specifically, one focal firm will have access to the knowledge of another partner firm, when that partner firm from a successive industry process brings its expertise and specialization to complete the supply chain operations. Therefore, the level of interdependence becomes a major determinant to the willingness and extent of firms to exchange knowledge and information.

Secondly, knowledge transfer based on functional complementarities also draws on the shared meaning between supply chain partners. As has been discussed in section 3.6.2, supply chain partnership generally lacks the ground to develop strong organizational identity and culture (Hult et al., 2004). The maintaining of a relationship depends on each party's reliance on the other parties' capabilities to complete the value chain process. The identity and culture are even weaker when partner firms are operating at different industrial stages possessing different expertise and specialization. In the absence of strong identity or culture, shared meaning is necessary to harness the collective action in the supply chain (Hult et al., 2004). Similarly, it is reasonable to argue that knowledge and information exchange will also be limited when partner firms lacked a common language.

#### ***4.4.1.2 Non-targeted Transfer of Knowledge in Supply Chain Partnership***

When firms participate in a more bounded interfirm partnership, such as an R&D

partnership, the target of knowledge generation is normally written into the contract, as well as the contributions and responsibilities of each partner. In many cases new firms or joint ventures are established to facilitate the co-development. The knowledge exchange processes in these partnerships are monitored and the performance of knowledge transfer is frequently assessed to make sure that the knowledge exchange and generation processes are kept at high quality and are making good progress (e.g. Doz et al., 2000; Argyres and Silverman, 2004; Oxley and Sampson, 2004).

In contrast, in supply chain partnerships the contracts are usually less specified or non-targeted; the responsibilities of participants are loosely defined; and the operating goals of partnership are less specified (see also section 3.5.2). Correspondingly, the achievement of partnership performance is non-targeted and operational-based. Under such a loosely defined partnership, knowledge transfer is largely a by-product of the cooperation rather than a preplanned outcome. There is evidence showing that firms may have the explicit intention to learn from supply chain partners when joining the partnership. For instance, Japanese automobile companies made more extensive use of supplier involvement than American manufacturers, with one major intention being to acquire advanced knowledge from the supplier (Helper, 1991). Apart from that, managers are normally unaware of the importance of knowledge exchange with supply chain partners (Beecham and Cordey-Hayes, 1998). In most circumstances, participants are uncertain about what types of knowledge and extent of knowledge they could acquire from the supply chain partner.

Consequently, there is a high level of performance ambiguity involved in the knowledge transfer activities (Heide and Miner, 1992). Especially, when supply chain partners set up safeguard policies to prevent the other party getting access to its knowledge in fear that the knowledge will be spilled over to potential competitors. As a result, the participants rarely support knowledge transfer through supply chain explicitly. In supply chain partnership, knowledge transfer is seldom written into the contract. Partner firms rarely monitor the performance of knowledge transfer. Thus

whether knowledge transfer will take place and will result in benefits is not guaranteed.

All these features suggest that the willingness to share knowledge and the extent of knowledge being shared in supply chain partnerships is more likely to be bounded by factors like interdependence to complete the industrial process, as well as the trust, commitment, and the shared understanding cultivated during the daily transactions between partner firms, rather than by written contracts or the performance expectations from participants. Knowledge transfer in the supply chain is more likely to take place in an informal context (Awazu, 2004). Therefore, it is reasonable to argue that the amount of knowledge that boundary spanners can bring to the counterpart is determined more by the strength of the relationship and the contribution of knowledge transfer activities to the completion of supply chain tasks.

Moreover, given that knowledge transfer activities are more loosely bounded in supply chain partnerships, the behaviour of the partners is less likely to be restricted by written agreement. As a result, knowledge transfer activities are likely to be influenced by the balance of power between supply chain partners. In supply chain partnerships, asymmetric power between partners may arise from factors such as differences in sizes, business resources, number of alternatives, and reputations (Anderson and Weitz, 1989; Ganesan, 1994; Cox, 1999; Kim et al., 2004). In an asymmetrical relationship, the dependency may not be reciprocal, so that one partner may have power over the other but not vice versa. In such a case exploitation rather than cooperation might result (Heide and Miner, 1992). Consequently, knowledge transfer may not be reciprocal. The more powerful party may request more knowledge contribution from the less powerful party, or otherwise the less powerful party is ignored for valuable knowledge exchange, due to the lack of recognition over the value of its knowledge (Beecham and Cordey-Hayes, 1998).

#### ***4.4.1.3 Concerns over Network-based Knowledge Spill-over***

Integrated supply chain management has put unique demands on firms to share

sensitive operational and strategic information with supply chain members that also conduct business with direct competitors (Moberg and Speh, 2003). Unlike other bilateral interfirm partnerships, supply chain partnership could be extended to a network level, in that one firm may be involved in several supply chain partnerships at the same time. In this way, one partnership could be a node in a large network of partnerships, so that firms are related to each other through a network of direct or indirect relationships (see also section 3.5.4). However, the network extension of relationship could cause serious concerns for participants over information and knowledge retention. For example, a supplier firm is in one partnership with a purchasing firm A, but this supplier could simultaneously participate in another partnership with purchaser B. Sometimes, the two purchasing firms A and B could be direct market competitors. Under such circumstances, there is the possibility for that supplier to pass on the knowledge acquired from purchaser A to purchaser B. When there is a lack of a formal agreement of non-disclosure (in cases where knowledge transfer is not officially recognized and contracted), it is very likely for valuable information and knowledge to be spilled over to the potential competitors. Consequently, the openness of supply chain partners could be highly restricted when participants are aware of the potential danger of the knowledge spillover.

Under such a scenario, it could be argued that effective knowledge transfer in a supply chain partnership is more dependent on the level of trust and commitment between partner firms. It is unwise for a firm to expose its valuable knowledge to a mistrusted or uncommitted partner. Moreover, effective knowledge transfer also depends on the interdependence that exists between partners. On many occasions, completion of supply chain tasks and operations requires continuous input from all the participants and sharing of valuable information and knowledge (Beecham and Cordey-Hayes, 1998). When the need to exchange valuable information outweighs the danger of knowledge spillover, knowledge transfer is more likely to occur.



#### **4.4.2 Multi-stage View of Interfirm Knowledge Transfer**

Noticeably, Mowery et al. (1996) argued that an interfirm partnership may enable one firm to gain access to the key knowledge-based capability of another, but without actually internalizing or acquiring that capability. Within a supply chain partnership, effective knowledge transfer is even less guaranteed due to its non-specified and non-targeted relationship nature. To illustrate, buyer or supplier may lack the trust and commitment, so that transparency is restricted and mutual access is limited to the minimum level to avoid valuable knowledge being exposed to the counterpart. Even when the relationship is close enough to allow buyer and supplier firms to get access to each other's knowledge, for example through formal or informal contact or by setting up joint development program to facilitate knowledge exchange between them (Handfield et al., 1999), over time they may still find that knowledge acquired from their partners rarely benefits their businesses. The reasons could be that, having frequent contact does not mean that firms will exchange or acquire knowledge; setting up knowledge transfer procedures between firms does not guarantee that firms will learn from each other; learning from the partner does not guarantee that knowledge will be utilized properly and effectively. The success of the supply chain knowledge transfer is likely to be determined by a series of related processes. For these reasons, this research attempted to unfold the process of knowledge transfer between supply chain partner firms.

##### ***4.4.2.1 Static View of Interfirm Knowledge Transfer***

As discussed in section 4.2.2, the knowledge-based view of the firm implies that interfirm knowledge transfer tends to be a multi-stage process, in that the success of knowledge transfer is determined by a series of knowledge transfer activities, such as acquiring, storing, and applying knowledge. However, much previous research has overlooked the multi-stage nature of interfirm knowledge transfer in its empirical work, and generally regards knowledge transfer as a single stage process (e.g. Mowery et al., 1996; Simonin, 1999b; Calantone et al., 2002; Cavusgil et al., 2003; Kotabe et al.,

2003; Modi and Mabert, 2007; Squire et al., 2008). For instance, when examining the influence of relationship structure on knowledge transfer between strategic alliances, Mowery et al. (1996) looked at only the outcomes of knowledge transfer, which was measured by technological portfolio overlaps of firms. The authors did not fully detail the actual process of knowledge transfer. Similarly, Simonin (1999b) did not disclose what is involved in the knowledge transfer process when analyzing the impact of knowledge ambiguity on the interfirm knowledge transfer. Moreover, Cavusgil et al. (2003) explored the relationship between tacit knowledge transfer and innovation capability of the firm. Although the authors pointed out that knowledge transfer should be a dynamic process, they only tested the impact of relationship factors on knowledge transfer without analyzing the actual knowledge transfer process.

A previous review of empirical literature suggests that knowledge transfer is commonly treated as a single stage phenomenon (He et al., 2006). There is generally a lack of research focus on knowledge transfer processes. Empirical researchers tend to regard the knowledge transfer process as a black box. Most only look at the input and output side of this process. There is a lack of clarification on what happens inside the process. However, it is unwise to ignore the process of knowledge transfer, because without capturing the process of knowledge transfer it is hard to understand what determines the effectiveness of knowledge transfer.

#### ***4.4.2.2 Multi-stage View of Knowledge Transfer in Supply Chain Partnership***

Grant (1996b) argued that knowledge transfer involves both transmission and receipt of knowledge, so that flow and absorption of knowledge are separate stages of knowledge transfer. Powell et al. (1996) suggested that organizational learning is both a function of access to knowledge and the capabilities for utilizing and building on such knowledge. Lorange (1996) proposed that organizational learning depends on the two complementary factors of discovery of new knowledge and the ability to adapt to the subsequent changes required. Likewise, Hult (2003) used the notions of inbound side and outbound side of knowledge management to describe the generation and

dissemination of knowledge and the deployment of knowledge to enhance performance ultimately. According to Wiig (1997):

Knowledge transfer is to bring knowledge from the various sources to where it can be utilized or its value otherwise realized...(the knowledge transfer) is a complex process that takes many paths depending upon the nature of particular knowledge, how it will be applied to deliver products and services, and the preferences or capabilities of the enterprise.

Based on this logic, Wiig (1997) has constructed a four-stage model of “knowledge life cycle” to illustrate the transition of knowledge from source to its use (see figure 4-1).

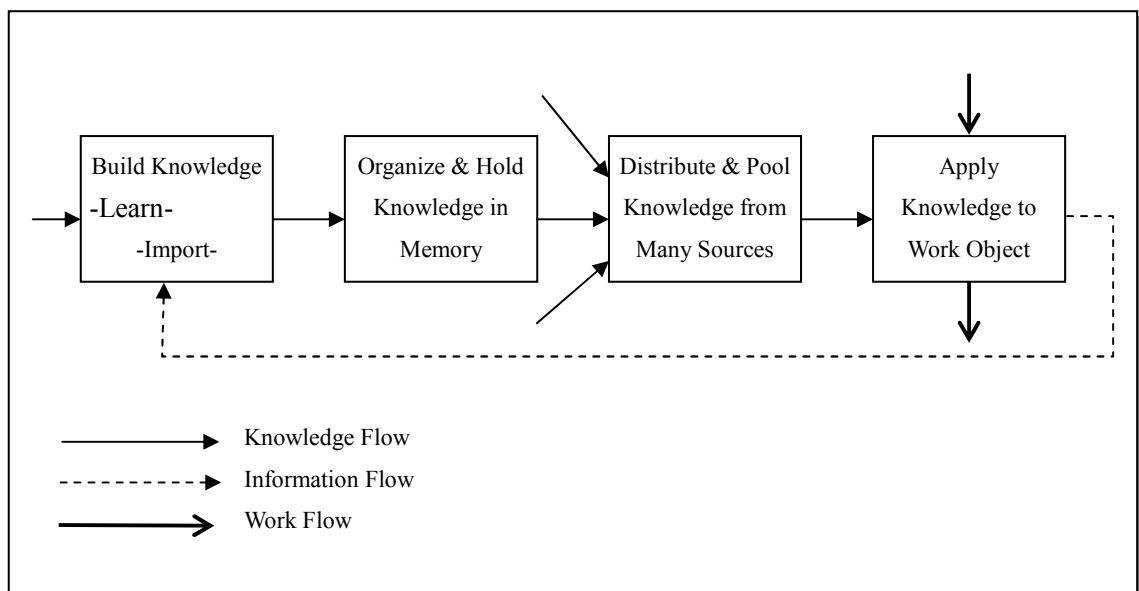


Figure 4-1 Four Stages of Knowledge Transition from Source to Use

Source: Wiig, 1997

In this model, both internal and external sources of knowledge are included. In the first stage, initial knowledge is created through innovation, learning, and importation. The process may involve knowledge assembling from outside and internal experts, R&D, and lessons learned. In the second stage, the knowledge recipient organizes and holds knowledge in memory. It also reconstructs, validates, and stores the obtained knowledge by weeding out outdated and wrong knowledge. The third stage involves distributing and pooling knowledge from many sources and disseminating knowledge

to where it is needed. The last stage is to do with applying knowledge to work objects and using knowledge to create and deliver products and services. At this stage there could be a feedback information flow to the knowledge creation stage enabling the organization to identify what works well and what does not, so that the organization will be able to experiment and learn how to improve the situation. As Wiig (1997) argued, all of these stages determine the success of knowledge transfer. This model includes not only the process of knowledge transfer from external sources, but also the process of knowledge creation internally, which provides a good illustration of the process of knowledge transfer.

The review of literature suggests that the concept of multi-stage knowledge transfer was echoed repeatedly in the prior studies although few studies have explored the multi-stage process empirically (see table 4-3). For instance, Cohen and Levinthal (1990) pointed out that a firm's innovative capabilities are largely determined by the firm's ability to recognize, assimilate and apply external knowledge to commercial ends. Cummings and Teng (2003) suggest that "even when knowledge is transferred to a willing recipient, the transfer will only be effective when the knowledge is retained". Thus, the ability of organizations to learn is determined by both the acquisition and the adoption of knowledge. Hult, et al. (2004) empirically tested knowledge acquisition and information distribution as two distinct activities of the supply chain participants. Minbaeva (2007) differentiated the disseminative capacity of the knowledge sender and the absorptive capacity of the knowledge receiver. In this sense, knowledge transfer involves the dynamic learning activities of two parties. This review of the literature indicates that three main stages of knowledge transfer emerged, namely acquisition, internalization, and utilization.

Table 4-3 Knowledge Transfer Process in Prior Studies

Author(s)	Knowledge Transfer Process		
	Acquisition	Internalization	Utilization
(Cohen and Levinthal, 1990)	Recognize	Assimilate	Apply

(Inkpen and Crossan, 1995)	Interpreting	Integrating	Institutionalizing
(Ritcher and Vettel, 1995)	Perception	Internalisation	Abstraction
(Inkpen and Dinur, 1998)	Acquisition	Sharing within organization	
(Lane and Lubatkin, 1998)	Recognize	Assimilate	Utilize
(Albino et al., 1999)	Acquisition	Communication	Application; acceptance; assimilation
(Andersen and Christensen, 2000)	Absorption	Communication	
(Hult et al., 2000a)	Information acquisition	Information dissemination	
(Kale et al., 2001)	Capture	Codify; Communicate; Coach	
(Lane et al., 2001)	Recognize	Assimilate	Apply
(Cummings and Teng, 2003)	Acquiring	Internalizing	
(Hult et al., 2003)	Acquisition	Distribution	Interpretation; Memory
(Johnson and Sohi, 2003)		Dissemination of information	Shared interpretation of information
(Hult et al., 2004)	Acquisition activities	Information distribution activities	

In this research the discussions of prior researchers are acknowledged and combined to generate a three-stage interfirm knowledge transfer framework. This framework is presented in figure 4-2. The model shows a sequential process of interfirm knowledge transfer with two streams of information feedback. Input to this model is the knowledge from the supply chain partner. The output of the model is the performance improvement that the supply chain firm could achieve through knowledge transfer practice. The actual process of knowledge transfer consists of acquiring, internalizing and utilizing knowledge.

As Nonaka (1994) argued, organizational learning is deeply related to action, in that it is a continuous process of learning, such that the knowledge transfer process demonstrated in this model is also a continuous process. In this model, interfirm

knowledge transfer is determined not only by the firm's ability to access or acquire the external knowledge, but also by its ability to assimilate and apply the acquired knowledge to the commercial end. The static or single-stage view of the knowledge transfer process adopted by many previous researchers tends to omit the importance of knowledge absorption and utilization. To give these knowledge transfer stages independent emphasis, as is the case in the present study, will provide a more comprehensive understanding of the reasons why effective interfirm knowledge transfer is hard to achieve under certain circumstances.

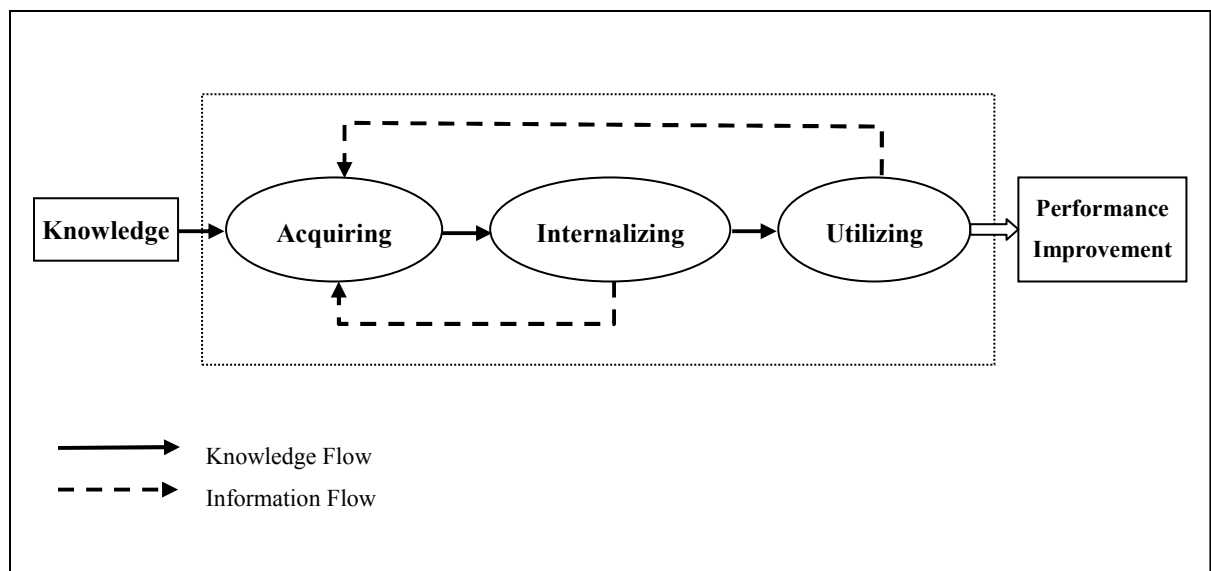


Figure 4-2 Supply Chain Interfirm Knowledge Transfer Process Model

According to Argyris and Schon's (1978) concept of double-loop learning, organizations continuously question and reconstruct existing perspectives, interpretation frameworks, or decision premises during the learning process. Constant feedback allows the organization to improve existing knowledge and learning practice. Wiig's (1997) knowledge transfer model emphasizes the information feedback from knowledge application to knowledge acquisition. This indicates the importance of assessing knowledge transfer through knowledge implementation to help the organization to improve knowledge transfer practice. Lorange (1996) also highlighted the importance of assessing organizational learning to help the organization to improve

its learning activities. However, in Lorange's (1996) proposition this assessment or feedback is taking place at the knowledge adaptation or internalization stage, so that the learning organization can evaluate the appropriateness of its previous learning activities and adjust those activities to acquire more valuable knowledge. To illustrate, an organization could evaluate its joint research programme through assessing the number of articles that have resulted from the programme, or the organization could evaluate the effectiveness of benchmarking activities by assessing the satisfaction of the participants. Combining the prior theorization of information feedback, the model includes information feedbacks from both knowledge internalization and utilization stages to reflect the possible reverse flow of information, through which partner firms may continuously adjust and improve their activities of knowledge acquisition (see figure 4-2).

It is worth noting, the framework presented in figure 4-2 is not used for substantive purposes, but to give an illustration of the concept of a multi-stage process of knowledge transfer. Overall, to include the notion of a dynamic knowledge transfer process, this paper defines interfirm knowledge transfer in supply chain partnerships as "a continuous process through which a firm internalizes the knowledge acquired from supply chain partner firms and applies the knowledge to its commercial end to generate additional value". Each of the three main stages, acquisition, internalization, and utilization, are examined in turn in the following sections (section 4.4.3 to 4.4.5).

#### **4.4.3 Knowledge Acquisition**

The knowledge-based view of the firm posits that an organization's relative ability to acquire and develop knowledge differentiates its high and low performance (Grant, 1996b). Therefore, acquisition is an essential part of the interfirm knowledge transfer process. Knowledge acquisition refers to the process of getting access to and having an initial understanding of the desired skills and knowledge by members of organizations through direct or indirect contact or interaction with the source of the skills and

knowledge. Acquisition is commonly regarded as the first step of knowledge transfer (e.g. Inkpen and Dinur, 1998; Albino et al., 1999; Hult et al., 2004). At this stage, knowledge acquisition mechanisms are vital to the success of knowledge transfer. Through adequate mechanisms of knowledge acquisition, a firm can access valuable external knowledge, which otherwise may not be reached.

#### ***4.4.3.1 Knowledge Acquisition Mechanisms***

Prior research in interfirm knowledge transfer has introduced various forms of knowledge acquisition activities. Table 4-4 illustrates some typical interfirm knowledge transfer mechanisms. The most frequently quoted mechanisms of knowledge acquisition include joint management meetings/conferences, joint development agreement, technology exchange/sharing, problem solving teams, interfirm visit, and benchmarking (e.g. Mowery et al., 1996; Inkpen and Dinur, 1998; Cummings and Teng, 2003; Cousins et al., 2008). Typical knowledge acquisition mechanisms in the supply chain include joint problem solving, ongoing manual adjustment (Love and Gunasekaran, 1999; Kotabe et al., 2003), supplier co-design (Beecham and Cordey-Hayes, 1998; Handfield et al., 1999), and co-location (Cousins et al., 2008).



Table 4-4 Interfirm Knowledge Acquisition Mechanisms

References Mechanisms	(Cousins et al., 2008)	(Cummings and Teng, 2003)	(Kotabe et al., 2003)	(Dyer and Nobeoka, 2000)	(Love and Gunasekaran, 1999)	(Inkpen and Dinur, 1998)	(Beecham and Cordey-Hayes, 1998)	(Mowery et al., 1996)	(Lorange, 1996)	(Appleyard, 1996)	(Mody, 1993)
Joint management meetings/conferences	√	√		√		√			√	√	√
Joint development agreement		√					√	√	√		
Technology exchange/sharing			√			√		√		√	√
Problem solving teams	√	√	√	√							
Interfirm visit	√	√		√						√	
Benchmarking					√				√	√	
Interfirm job rotation/ employee transfer		√		√		√					
Industry association				√		√					√
Joint employee training		√							√		
Document exchange		√								√	

---

R&D contract				√	√	
Informal communication	√		√			
Voluntary learning teams				√		
Open-book accounting					√	
Informal professional networks						√

---

Moreover, various knowledge acquisition mechanisms could be classified as different forms. According to Dyer and Nobeoka (2000), knowledge acquisition could be either bilateral or multilateral. Bilateral knowledge acquisition refers to mechanisms which involve transferring knowledge between two firms. Examples of bilateral mechanisms could be joint development agreement, technology exchange, interfirm visit, and joint employee training. On the other hand, multilateral knowledge acquisition refers to those that involve a group of firms, thus member firms have equal access to the knowledge available. Examples could be conferences, joint problem solving teams, interfirm job rotation, and industry association.

Meanwhile, mechanisms of knowledge acquisition could also be at the organizational level or individual level. Mechanisms of organizational knowledge transfer could be technology exchange/sharing, joint development agreement, R&D contract, industry association, and benchmarking. Alternatively, individual employees could serve as agents of knowledge transfer, bearing in mind that the individual is the basic unit of knowledge storing, creation and application in the firm (Grant, 1996b; Spender, 1996). Mechanisms at individual level could be joint employee training, interfirm job rotation/employee exchange, interfirm visit, and joint problem solving team.

#### ***4.4.3.2 Knowledge Acquisition Effectiveness***

Different researchers tend to use different instruments to measure the extent of knowledge acquisition. For instance, Cavusgil et al. (2003) used complexity, codifiability and observability of the knowledge transferred to measure the extent of tacit knowledge transfer. Cummings and Teng (2003) used frequency and people involved to measure the acquisition of knowledge. The essential benefit of these measures is to indicate the effectiveness of knowledge acquisition by multiple indicators related to the extent, quality and value of knowledge acquired by the firm.

In supply chain partnership, types and effectiveness of knowledge acquisition are more determined by the supply chain firm's internal characteristics and interaction with

other firms (Dyer and Nobeoka, 2000). Firstly, given that supply chain partnership is loosely bounded, formal procedures for knowledge transfer may not exist or be less supported by firms. Likewise, large-scale knowledge transfer could be restricted due to concerns over unwanted spillover from participants. Consequently, informal means of knowledge transfer such as individual communication or during-the-job information exchange may play a more important role than in other types of interfirm partnerships (e.g. Kotabe et al., 2003; Awazu, 2004; Mason and Leek, 2008; Lawson et al., 2009), especially when a partnership is loosely formed. Under a loosely bounded supply chain partnership interface, the nature of organizational relationship and the intention of partners to acquire external knowledge will determine the forms of acquisition mechanisms and the amount of information exchange between partners (Beecham and Cordey-Hayes, 1998).

Second, supply chain partnership tends to be strongest when partners are highly dependent on each other's complementary functions to complete the industrial process. Knowledge acquisition tends to be promoted more when participants can contribute differently and complementarily to the industry process. In that case, supply chain partners will provide more support to mechanisms, such as joint problem solving and supplier co-design (Beecham and Cordey-Hayes, 1998; Handfield et al., 1999; Dyer and Nobeoka, 2000). However, too much difference in vertical functions will sometimes limit a firm's ability to acquire knowledge. When partners are operating in completely different industrial stages or areas, partners may have limited overlap in knowledge and expertise. As a result, firms may have difficulties in understanding each other's knowledge.

Third, although the extended network relationship may restrict the willingness of partners to exchange knowledge due to concerns over unwanted knowledge spillover, the extended nature of supply chain partnership structures will allow more multilateral knowledge transfer mechanisms to occur. For instance, Toyota initiated the supplier association (Kyohokai) which invited its supply chain partners to jointly exchange

information to successfully improve their collective performance (Dyer and Nobeoka, 2000). As will be discussed in more detail in Chapter 5, knowledge acquisition tends to be affected by factors such as partnership magnitude and balanced power in supply chain partnerships. Furthermore, discussions of knowledge acquisition measurement will be provided in Chapter 6.

#### **4.4.4 Knowledge Internalization**

The knowledge transfer model of Wiig (1997) differentiated knowledge storing from knowledge distributing and pooling as separate processes. Nevertheless, the two processes are mainly to do with how an organization internalizes the knowledge acquired. Cohen and Levinthal (1990) argued that a firm's innovative capabilities largely depend on its ability to assimilate new and external knowledge. Similarly, Kogut and Zander (1992), argue that the ability of the firm to learn is determined by the combinative capabilities of the firm. The combinative capability refers to the firm's ability to generate new applications from existing knowledge, which results from combining the internal learning and external knowledge acquisition. Nonaka (1994) used the notion of internalization to capture the idea of organizational learning, which is completed by transforming explicit knowledge to tacit knowledge of the organization. For interfirm knowledge transfer, the internalization of knowledge will be absorbing the acquired external knowledge into internal capabilities. Based on the argument of Nonaka (1994), firms are capable of internalizing new or external knowledge into their internal capabilities. Thus, both storing and distributing/pooling of knowledge are part of the bigger process of internalizing knowledge. The research presented in this thesis used internalization to represent the process of storing, disseminating and combining existing knowledge with new knowledge in the organization.

##### ***4.4.4.1 Knowledge Internalization and Absorptive Capacity***

Internalization is largely a function of a firm's internal ability to store, absorb, and

disseminate new knowledge (Kogut and Zander, 1992; Grant, 1996b; Mowery et al., 1996; Wiig, 1997). Different terms have been used to describe this ability, such as ‘combinative capability’ (Kogut and Zander, 1992), ‘receptivity’ (Hamel, 1991), and ‘learning capacity’ (Simonin, 1999b). A more commonly accepted term is provided by Cohen and Levinthal (1990: 128) as ‘absorptive capacity’ (Cohen and Levinthal, 1990; Grant, 1996b; Mowery et al., 1996). Absorptive capacity is defined as “a function of the level of prior related knowledge... (it) confers an ability to recognize the value of new information, assimilate it and apply it to commercial ends”. Mowery et al. (1996) suggested that interfirm partnership offers the opportunity to access knowledge, but knowledge that is not internalized is unlikely to enhance organizational capability. A firm’s ability to absorb knowledge influences whether or not the acquired knowledge can be successfully exploited (Cohen and Levinthal, 1990). Moreover, “only when a recipient internalizes knowledge can it be sufficiently understood and adapted by the recipient to allow for its effective re-creation, and ultimately its use” (Cummings and Teng, 2003). Thus, internalization is also essential to the process of knowledge transfer.

The literature suggests that internalization mainly includes three aspects of organizational activities, namely storing of knowledge, dissemination of knowledge, and combining existing knowledge with acquired knowledge (Kogut and Zander, 1992; Wiig, 1997). Firstly, to be able to absorb the knowledge, the firm has to have the ability to store or memorize the knowledge it acquired from outside (Wiig, 1997). This requires the firm to have adequate facilities and technology to store the knowledge (Wiig, 1997). Moreover, firms need to have experts or specialists, who are capable of grasping, interpreting, and implementing the knowledge for the parent organization, and individuals with adequate understanding of the new knowledge (Cohen and Levinthal, 1990). Secondly, to absorb the knowledge, the firm has to have the ability to combine prior knowledge with new external knowledge, so that new knowledge will be transformed into the more compatible knowledge, which is ready for use by the firm (Grant, 1996b; Mowery et al., 1996). Thirdly, the firm needs to disseminate the

knowledge to where it is needed, for instance to appropriate people, or to embed the knowledge into the existing systems (Wiig, 1997), so that knowledge can be utilized by the firm when needed.

#### ***4.4.4.2 Knowledge Internalization Effectiveness***

Indicating the effectiveness of internalization is not straightforward. Given that firms may have many sources of internal or external knowledge, it is difficult to find out which part of the knowledge has been absorbed and to what extent. The literature suggests that the success of knowledge internalization could be indicated by the extent of the knowledge ready to be used by the firm. Patent citation data has been used by prior researchers to measure the extent of technological knowledge absorbed by a firm from other firms, in consideration that change in technology patents tends to reflect the absorption of external knowledge (Almeida, 1996; Mowery et al., 1996). Moreover, Cummings and Teng (2003), following the measurement of some prior researchers (Mowday et al., 1979; Szulanski, 1996; Pierce et al., 2001), measured the extent of knowledge internalization by three indicators, namely knowledge ownership, commitment to the knowledge and satisfaction with transferred knowledge. Noticeably, Hult et al. (2004) employed the concept of information distribution activities to indicate the extent of knowledge absorbed by the firm from supply chain partners. Based on the ideas of organizational learning, Hult et al. (2004) acknowledged that knowledge is more likely to be absorbed, when the focal firm is actively engaged in distributing and circulating the knowledge across the organization.

Because the supply chain partnership is often loosely bounded, knowledge transfer activities in such relationship contexts may not be officially recognized by the management agenda. Consequently, the dissemination of external knowledge could be restricted due to the lack of official support and the management team's lack of confidence over the value of the knowledge and its source. It is reasonable to argue that the barrier will be particularly high when the management team lacks a common understanding or expertise with the supply chain partner. The specialization of partners

at successive stages of the industrial process sometimes may result in the lack of overlapped expertise between partners (Kotabe et al., 2003). Thus, it seems unrealistic and risky for managers to disseminate new knowledge as this is beyond their conventional way of doing things. As a result the absorptive capacity of partners could be restricted due to the lack of related knowledge or experience, and the extent of knowledge internalization will also be restricted. Therefore, the overlap of expertise and shared meaning between supply chain partners may play an important role in the knowledge internalization process.

#### **4.4.5 Knowledge Utilization**

Knowledge utilization is considered as the last stage involved in the knowledge transfer process, which refers to the process of getting acquired skills and knowledge institutionalised into the organization's internal processes and implementing such skills and knowledge into appropriate operations areas. It is at this stage that acquired knowledge is going to realize its potential value to improve processes, practices, and products or services (Wiig, 1997). Even though not all new knowledge will be applied to a commercial end, a firm could use the stored knowledge to enhance its "dynamic learning capability" (Dyer and Nobeoka, 2000) by improving its innovative capabilities and/or capacity for future knowledge creation (Calantone et al., 2002; Cavusgil et al., 2003). Accordingly, knowledge utilization tends to be a multi-dimensional concept, given that utilization of knowledge could be realized in various forms.

##### ***4.4.5.1 Dimensions of Knowledge Utilization***

Despite the recognition of the importance of knowledge utilization, there is generally a lack of conceptualization over knowledge utilization in the studies of interfirm knowledge transfer (He et al., 2006). Nevertheless, according to the school of Market Research Use, which is part of the marketing sciences, knowledge use could be explained as a multi-dimensional concept with three forms, namely instrumental use,



conceptual use, and symbolic use (Beyer and Trice, 1982; Deshpande and Zaltman, 1982; Menon and Varadarajan, 1992). Firstly, instrumental use of knowledge involves the firm's use of knowledge in specific and direct ways to solve problems or for commercial ends. Instrumental use highlights the filling of information gaps where specific problems exist (Menon and Varadarajan, 1992). Secondly, conceptual use involves the firm's use of knowledge for general enlightenment which influences actions, but in indirect and less specific ways. Conceptual use is more subtle and indirect, the effect of it is difficult to observe (Menon and Varadarajan, 1992). Thirdly, symbolic use involves the firm's use of knowledge to legitimate and sustain a predetermined position, for example using knowledge selectively, or otherwise distorting it to justify actions taken for other reasons. Contrary to instrumental and conceptual uses of knowledge, symbolic use implies using information in a manner inconsistent with the intended purpose (Menon and Varadarajan, 1992). Knowledge and information may be used selectively and politically to confirm predetermined positions, legitimize previously held dispositions, or justify actions taken for other reasons.

These three dimensions of knowledge utilization are highlighted in the current research for the following reasons. Firstly, the Market Research Use literature concentrates on the application of organizational research by individuals and organizations, in which much effort has been taken to examine the process and nature of information use, so that more empirical instruments can be considered for possible adoption. Secondly, although supply chain knowledge acquired from external partners is not the same as knowledge generated from organizational research, at the stage of knowledge utilization, organizational application activities for both sources of knowledge share the same basic characteristics once the organization decides to use the knowledge. This is because no matter whether knowledge is acquired from external sources or generated from internal research, they become pools of knowledge available to be used (Wiig, 1997). Thirdly, because firms may have pools of knowledge, it is very hard to draw a clear boundary between different types of knowledge. Hence measuring knowledge

utilization in particular knowledge types is quite difficult. Researchers may find it extremely hard to avoid missing certain types of knowledge. On the other hand, three dimensions of knowledge utilization do not attempt to differentiate between knowledge types, but instead try to capture the way in which knowledge is utilized. These dimensions are believed to be more capable of including all types of knowledge utilization, and will enable reasonable measurement to be developed.

#### ***4.4.5.2 Knowledge Utilization Effectiveness***

Effective knowledge utilization is believed to bring benefits to a firm's performance which otherwise could not be realized (Lane et al., 2001; Soekijad and Andriessen, 2003; Williams, 2007). However, the issue becomes more controversial when the knowledge boundary is vague and knowledge utilization is not legitimized or recognized by the organization. As also suggested by Wigg (1997), firms are capable of pooling various sources of knowledge into their knowledge base. Similarly, in supply chain partnership, knowledge from supply chain partners is one of the many sources of external knowledge. In this sense, the knowledge base ready to be used by the firm may be a mixture of knowledge from various external sources and internally generated knowledge. Hence, direct instrumental use of knowledge is often rare, especially when the issues are complex, the consequences are uncertain, and a multitude of actors are engaged in the decision-making process (Weiss, 1980). Meanwhile, conceptual and symbolic uses are more indirect and less obvious (Menon and Varadarajan, 1992). Consequently, it may be impossible to work out a linear relationship between outcome and specific knowledge. The effectiveness of knowledge utilization cannot be indicated by the actual outcome of knowledge transfer or improvement in firm performance due to the particular knowledge application. Obviously, this gives extra difficulties for knowledge transfer activities to be legitimized by the firm, especially when supply chain partners lack formal recognition of knowledge transfer activities.

Prior research suggests that effective use of knowledge also depends upon a firm's ability to modify or give up obsolete existing practices to adapt to new ways of doing

things (Hamel, 1991; Beecham and Cordey-Hayes, 1998). When old procedures becomes routine, members of the firm may be more reluctant to believe that new procedures could improve efficiency (Probst et al., 2003). Knowledge transfer may not generate real benefits unless individuals have a more open-minded attitude toward new knowledge and are willing to “unlearn” themselves. In supply chain partnership, the problem becomes more obvious when partner firms have limited mutual understanding and knowledge overlaps due to different functional specializations and less clear partnering statements. Without sufficient understanding of the potential benefits, managers and employees may not risk themselves to give up already accepted procedures to try out new practice. Overall, effective knowledge utilization is not only a function of a firm’s intention to be ready to change and adapt to new knowledge, but also a function of a supply chain partner’s shared meaning and accumulation of related expertise.

#### **4.4.6 Obstacles to Effective Supply Chain Knowledge Transfer**

The above discussions suggest that interfirm knowledge transfer tends to be a complex process. Various organizational factors are likely to restrict the conduct of knowledge transfer. Because of the unique characteristics of supply chain partnerships compared to other interfirm partnerships, the barriers also arise from a unique set of reasons: (1) as mentioned above, supply chain knowledge transfer is non-targeted and less guaranteed, knowledge transfer between supply chain partners is more likely to take place without explicit compliance and recognition from participants; (2) because supply chain partners are working at different stages of the industry process, one firm does not necessarily have the expertise of its supply chain partner. Thus, shared meaning may also be limited due to a loosely defined partnership; (3) the network extension of a supply chain partnership also increases the danger of unwanted knowledge spillover, such that the willingness to share valuable knowledge could be limited. Overall, the obstacles to effective knowledge transfer in supply chain partnership may appear in different forms, at different stages of knowledge transfer,

and originate from either source or recipient of the knowledge.

However, prior literature appears to have limited analysis on the potential obstacles to knowledge transfer in the supply chain. In order to have a clearer view of possible obstacles to supply chain knowledge transfer, four unstructured in-depth interviews were conducted in the UK and China in year 2005. It is necessary to summarize this empirical study in the literature review part of this thesis, because the results help the author to have a more comprehensive understanding of the issues of interfirm knowledge transfer and pave the way for the construction of the theoretical framework and the fieldwork as it is introduced in later chapters (Chapters 5 and 7).

Two of the Chinese interviews were conducted by telephone with two senior managers in a Chinese IT company. Another Chinese interview was conducted face-to-face with a senior manager from a Chinese steel company. The UK interview was conducted face-to-face with a middle level manager from a tourism company. Each interview lasted for at least 2 hours. The interviewees were first provided with the definitions of supply chain partnership and interfirm knowledge transfer. They were then asked to consider a typical supply chain partnership they had experience of. They were also asked to describe practices that could be classified as knowledge transfer activities and list a number of barriers that could restrict effective knowledge transfer activities. The interviews were recorded and translated into English. Although the respondents were from different industries and contexts, the synthesized responses still provided a rough picture of what factors could possibly affect effective knowledge transfer. Table 4-5 illustrates the typical obstacles that may hinder effective knowledge transfer between supply chain partners.

At the acquisition stage, knowledge acquisition is likely to be limited due to lack of management support, self-protectiveness, lack of trust of the partner, overlaps in business interests between partners, imbalance of mutual power, and lack of relevant expertise of boundary spanners. At the internalization stage, effective absorption of

new knowledge is likely to be restricted due to suspicions of management over the value of knowledge and the source of knowledge, underestimation of new knowledge by the focal firm, and the lack of relevant expertise to absorb the new knowledge. At the utilization stage, effective use of new knowledge is likely to be hindered by the underestimation of new knowledge by members of the firms, lack of relevant expertise or knowledge, concerns on becoming overly dependent on the counterpart, and the unwillingness to give up or modify existing practices.

The obstacles in table 4-5 are not exhaustive and it only illustrates typical examples of possible barriers. In practice there could be many more forms of barriers to the knowledge transfer practice between supply chain partners. Remedy of such obstacles largely relies on a clear understanding of knowledge transfer mechanisms and processes and the relationship factors that form the context of supply chain knowledge transfer.

Table 4-5 Possible Barriers to Knowledge Transfer in Supply Chain Partnership

Possible Barriers	Knowledge Transfer Stage	Origin of Barrier
Practices that could result in knowledge transfer are unsupported by the management due to financial concerns; (Intension)	Acquisition	Source/Recipient
Importance of knowledge transfer is overlooked by the management due to lack of official guidance; (Intension)	Acquisition	Source/Recipient
Firm is unwilling to expose valuable information to the partner due to concerns over unwanted knowledge spill over; (Trust, Commitment)	Acquisition	Source
Information sharing is kept at the minimum level, because excess knowledge exchange is considered as unnecessary to carry out the operation when the relationship is not expected to last for long; (Commitment, Interdependence)	Acquisition	Source/Recipient
Knowledge transfer activities are initiated by a more powerful party, so that the less powerful partner becomes resistant over the practice, due to concerns of over-dependence; (Balance of power)	Acquisition	Source/Recipient
A relatively small partner in a supply chain partnership is ignored by its more powerful partner, so that transparency is blocked due to ignorance; (Balance of power)	Acquisition	Source
Boundary spanners are unable to understand the knowledge of the supply chain partner due to lack of relevant expertise; (Shared meaning, Absorptive Capacity)	Acquisition	Recipient
Source of the knowledge acquired is doubted by the management team; (Trust, Commitment)	Internalization	Recipient
Value of knowledge acquired by boundary spanners is doubted by the management team; (Intension)	Internalization	Recipient

Knowledge acquired from external sources is undervalued by the management team; (Intension)	Internalization /Utilization	Recipient
New knowledge is undervalued by staff members of the firm; (Intension)	Internalization /Utilization	Recipient
Staff members are incapable of grasping new knowledge due to lack of relevant expertise; (Shared meaning, Absorptive capacity)	Internalization /Utilization	Recipient
Knowledge transfer is initiated by a more powerful counterpart, smaller firm is unwilling to adapt to new ways of doing things, because of the fear of being over-dependent; (Balance of power)	Utilization	Recipient
Staff members of the firm are reluctant to give up or modify existing practices, so that the application of valuable external knowledge is prohibited. (Intension)	Utilization	Recipient
Note: Phrases in brackets give the relationship factors that are related to barriers of knowledge transfer.		

#### **4.4.7 Contributions of Interfirm Knowledge Transfer to Firm Performance**

Effective interfirm knowledge transfer is expected to contribute to firm performance in various ways, as is also indicated by the value congruency theory, which suggests that there should be a value consistency or normative fit between supply chain strategies, supply chain capabilities and performance (Morash, 2001). Hence, knowledge transfer that is enabled by the organizational capabilities, in turn would be expected to generate beneficial outcomes to the supply chain firms. Nevertheless, what benefits could supply chain partners actually gain from interfirm knowledge transfer? Answers to the question are needed to explain firms' intentions to join supply chain partnerships and pursue learning-related activities.

##### ***4.4.7.1 Tangible vs. Intangible Benefits of Knowledge Transfer***

According to Simonin (1997), a firm can achieve both tangible and intangible benefits from interfirm collaboration and interfirm learning. Tangible benefits are those that are explicit and financial, such as generating additional profits, improving market share, and sustaining competitive advantage. For instance, Darr et al. (1995) reported that unit cost of production was reduced through knowledge acquisition in service franchisees.

Moreover, Lawson and Lorenz (1999) found that tacit knowledge transferred through regional firm clusters benefits sustained regional competitive advantage. Stuart (2000) suggested that focal firms could exchange leading-edge technological resources through inter-corporate technology alliances, which improve sales growth and the innovative rate of the firm. Willams (2007) found that replication and adaptation lead to successful knowledge transfer in the context of interfirm relationships, which leads to improved performance of the receiving unit. Evidence has also been gained in the context of international joint ventures that a firm's ability to learn and apply knowledge from external sources will benefit its performance, including business volume, market share, goal achievement, and profit making (Lane et al., 2001).

Meanwhile, a firm could gain intangible benefits through interfirm knowledge transfer.



Such benefits could be learning or knowledge-based, such as learning specific skills and competencies, learning about interfirm cooperation, and learning how to behave cooperatively, and learning how to learn from collaborations (Simonin, 1997). For instance, Cavusgil (2003) has gained evidence that interfirm transfer of tacit knowledge benefits a firm's innovative capability and innovation performance. Tsang (2002) found that firms improve skills of knowledge acquisition from their International Joint Ventures (IJVs) through learning-by-doing, i.e. firms gain experience of learning through prolonged interaction and learning related activities with their IJVs.

In addition, knowledge transfer is also believed to benefit intangibly the relationship performance of the firm, which is to do with a firm's capability to build and manage the interfirm partnership. For instance, Gulati (1995) suggested that information gained from social networks that were cultivated from prior alliances helps the firm to manage the new alliance better. Powell et al. (1996) found that inflow of knowledge from external ties positively affect a firm's future collaborative activities. Johnson and Sohi (2003) suggested that a firm's learning activities in interfirm partnering competence would influence its interfirm relationships in a positive way, in terms of relationship effectiveness/efficiency and commitment. Santos-Vijande et al. (2005) found that a firm's learning orientation stimulates the market-oriented behaviour and it also positively affects the establishment of long-term relationships with strategic clients as indicated by trust, affective commitment, and willingness to continue the relationship.

#### ***4.4.7.2 Specific Benefits of Knowledge Transfer to Supply Chain Partners***

Consistently, interfirm knowledge transfer could also benefit supply chain partner firms in both tangible and intangible ways. For instance, Nobeoka et al. (2002) found that greater learning opportunities may emerge from a broader customer scope strategy, which result in superior supplier performance. They suggest that suppliers should develop customer management capabilities that allow them to cultivate highly cooperative interfirm relationships with multiple customers. Firms that structure their customer relations within a framework of learning and knowledge acquisition can

potentially develop a competitive advantage. In this case, firms could gain both tangible and intangible benefits from learning-oriented collaboration activities.

Specifically, in terms of tangible benefits, two types of performance benefits have been examined by prior researchers, either supply chain performance or market related performance. Dyer and Nobeoka (2000) evidenced significant productivity improvement and inventory reduction among Toyota and its suppliers as result of effective knowledge transfer practices. Kotabe et al. (2003) suggested that the interfirm technical exchange and technology transfer could enhance supplier operational performance, which is indicated by the supplier's improvement in process design, product design, product quality and reduction in lead time. Hult et al. (2004; 2007) gained evidence that knowledge acquisition activities through the supply chain benefit a firm's supply chain efficiency as indicated by the cycle time performance. Spekman et al. (2002) looked at the positive impact of learning in the supply chain on supply chain performance in terms of end customer satisfaction and customer focus. All these benefits are related to the efficiency and effectiveness of the value production process from raw materials to end customers. They are usually measured in terms of improvement in operational efficiency, inventory levels, product quality, production cycle time, delivery time and reliability, and customer satisfaction.

Tan et al. (1998b) suggested that the short-term objectives of supply chain management are primarily to increase productivity and reduce inventory and cycle time, while the long-term objectives are to increase market share and profits for all members of the supply chain. Thus, supply chain performance improvement initiative is the means to achieve the ultimate market and financial performance (Li et al., 2006; Lawson et al., 2009). In this sense, effective knowledge transfer using the supply chain as a conduit is also expected to be an important means to improve the market performance of the firm ultimately. It is important to note that although a number of researchers have examined the effect of interfirm knowledge transfer on market related performance of the firm, such as profitability and ROI (Inkpen and Crossan, 1995; Calantone et al., 2002), firm

size growth (Powell et al., 1996), sales growth (Stuart, 2000; Koka and Prescott, 2002; Wu and Cavusgil, 2006), business volume and market share (Lane et al., 2001; Wu and Cavusgil, 2006), and even market value of firm (Anand and Khanna, 2000), relatively few researchers have been looking at the effect of knowledge transfer on such performance measures in the context of supply chain partnership (e.g. Molina et al., 2007; Cousins et al., 2008; Lawson et al., 2009). For this reason, the current research also sought to examine the impact of supply chain partnership knowledge transfer on firms' market performance.

In the case of intangible benefits, supply chain partner firms could enhance their knowledge base through their knowledge transfer practice and improve internal capabilities to generate further innovations or simply learn more in the future. For instance, a supply chain firm could improve innovation capacity through interfirm knowledge transfer, which will ultimately enhance the product performance of the firm (Calantone et al., 2002; Cavusgil et al., 2003). As Dyer and Nobeoka (2000) suggested, effective knowledge transfer among supply chain partners could establish "dynamic learning capability", which creates sustainable competitive advantages for the individual firm and the supply chain network. Furthermore, the quality of the supply chain relationship and the firm's capability to manage the supply chain relationship could also be improved through learning related activities. As indicated by Hult et al. (2000b) organizational learning have a positive influence on customer orientation and relationship commitment in the global supply chain. Ethiraj et al. (2005) found that learning through repeated interaction with clients over time and across different projects improves firms' capabilities of dealing with clients.

It is worth noting that the essential goal of knowledge transfer between supply chain partners is to enhance and sustain overall performance and competitive advantage (Love and Gunasekaran, 1999). Therefore, the current research mainly focused on the tangible performance of the firm, including supply chain performance and market performance, when carrying out the empirical study.

## 4.5 Summary

This chapter reviewed the knowledge-based view of the firm which is the main theoretical basis of this research in understanding interfirm knowledge transfer activities. The nature of knowledge to be transferred was analyzed based on the discussion of differences between information and knowledge, and various types of knowledge. This chapter also clarified the characteristics of knowledge transfer in supply chain partnership by acknowledging the unique characteristics of supply chain partnership from other types of interfirm partnership. Specifically, knowledge transfer in supply chain partnership is unique because of the vertical knowledge exchange interfaces, the less targeted and thus less guaranteed knowledge transfer activities, the higher risk of knowledge spillover due to the extended supply network, and the need to unfold the process of knowledge transfer. Accordingly, a multi-stage knowledge transfer model was proposed, which consists of three main knowledge transfer processes including knowledge acquisition, knowledge internalization, and knowledge utilization.

This dynamic model paves the way for a more comprehensive understanding of the supply chain knowledge transfer process, which forms the basis for the construction of the theoretical framework in the next chapter (Chapter 5). The unique characteristics of supply chain knowledge transfer also give rise to certain relationship factors, such as trust, commitment, interdependence, shared meaning, and balanced power, which are likely to determine the success of knowledge transfer. The influence of these factors will be discussed in detail in the next chapter. Potential barriers to effective knowledge transfer in the supply chain were listed, based on a series of interviews with practitioners. Lastly, the potential benefits of interfirm knowledge transfer to supply chain partners were discussed.

## **CHAPTER 5 THEORETICAL FRAMEWORK OF KNOWLEDGE TRANSFER IN THE SUPPLY CHAIN**

### **5.1 Preamble**

Chapters 3 and 4 suggest that a supply chain partnership has unique characteristics, which makes the practice of knowledge transfer unique in the context of supply chain partnerships. Based on this argument, this chapter intends to establish the theoretical framework of knowledge transfer between supply chain partners, which will lead to research hypotheses to be tested in the later stage of this research. This chapter extends the literature review by synthesizing the previous empirical studies of interfirm knowledge transfer and extracting the organizational factors that have potential effects on the knowledge transfer performance (see table 5-1). It is important to note that the current research gives particular emphasis to the unique characteristics of knowledge transfer in supply chain partnerships. Such emphasis has given rise to relationship factors more likely to affect the knowledge transfer's effectiveness, such as trust, commitment, interdependence, shared meaning, and balanced power. The theoretical model, which is established based on the above conceptualisation, demonstrates the relationships between various supply chain partnership characteristics and interfirm knowledge transfer processes, as well as the relationships between interfirm knowledge transfer and the performance outcomes. The proposed relationships, as are presented in the research hypotheses, are supported by relevant previous studies of interfirm knowledge transfer (see table 5-2).

### **5.2 Review of Previous Interfirm Knowledge Transfer Studies and Models**

As has been touched on in Chapter 1, an increasing amount of empirical research has been conducted to explore interfirm knowledge transfer (He et al., 2006). Typically, scholars attempt to clarify the mechanisms of knowledge transfer, and indicate factors that have impact on the transfer of knowledge across firms' boundaries. Various models of knowledge transfer have been proposed, which has contributed towards an understanding of interfirm knowledge transfer. Table 5-1 provides a synthesis of emerging representative studies of interfirm knowledge transfer. The purpose of this

table is to give a clearer idea of the main concepts which have been covered by the previous researchers, and how those concepts were related. It also helps to identify the key factors that have potential impact on knowledge transfer processes, and the conceptual gaps that need to be filled in by the current research.

This table illustrates the types of interfirm partnerships that have been the focus of individual studies, such as strategic alliance, R&D partnership, and buyer-supplier partnership. It also lists the research methods and the main concepts that were examined by the respective authors. Furthermore as was discussed in section 4.4.2, the dynamic process of knowledge transfer is essential to the understanding of interfirm knowledge transfer. Consequently, whether these studies have disclosed the dynamic knowledge transfer process is pointed out in this table. Discussion below gives a closer view on prior studies in terms of relationship focus, process of knowledge transfer, and influential factors of knowledge transfer.

Table 5-1 A Synthesis of Empirical Studies of Interfirm Knowledge Transfer

Author(s)	Interfirm relationship	Method / Unit of analysis	Main concepts examined	Process of knowledge transfer	Main findings
(Cohen and Levinthal, 1990)	Interfirm relationship (non-specified)	Questionnaire survey / Department	<b>Absorptive capability</b> ; firm internal R&D; competitors knowledge/extra-industry knowledge; technical knowledge of firm	Not examined	R&D activities of the firm enhance firm's absorptive capacity which is necessary for the exploitation of external knowledge and quick response to the technological advances; technology adoption is affected by the degree to which an innovation is related to the pre-existing knowledge base of prospective users.
(Hamel, 1991)	International strategic alliances	Interview / Plant	<b>Intent</b> ; <b>receptivity</b> ; <b>transparency</b>	Not examined	Intent, receptivity, and transparency are principal determinants of learning process; asymmetries in learning alter the relative bargaining power of partners; stability and longevity may be inappropriate metrics of partnership success; partners may have competitive and collaborative aims in relation to others; process may be more important than structure in determining learning outcomes.
(Ritcher and Vettel, 1995)	Joint Ventures	Case studies / Plant	Knowledge layers; <b>Learning modes</b>	Perception; internalization ; abstraction	Joint ventures should be guided by a learning vision promoting the perception, internalization and abstraction of the partners knowledge potentials; the acquired knowledge needs to be distributed through a network of proper communication channels; the actual accomplishment of the above measures to taken requires a champion; personal development program is needed to make individuals becoming culturally sensitized and develop receptivity potential for organizational changes.
(Powell et al., 1996)	Strategic alliances	Secondary data, longitudinal / Plant	Number of alliances; <b>Diversity of alliances</b> ; <b>Collaborative R&amp;D and network experience</b> ; firm's central connectivity; growth rate of the firm; number of subsequent non-R&D/R&D collaboration; firm size	Not examined	Collaborative R&D and network experience have positive effects on firms' future network portfolios diversity; the amount of network R&D activity and collaborative R&D and network experience help determine the central connectivity of the firm; central connectivity and network experience have positive effects on size and publicity of the firm; central connectivity has positive effects on firm's future collaborative R&D activity.
(Mowery et al., 1996)	Strategic alliances	Secondary data / Plant	Interfirm transfer of technological capabilities; <b>relationship structure</b> ; <b>absorptive capacity</b> ; <b>learning intention</b>	Not examined	Equity joint ventures promote greater knowledge transfer than do contract-based alliances; higher levels of transfer occur in bilateral non-equity arrangements than in unilateral contracts; some alliances are vehicles for accessing rather than acquiring capabilities; absorptive capacity, which is determined by the pre-alliance experience in related technological areas, influences the extent of knowledge transfer; Distance, cultural differences could place obstacles to interfirm knowledge transfer.
(Simonin, 1997)	Strategic alliances	Questionnaire survey / Plant	<b>Collaborative experience</b> ; <b>collaborative know-how</b> ; <b>tangible collaborative benefits</b> ; <b>intangible collaborative benefits</b>	Not examined	Firms develop collaborative know-how from past collaborations; collaborative know-how allows firms to achieve greater benefits from collaborations; collaborative experience alone is insufficient for the achievement of the greatest benefits from collaboration; collaborative experience must be internalized first, and develop into specific collaborative know-how to contribute to future collaborative benefits.
(Beecham and Cordey-Hayes,	Supply chain partnership	Interview / Plant	<b>Level of partnering</b> ; <b>contributing factors to</b>	Not examined	One of the main reasons why partnerships fail is due to managerial rather than technical reasons, i.e. inconsistent managerial attitudes toward partnership; nature of technology and

1998)			<b>technology partnering;</b> technology partnering performance		overall managerial receptivity determine the intensity of knowledge exchange; firms tend to underestimate the difficulties of technology partnering which often lead to the failure the partnership; technology partnership can bring benefits to the participants, but not always; lifetime of partnership success depends on the nature and complexity of the product or project; the speed of evolving of that lifetime depends partly upon partners' ability to unlearn obsolete and misleading knowledge and assimilate new knowledge.
(Simonin, 1999b)	Strategic alliances	Questionnaire Survey / Plant	<b>Knowledge ambiguity;</b> <b>knowledge transfer;</b> <b>collaborative know-how;</b> <b>learning capacity;</b> <b>alliance duration</b>	Not examined	Knowledge ambiguity is a full mediator of tacitness, prior experience, complexity, cultural distance, and organizational distance on knowledge transfer; ambiguity is negatively related with knowledge transfer; effect of ambiguity is moderated by the firm's level of collaborative know-how, its learning capacity, and the duration of the alliance.
(Dussauge et al., 2000)	Strategic alliances	Secondary data / Plant	Alliance outcomes; <b>alliances types;</b> <b>alliances characteristics;</b> <b>alliance duration before outcome</b>	Not examined	Link alliances (partners contribute differently, e.g. buyer-supplier partnership) are more likely to lead to capability transfers between partners than scale alliances (partners contribute similarly, e.g. joint manufacturing); link alliances are more likely to undergo reorganization or takeover by one partner than scale alliances; learning potential will lead to earlier reorganization or takeover for link alliances than scale alliances; two types of alliances are equally likely to dissolve.
(Dyer and Nobeoka, 2000)	Supply chain partnership	Case study / Plant	Tacit knowledge transfer; <b>knowledge transfer mechanisms;</b> <b>network identity;</b> <b>coordinating principles;</b> <b>network strength</b>	Not examined	Production knowledge is viewed as the property of the network; Network can be superior to a firm as organizational learning unit, if network can create a strong identity and coordinating rules; rules are imposed to prevent knowledge hiding and free riding problem; interconnected strong tie network is effective at the transfer of tacit knowledge; it takes time for the firm to develop capabilities and processes necessary to facilitate knowledge transfer.
(Calantone et al., 2002)	Interfirm relationship (non-specified)	Questionnaire survey / Plant	<b>Learning orientation;</b> <b>firm innovativeness;</b> firm performance; <b>commitment to learning;</b> <b>shared vision;</b> <b>open mindedness;</b> <b>intra-organizational knowledge sharing;</b> organization age	Not examined	Learning orientation, which emphasizes the organizational value of obtaining knowledge, is critical for innovativeness and performance of the firm; firm innovativeness which focuses on the organization's willingness to change, is positively related with firm performance; organization age has moderating effect on relationship between learning orientation and firm innovativeness but not on the relationship between learning orientation and performance.
(Hult et al., 2002b)	Supply chain partnership	Questionnaire survey / Plant	Entrepreneurship; <b>innovativeness;</b> learning; <b>cultural competitiveness;</b> cycle time	Not examined	The study drew on multiple chain participants by focusing on inbound logistics portion of one Fortune 500 multinational corporation's supply chain. The study found that cultural competitiveness explained the most variance in cycle time.
(Cavusgil et al., 2003)	Interfirm relationship (non-specified)	Questionnaire Survey / Plant	<b>Tacit knowledge transfer;</b> <b>innovation capability;</b> <b>relationship strength;</b> <b>collaborative experience</b>	Not examined	Interfirm relationship strength affects the extent of tacit knowledge transfer; the extent of tacit knowledge transfer positively affects firm innovation capability; the innovation capability is influential as to firm innovation performance; collaborative experience has moderating effect on the relationship between relationship strength and extent of tacit knowledge transfer.
(Cummings and Teng, 2003)	Intrafirm relationships between R&D	Questionnaire Survey / Plant	Knowledge transfer success; <b>knowledge embeddedness;</b> <b>knowledge articulatability;</b>	Acquiring; Internalizing	Articulatability of knowledge is negatively related to transfer success indicated by knowledge internalization; appropriate de-contextualization process is necessary for the transfer of less articulated knowledge; knowledge embeddedness is negatively related with



	units; strategic alliances; acquisitions in high-technology industry		<b>organizational distance;</b> <b>physical distance;</b> <b>knowledge distance;</b> <b>norm distance;</b> project priority; <b>learning culture;</b> <b>transfer activity</b>		transfer success; norm distance and knowledge distance between source and recipient of knowledge has negative influence on the transfer success; interaction between learning parties promotes knowledge transfer success, likewise participation to the articulation process and use of more types and numbers of transfer activities contribute to transfer success; relationship building between parties could improve transfer success.
(Kotabe et al., 2003)	Buyer-supplier relationship	Questionnaire Survey / Plant	Technical exchanges; technology transfer; supplier performance improvement; <b>link duration</b>	Not examined	Firms rely on bilateral flow of knowledge; positive relationship exists between technical exchange and supplier performance improvement shown in US sample but not in Japanese sample; high-level technology transfer is positively related with supplier performance improvement; link duration has positive moderating effect on the relationship between higher-level technology transfer and supplier performance improvement, but has no effect on the relationship between ordinary technical exchanges and supplier performance improvement.
(Hardy et al., 2003)	Inter-organizational collaboration	Comparative Case study / Collaboration	<b>Involvement;</b> <b>Embeddedness;</b> Strategic effects; Knowledge creation effects; Political effects.	Not examined	Collaborations that are both involved and embedded are more likely to be associated with knowledge creation effects; those that are only involved are more likely to be associated with strategic effects; those that are only embedded are more likely to be associated with political effects.
(Chen, 2004)	Strategic alliances	Questionnaire survey / Plant	Knowledge transfer performance; <b>knowledge explicitness;</b> <b>absorptive capacity;</b> <b>alliance characteristics;</b> <b>trust and adjustment between partners;</b> <b>conflict level</b>	Not examined	Knowledge transfer performance is positively affected by the explicitness of knowledge and firm's absorptive capacity; equity based alliance will transfer tacit knowledge more effectively while contract-based alliances is more effective for the transfer of explicit knowledge; trust and adjustment have positive effects on knowledge transfer performance; conflict possesses a curvilinear effect on knowledge transfer performance.
(Hult et al., 2004)	Supply chain partnership	Questionnaire survey / Plant	<b>Achieved memory;</b> knowledge acquisition activities; information distribution activities; <b>shared meaning;</b> <b>importance of supply chain relationship;</b> <b>frequency of supply chain relationship;</b> cycle time	Knowledge acquisition activities; information distribution activities	The study showed that chains possessing more memory sought new knowledge more than chains possessing less memory. It also found that knowledge acquisition activities shape information distribution activities. The study showed that information distribution activities shaped shared meaning. It concluded that shared meaning provides a common frame of reference and that it had a positive favourable relationship with the cycle time.
(Wang et al., 2004)	International Joint ventures	Questionnaire survey / Plant	<b>Capacity to transfer;</b> <b>willingness to transfer;</b> knowledge contributed by MNC; <b>Capacity to learn;</b> <b>intent to learn;</b> knowledge acquired by local subsidiary	Knowledge contribution by parent; knowledge acquisition by subsidiary	Knowledge contributed by the parent to the subsidiary is affected by two groups of factors: parent's capacity to transfer knowledge and parent's willingness to transfer knowledge. Holding constant knowledge contributed by the parent, knowledge acquired by the subsidiary from its parent is determined by two groups of factors: subsidiary's capacity to acquire knowledge and subsidiary's intent to acquire knowledge.
(Ethiraj et al., 2005)	Buyer-supplier relationship	Secondary data / Project	<b>Client-specific capabilities;</b> <b>project management capabilities;</b> Project contribution	Not examined	Client-specific capabilities are a function of repeated interactions with clients over time and across different projects. This learning from repeated interactions with a given client reduces project execution costs and helps improve project contribution. Project management capabilities are acquired through deliberate and persistent investments in infrastructure and systems to improve the firm's software development process. Marginal returns to acquiring

(Lamming et al., 2005)	Supply chain partnership	Interviews /Plant	Modes of sharing information and knowledge	Not examined	different capabilities may be different. Transparency revolves around reflexivity, whereas one-way open-book approaches appear static and concerned with the treatment (or management) of existing knowledge, working 'on' knowledge, whereas transparency is concerned with dynamics and potentials, that is working 'with' knowledge. Benefits of transparency may lie in the questions it forces organizations to address, rather than in the immediate answers themselves.
(Muthusamy and White, 2005)	Strategic alliances	Questionnaire survey / Plant	<b>Reciprocal commitment; ability-based trust; benevolence-based trust; integrity-based trust; mutual power/influence;</b> Extent of interfirm learning	Not examined	Social exchanges such as reciprocal commitment, trust, and mutual influence between partners are positively related to learning and knowledge transfer in strategic alliances.
(Nieto and Quevedo, 2005)	Interfirm relationship (non-specified)	Survey / Plant	<b>Technological opportunity; knowledge spillovers; absorptive capacity;</b> innovative effort	Not examined	It is demonstrated that the absorptive capacity variable determines innovative effort to a greater extent than the two structural variables (technological opportunity and knowledge spillovers). It is also shown that absorptive capacity has a moderating effect on the relationship between technological opportunity and innovative effort.
(Sampson, 2005)	R&D alliance	Secondary data / Plant	<b>Prior alliance experience;</b> Firm innovative performance	Not examined	Prior alliance experience does increase collaborative benefits. However, firms do not seem to benefit from extensive experience-collaborative benefits are improved most with some experience, but extensive experience does not add to this effect. This lack of cumulative benefits from prior alliance experience appears to be partly due to the depreciation of knowledge over time, since only recent experience has a positive impact on collaborative returns. Prior experience matters more for those alliances characterized by greater complexity or with more uncertain outcomes. Managerial experience is a firm capacity that has important implications for performance.
(Zhao et al., 2005)	International joint ventures	Case study / Plant	<b>Characteristics of source network; Characteristics of recipient network;</b> Transfer of R&D capabilities	Not examined	The study suggests ways that the dual networks influence both types of knowledge transfer (i.e. knowledge transfer from the MNE source networks into IJVs and knowledge diffusion from IJVs to their local recipient networks).
(Wu and Cavusgil, 2006)	Strategic alliances	Questionnaire survey / Department	<b>Organizational commitment; learning intention; partner sensing; relationship initiation;</b> alliance performance; firm performance	Not examined	Learning intention, partner sensing, and relationship initiation are positively associated with organizational commitment. Organizational commitment is positively associated with both alliance performance and a firm's market performance. Organizational commitment is a key to aligning common interests with private interests and to generating value for both firms. Under high market uncertainty, the effect of commitment is more salient in generating higher rents for the alliance than for the firm. Organizational commitment may not be an effective strategy for large firms in generating firm specific rents.
(Modi and Mabert, 2007)	Buyer-supplier relationship	Questionnaire survey / Plant	<b>Competitive pressure; Evaluation and certification; Future business incentives;</b> Cooperational knowledge transfer activities; collaborative communication; supplier performance	Not examined	Evaluation and certification efforts are the most important supplier development prerequisites before undertaking operational knowledge transfer activities such as site visits and supplier training. Furthermore, collaborative inter-organizational communication is identified as important supporting factor in transforming an organization's efforts to develop suppliers into supplier performance improvements.

(Mason and Leek, 2008)	Supply network	Case study / Plant	improvement <b>Network structure;</b> <b>interfirm routines;</b> <b>knowledge forms</b>	Not examined	Dynamic business models help organizations identify and link key actors with each other (at the firm and individual level), and aid the identification and specification of appropriate knowledge types and knowledge transfer mechanisms for different actors, in different contexts.
(Squire et al., 2008)	Buyer-supplier relationship	Questionnaire survey/ Plant	<b>Buyer-supplier cooperation;</b> <b>Interfirm trust;</b> <b>Relationship duration;</b> <b>Supplier performance;</b> Knowledge transfer	Not examined	The results indicate that knowledge transfer is positively influenced by the extent of cooperation, but this relationship is moderated by the level of trust and the performance of the supplier firm.

---

Note: Phrases in Bold represent key influential factors of interfirm knowledge transfer covered by previous studies.

---

### 5.2.1 Interfirm Relationship Focus

As has been mentioned in section 3.4, various arrangements of interfirm partnership exist. Accordingly, when studying interfirm knowledge transfer, researchers have been concentrating on various forms of relationship in order to give more specific theoretical implications. It is found from the review that a good number of studies focused on interfirm knowledge transfer in strategic alliances (e.g. Ritcher and Vettel, 1995; Mowery et al., 1996; Powell et al., 1996; Simonin, 1997, 1999b; Wu and Cavusgil, 2006). Moreover, it is interesting to see more researchers became interested in issues of interfirm knowledge transfer in the context of supply chain or buyer-supplier relationship (e.g. Heide and Miner, 1992; Beecham and Cordey-Hayes, 1998; Dyer and Chu, 2000; Kotabe et al., 2003; Hult et al., 2004; Modi and Mabert, 2007; Mason and Leek, 2008; Squire et al., 2008; Lawson et al., 2009). Given that the buyer-supplier relationship is mainly to do with vertical interfaces between firms, many researchers viewed the buyer-supplier relationship as an important platform for knowledge transfer.

Nevertheless, many studies have focused on either strategic alliance in general (e.g. Mowery et al., 1996; Simonin, 1999b) or did not specify the interfirm relationship within which the knowledge transfer took place (e.g. Cavusgil et al., 2003; Nieto and Quevedo, 2005; Ramasamy et al., 2006). For instance, both equity-based and non-equity based strategic alliances might be included in a study (Mowery et al., 1996; Simonin, 1997, 1999b). Ramasamy et al. (2006) examined knowledge transfer between business partners in China, but did not specify the types of business partnership. Cummings and Teng (2003) examined knowledge transfer in three levels, namely between R&D units inside the firm, between R&D-related strategic alliances, and the knowledge transfer through equity acquisitions. Nevertheless, the characteristics of strategic alliance were not clarified in their study. Powell et al. (1996) concentrates on various forms of R&D partnerships between biotechnology firms and other entities, such as hospitals, universities, and government agencies. Given that the characteristics of relationships may vary with specific partners, generalizability of the study may be limited. There are only a few of these researchers which concentrated on a particular type of strategic alliance. One of these studies is done by Ritcher and Vettel (1995) who carried out several case studies of joint ventures in Japan to verify the interfirm knowledge transfer model they have developed.

According to Koka and Prescott (2002), the number and type of alliances, nature of the partners and their alliance structures as well as relationship dynamics determine a firm's access to knowledge spill-over and its ability to leverage information. Inkpen and Tsang (2005) highlighted that social capital dimensions are not uniform in their effects on knowledge transfer, and dynamics of knowledge transfer may vary across network types. The structure of strategic alliances could even determine the nature of knowledge transfer practices (Mowery et al., 1996). Hence, the usefulness and amount of knowledge available to firms and the mechanisms of knowledge transfer could be varied with respect to the partnership structure and the relationship arrangement. In this sense, without the clearly defined interfirm relationship the theoretical underpinnings derived from these studies could be vague.

### **5.2.2 Process of Knowledge Transfer**

According to Slater and Narver (1994), “organizational learning is a complex, multidimensional construct occurring at different cognitive levels...and encompassing multiple sub-processes”. It implies that interfirm knowledge transfer would also be a complex process, through which organizations learn from each other. As has been discussed in section 4.4.2, the dynamic process of knowledge transfer is important to the understanding of interfirm knowledge transfer. However, not many researchers explicitly examined the process of knowledge transfer in their theoretical model, and most studies treated interfirm knowledge transfer as a “black box”. It seems that many empirical studies were built upon the assumption that the process of interfirm learning is unlikely to be differentiated and lead to varied performance. However, the three main stages of knowledge transfer (acquisition, internalization, and utilization) which emerged from the literature (see table 4-3) imply that previous researchers are more likely to be limited by the inability of research methods to deal with the complexity involved in studying the dynamic process of knowledge transfer (He et al., 2006).

Within those studies which have disclosed the multiple stages of interfirm knowledge transfer, Ritcher and Vettel (1995) suggested in their model that knowledge transfer between joint venture partner firms should be a multi-stage process with perception, internalization, and abstraction. These processes, however, are more concerned with the

establishment of a knowledge transfer relationship between partner firms rather than actual knowledge transfer processes. Minbaeva (2007) explored the knowledge transfer processes between headquarters and subsidiaries of Multinational Corporations (MNCs) and differentiated the disseminative capacity of the knowledge sender and the absorptive capacity of the knowledge receiver. The actual process of knowledge transfer, however, was not examined by the study. Cummings and Teng (2003) included two stages of knowledge transfer activities into their theoretical model, namely acquisition and internalization. Nevertheless, the research findings based on that model were not specific to the interfirm relationship in the supply chain. It is worth noting that Hult et al. (2004), conducted an empirical study of a large transportation company's supply chain, in which study the effects of knowledge acquisition and knowledge distribution on the supply chain cycle time performance were examined. Although several studies have included the multi-stage view of interfirm knowledge transfer into their theoretical model, none of the studies has a comprehensive coverage of the whole process of interfirm knowledge transfer. Given that acquisition, internalization, and utilization are all essential to the understanding of how knowledge transfer could bring benefits to the supply chain partners, a more complete model is needed to assist the empirical study of knowledge transfer in supply chain partnerships.

### **5.2.3 Factors Influencing Interfirm Knowledge Transfer**

To improve the understandings of the context under which knowledge can be transferred more effectively, prior researchers have empirically examined various organizational factors, which could influence knowledge transfer success. For instance, Mowery et al. (1996) tested the effects of alliance structure, absorptive capacity, and learning intention on the knowledge transfer practice between strategic alliances, which contributes significantly to the understanding of interfirm knowledge transfer. Simonin (1999b) empirically examined the relationship model between knowledge ambiguity, antecedents to knowledge ambiguity, and technology knowledge transfer in strategic alliances. The study contributes to the understanding of knowledge transfer by providing empirical evidence of the mediating effect of knowledge ambiguity on the knowledge transfer practice. However, without disclosing the actual process of knowledge transfer, the effects of knowledge ambiguity tend to be arbitrarily imposed on the knowledge transfer, which is regarded as a single phenomenon. Cavusgil et al.

(2003) examined the influence of relationship strength on the interfirm tacit knowledge transfer, and the mediating effects of collaborative experience and firm size. The result supports the view that relationship strength does have positive influence on tacit knowledge transfer, and that firms with higher collaborative experience are more effective in transfer of tacit knowledge. Minbaeva (2007) examined the four determinants of degree of knowledge transfer from headquarters to subsidiaries, namely characteristics of knowledge, characteristics of both knowledge senders and receivers, and the relationships between them. The empirical result suggested that the characteristics of knowledge senders (Disseminative Capacity), knowledge receivers (Absorptive Capacity), and the relationships between them are important determinants of knowledge transfer.

In those studies which focused on supply chain relationships, Dyer and Nobeoka (2000) analysed the impact of knowledge transfer mechanisms, network identity, network strength, and coordinating principles of the network on the success of interfirm knowledge transfer in Toyota's supplier network. The study has provided good indication of facilitators to knowledge transfer practice. However, due to the case study nature of the research, the result is unlikely to be generalizable. Kotabe et al. (2003) empirically tested the mediating effect of link duration between buyer and supplier firms when they examined the relationship between technical exchange and technology transfer and supplier performance improvement in the automotive industry. The result indicated that link duration has certain positive effects on the effectiveness of technological transfer, but not on technical exchange. Moreover, Hult et al. (2004) showed that the achieved memory of the firm had a positive effect on the knowledge acquisition activities between supply chain firms. Mason and Leek (2008) examined the link between supply network structure, interfirm routines and knowledge forms. Modi and Mabert (2007) examined the effect of supplier development strategies on the supply chain firms' operational knowledge transfer activities and provided evidence on the positive role of the evaluation and certification efforts in undertaking operational knowledge transfer activities such as site visits and supplier training.

An initial conceptual model, therefore, was developed to summarize the various influential factors that have been covered by the prior researchers and to illustrate the major concepts covered in the prior studies. It paved the way for the development of the

main theoretical model, which is discussed in detail in later sections (section 5.4 to 5.8). As indicated in figure 5-1, prior researchers have focused on how knowledge flows from the source to the recipient, and what benefits the knowledge transfer process can bring to the firm. However, the process is largely conceptualised as a black box without sufficient understanding of what happens during the process. When exploring the factors which influence the knowledge transfer effectiveness, four main factors were frequently analysed: absorptive capacity, learning intention, nature of knowledge, and characteristics of interfirm relationship. The following subsections provide a more detailed view on each of these factors.

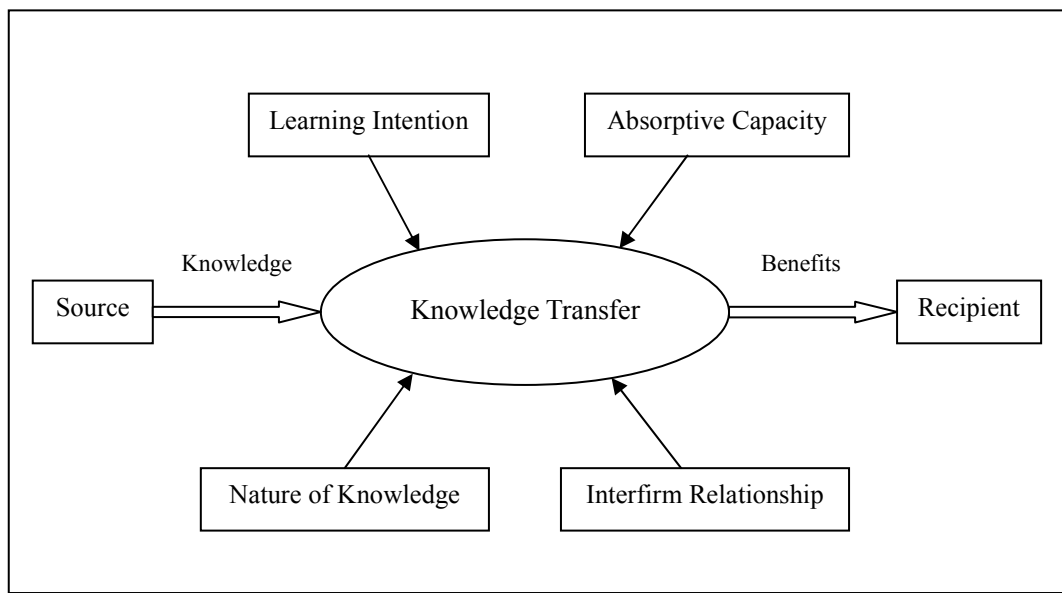


Figure 5-1 Emerging Influential Factors to Interfirm Knowledge Transfer

#### **5.2.3.1 Absorptive Capacity**

One of the most frequently highlighted organizational factors that influence the interfirm knowledge transfer relates to the internal capabilities of firms in acquiring and exploiting external knowledge (see also section 4.4.4.1). Cohen and Levinthal (1990) defined the ability to recognize the value of new information, assimilate it and apply it to commercial ends as ‘absorptive capacity’. Emphasizing the importance of absorptive capacity, subsequent researchers also included this concept in their evaluation of interfirm knowledge transfer (e.g. Mowery et al., 1996; Chen, 2004; Wang et al., 2004; Dyer and Hatch, 2006).



Noticeably, researchers have used different notions to describe a firm's capabilities to learn from others. For instance, Hamel (1991) used 'receptivity' to capture a firm's overall ability to absorb skills from its partner. Kogut and Zander (1992) used 'combinative capabilities' to describe a firm's ability to recombine existing knowledge and external knowledge to generate new knowledge. Simonin (1999b) suggested using the concept of 'learning capacity' to indicate a firm's ability to allocate appropriate resources in knowledge transfer. Nevertheless, different terminologies sought to measure the same underlying concept, i.e. a firm's accumulated capabilities to acquire and absorb new knowledge. Hence, instead of using those more narrowly defined terms, the research presented in this thesis still uses 'absorptive capacity' to indicate a firm's overall capabilities to allocate appropriate resources to the learning process, accumulate prior knowledge with new knowledge, and adequately utilize the knowledge in the production process.

The literature suggests that two aspects of internal capability are relevant to the firm's ability to learn: intangible capability and tangible capability. Firstly, as indicated by prior scholars, a firm's ability to learn new knowledge largely depends on its prior knowledge or capabilities (Cohen and Levinthal, 1990; Kogut and Zander, 1992; Trott et al., 1995; Mowery et al., 1996; Beecham and Cordey-Hayes, 1998). In order for a firm to assimilate or use new technologies, it must have within it a certain level of existing knowledge or capabilities, which complement the external knowledge (e.g. Trott et al., 1995; Mowery et al., 1996; Hult et al., 2004; Wang et al., 2004; Dosi et al., 2008). Cohen and Levinthal (1990) suggested that a firm's development of absorptive capacity depends on the communication between external environment and the organization, as well as among the subunits of the organization, and also on the character and distribution of expertise within the organization. Wang et al. (2004) argued that the capacity to learn of the firms could be determined by the qualifications of employees and the firms' emphasis on training. Thus, the intangible capability that is embedded in an organization as a whole could be a function of the interaction between external environment, organizational structure and routines, and individuals' expertise.

Secondly, the ability of the firm to learn new knowledge also depends on its tangible capabilities, which refers to the firm's financial capabilities and allocation of appropriate resources to invest in learning-related activities, such as R&D and staff

development activities and communication (Cohen and Levinthal, 1990; Mowery et al., 1996; Simonin, 1999b; Wang et al., 2004; Dosi et al., 2008). Simonin (1999b) pointed out that the appropriateness of resource deployment, both human and support assets, shapes the learning outcomes. For example, inappropriate information processing and communication capabilities between alliances are very likely to prevent acquisition and diffusion of new knowledge. Likewise, assigning high quality staff to the alliance will also enhance the capability and intent of the firm to learn from its partner. However, the author also pointed out that the firm may be able to compensate for its lack of prior experience and for the complex nature of a technological asset by deploying greater resources to learn (Simonin, 1999b). In this sense, the capability of the firm to learn is largely determined by having sufficient and adequately allocated resources for learning related activities.

Actually, these two aspects of capabilities are interrelated. Cohen and Levinthal (1990) observed that firms may invest in basic R&D research without specific purposes, which may provide firms with general background knowledge that would permit them to exploit readily useful scientific and technological knowledge through their own innovations or to be able to respond quickly to new developments. Likewise, Mowery et al. (1996) argued that “absorptive capacity results from a prolonged process of investment and knowledge accumulation within the firm...the current absorptive capacity is influenced by its historic participation in specific product markets, lines of R&D, and other technical activities”. Thus, intangible capabilities of the firm to learn are very likely to be cultivated from the firm’s previous deployment of tangible capabilities.

Prior studies of interfirm knowledge transfer tend to agree upon the crucial role of absorptive capacity in successful knowledge transfer (Wijk et al., 2008). According to Cohen and Levinthal (1990), the absorptive capacity is a necessary condition for a firm’s exploitation of external capabilities or knowledge. Mowery et al. (1996) reveals that absorptive capacity is an important factor in acquisition of capabilities through alliances. The empirical study of Simonin (1999b) suggested that proper resource allocation accelerates learning curves, i.e. the enhanced learning capacity of the firm could facilitate the success of knowledge transfer. Likewise, Chen (2004) also identified the positive effects of absorptive capacity on the knowledge transfer performance. The

study of Hult et al. (2004) provided a good illustration of how existing knowledge of the firm could facilitate its further learning activities. Wang et al. (2004) suggested that knowledge acquisition by the local subsidiary tends to be determined by its capacity to learn. Moreover, Nieto and Quevedo (2005) indicated that absorptive capacity determines innovative effort of the firm to a large extent.

Furthermore, when looking at both sides of bilateral partnerships, previous researchers highlighted the importance of a balance of absorptive capacities on knowledge transfer effectiveness. For example, Crossan and Inkpen (1995) argued that differences in the skill levels of joint-venture partners help determine what can be learned. Too large differences in skills between partner firms will inhibit effective learning. Likewise, Beecham and Cordey-Hayes (1998) indicated that uneven capability of the partner firms could inhibit the knowledge transfer success. They suggested that small suppliers in the UK motor manufacturing industry have difficulties in assimilating and adopting new technologies through customer-supplier partnership arrangements mainly due to the limited internal capability of the firm (Beecham and Cordey-Hayes, 1998). Overall, the findings of prior studies form the basis for the important influence of absorptive capacity on the process of knowledge transfer. It is reasonable to view the absorptive capacity of a firm as being as important a competence as its developmental capacity (Wernerfelt, 1984).

#### ***5.2.3.2 Learning Intention***

Another commonly highlighted organizational factor that influences knowledge transfer effectiveness relates to the cultural or intentional characteristics of the organization. Interfirm knowledge transfer scholars highlighted the importance of differences in national or organizational culture to learn from others when examining the nature of interfirm knowledge transfer (Hamel, 1991; Mowery et al., 1996; Calantone et al., 2002; Cummings and Teng, 2003). It is argued that the willingness and ambition to learn from others are embedded in the culture of organizations. The literature suggested that national culture could make a difference. For instance, there is evidence showing that Japanese firms are more inclined to learn from their partners compared to U.S. firms. This is because Japanese firms tend to employ more incentives and use more proactive approaches to promote learning (Mody, 1993; Crossan and Inkpen, 1995; Mowery et al., 1996). Hamel (1991) mentioned that when Japanese managers were asked why

Japanese firms learn more than their Western partners, they answered that “We had the attitude of students, and our Western partners the attitude of teachers”. Hamel (1991) also regarded the ‘intent’, which conveys the objectives of the organization with respect to inter-partner learning, as one of the main determinants of learning in international alliances.

Meanwhile, previous researchers have also realized the potential effects of differences in organizational culture which exist between firms on the knowledge exchange activities. Beecham and Cordey-Hayes (1998) argued that progressive technology partnering arrangements depend on the degree to which management possesses the “right” attitude toward sharing knowledge with others outside the firm. Love et al. (2002) argued that “to foster organizational learning, it is necessary to concentrate on both individual and group skills, design of support structures and the creation of an overall organizational attitude that encourages learning”. Johnson and Sohi (2003) suggested that firm must provide the appropriate platform, as manifest in the firm’s culture in terms of learning intent, receptivity, and transparency, for learning activities to occur. Wang et al. (2004) argued that the transfer of knowledge between MNCs to local subsidiaries tends to be determined not only by the parent’s willingness to transfer but also by the subsidiary’s intent to learn. In this sense, the subjective intention and attitude of the organization concerning learning play an important role in effective interfirm knowledge transfer.

Generally, the learning intention refers to a firm’s willingness to value the interfirm learning and its commitment to take efforts to learn from other firms. It is associated with the firm’s strategic vision towards partnership and interfirm learning (Hamel, 1991; Inkpen, 1998; Calantone et al., 2002). Furthermore, when talking about firms’ learning intention, prior studies suggested that a consistent attitude toward partnership and organizational learning from individuals is an important factor to be considered (see for example Buckley et al., 2006). For instance, Beecham and Cordey-Hayes (1998) suggested that one of the main reason that learning partnership fails is due to inconsistent managerial attitudes toward partnership. Similarly, Minbaeva (2007) highlighted that the ability and willingness of organizational actors to share their knowledge are crucial to the success of knowledge transfer. Modi and Mabert (2007) concluded that incentives are important to effective supplier development partnerships.

Likewise, Calantone et al. (2002) suggested that “learning orientation” (i.e. firms’ organization wide activities of creating and using knowledge to enhance competitive advantage) is determined not only by firms’ commitment to learning, but also by shared vision, open-mindedness, and intra-organizational knowledge sharing. Accordingly, the latter three components are largely to do with the consistent attitude of individual members within the organization (Soekijad and Andriessen, 2003).

When bilateral interfirm knowledge transfer is examined, prior scholars suggested that a firm with a more proactive and ambitious learning culture compared to its partner firm tends to practice knowledge transfer more effectively. For instance, Hamel (1991) has evidenced the asymmetric capability acquisition between Japanese companies and U.S. partners, which led Japanese companies to emerge from alliances stronger than their U.S. partners. Likewise, Mowery et al. (1996) showed that cultural differences could place obstacles to the effective transfer, when strategic alliances between Japanese and U.S. firms were examined. Cummings and Teng (2003) argued that the learning culture of the recipient firm tends to facilitate the knowledge transfer success. Johnson and Sohi (2003) suggested that the higher the levels of firm culture factors in terms of learning intent, receptivity, and transparency are, the more the firm will engage in learning activities for interfirm partnering competence. Moreover, Hult et al. (2000a) gained evidence that organizational learning in the purchasing process is influenced by the organizational culture factors of localness, transformational leadership, and openness. The study provided a good illustration of the influence of organizational culture on knowledge transfer activities which took place across the vertical boundaries of firms. Overall, the literature suggests that the learning intention of the firm is a facilitator to successful interfirm knowledge transfer (see figure 5-1).

### ***5.2.3.3 Nature of Knowledge***

When examining interfirm knowledge transfer effectiveness, researchers also looked at the nature of the knowledge to be transferred (Wijk et al., 2008). One of the most frequently highlighted natures of knowledge is the difference between explicit and tacit knowledge (e.g. Inkpen, 1998; Simonin, 1999b; Cavusgil et al., 2003; Modi and Mabert, 2007; Becerra et al., 2008). As discussed in section 4.3.2, compared with explicit knowledge, tacit knowledge is more context specific, it is less communicable and more difficult to articulate, it is more revealed through application, and it is more embedded

in the cogitations of the individuals. Due to these characteristics, tacit knowledge is considered as more difficult to transfer (Grant and Baden-Fuller, 1995; Grant, 1996b; Modi and Mabert, 2007).

The results of prior studies generally agree upon the hindrance of tacitness to effective knowledge transfer. For instance, the empirical study of Simonin (1999b) suggested that knowledge tacitness tends to increase the knowledge ambiguity which in turn inhibits the effective interfirm knowledge transfer. Likewise, Cavusgil et al. (2003) suggested that tacit knowledge is more difficult to transfer and deploy across organizational borders. Taking the less codifiable nature of tacit knowledge into consideration, Lawson and Lorenz (1999) suggested that tacit knowledge is more difficult to transfer in the absence of labour mobility. On the other hand, Hatch and Dyer (2004) suggested that while human capital are mobile, their firm-specific knowledge comprised of both codified and tacit knowledge acquired in a specific environment are often not fully mobile, i.e. human capital is inimitable. They further comment that acquiring human capital with prior industry experience from external sources significantly reduces learning performance. Moreover, Cummings and Teng (2003) indicated that knowledge embeddedness has negative effects on the transferability of the knowledge transfer success. The study of Chen (2004) revealed that knowledge explicitness will positively affect the knowledge transfer performance of strategic alliances.

Lam (1997) showed how the degree of tacitness of knowledge held in organizations could vary considerably between firms in different societal settings. The author extended the traditional understanding of tacit knowledge by arguing that difficulties in the transfer of knowledge arise not simply from the 'tacit' nature of knowledge itself, but from differences in the degree of tacitness of knowledge and the way in which it is formed, structured and utilized between firms in different countries. Such differences are shown to have contributed to project failures, weakened the technological relationship between the partner firms over time and led to asymmetry in knowledge transfer. Overall, one could expect the effectiveness of knowledge transfer to be restricted when involving tacit knowledge rather than explicit knowledge. While the literature supports the proposition that explicit knowledge is more easily learned and transferred, tacit knowledge will normally be more sticky and difficult to be transferred.

#### ***5.2.3.4 Characteristics of Interfirm Relationships***

The knowledge-based view of the firm implies that the coordinating mechanisms of the interfirm network tend to determine the effectiveness of interfirm knowledge transfer (Grant and Baden-Fuller, 1995). The coordinating arrangement or mechanism of the interfirm network is very likely to be determined by the characteristics of relationship between firms (Grant and Baden-Fuller, 1995; Mowery et al., 1996; Zhao et al., 2005). In this sense, the relationship interface, i.e. how partner firms interact with each other, determines the success of interfirm knowledge transfer. A review of the literature suggests that prior scholars have paid much attention to the role of interfirm relationship characteristics in knowledge transfer effectiveness (see also in Wijk et al., 2008). For instance, Mowery et al. (1996) examined the effect of alliance structure. Dyer and Nobeoka (2000) discussed the role of supply network strength. Similarly, Cavusgil et al. (2003) examined the relationship between interfirm relationship strength and tacit knowledge transfer. Zhao et al. (2005) explored the role of source and recipient network characteristics in transferring R&D capabilities in international joint ventures. Hardy et al. (2003a) explored the level of involvement and embeddedness in inter-organisational collaborations and their collaborative outcomes in terms of strategy, knowledge creation, and political effects. Kotabe et al. (2003) tested the mediating effect of link duration between buyer and supplier firms. Squire et al. (2008) examined the effects of four relational properties: cooperation, trust, relationship duration, and supplier performance on the interfirm knowledge transfer in buyer-supplier relationships. Other researchers have concentrated on various aspects of the interfirm relationship but commonly emphasized the importance of relationship characteristics to the success of knowledge transfer.

Specifically, prior researchers have looked at three aspects of relationship characteristics in the empirical studies. One of the most important aspects is to do with the status of the interfirm relationship. Issues like relationship strength/closeness were emphasized. For instance, Cavusgil et al. (2003) indicated that interfirm relationship strength favours the extent of tacit knowledge transfer. Soekijad and Andriessen (2003) found that knowledge transfer will be facilitated by interfirm level factors such as relationship strength, mutual trust, need for cooperation, and shared goals. Similarly, Chen (2004) suggested that partner interaction in terms of trust and mutual adjustment have positive effects on knowledge transfer performance.

Another aspect of relationship characteristics which attracted the attention is to do with coordination mechanisms of interfirm partnerships. For example, Hamel (1991) examined the effect of transparency on the inter-partner learning process. Dyer and Nobeoka (2000) found that if the network can create strong identity and coordinating rules, an interfirm network could be more effective in creating and recombining knowledge than the firm itself. Cummings and Teng (2003) indicated that the interface between learning parties in terms of interactive and iterative communications promotes knowledge transfer success. In terms of the nature of contractual agreements, Mowery et al. (1996) found that equity joint ventures promote greater knowledge transfer than do contract-based alliances, while higher levels of transfer occur in bilateral non-equity arrangements than in unilateral contracts. The more recent study of Chen (2004) found that an equity based alliance will transfer tacit knowledge more effectively while contract-based alliances are more effective for the transfer of explicit knowledge.

Historical components of the interfirm partnership characteristics, such as prior experience and partnership duration, were also highlighted by prior researchers. Researchers have typically been interested in how the variations in the length of relationship and prior experience will affect the knowledge transfer practice (Squire et al., 2008). For example, Simonin (1999b) examined the effect of prior experience with the knowledge on knowledge transfer. Simonin (1999b) also gained evidence on the moderating effect of alliance duration on the relationship between knowledge ambiguity and knowledge transfer. Kotabe et al. (2003) found that link duration between buyer-supplier partner firms enhances the relationship between technology transfer and supplier performance improvement. Ethiraj et al. (2005) gained evidence on the contribution of learning through repeated interactions with the client over time to the development of client-specific capabilities.

#### ***5.2.3.5 Summary of the Influential Factors of Knowledge Transfer***

The above observations indicate that although some researchers may look at one or the other aspect of influential factors, there is evidence showing that different organizational factors may be interrelated. As highlighted by Eaterby-Smith and Prieto (2008), mutual interaction exists between dynamic capabilities, knowledge management and learning processes. For instance, it was found that collaborative experience may



determine the central connectivity of the firm, which in turn has positive effects on the firm's future collaborative R&D activities (Powell et al., 1996). In this sense, the historical component of the interfirm relationship may have effects on the cooperation practices at a later stage.

Moreover, Simonin (1999b) found that both voluntary and involuntary transfers of knowledge are possible in strategic alliances, which depends partly on the degree of protectiveness of the knowledge holder and on the intent of the knowledge seeker. According to Simonin (1999b), the intent is best manifested by the presence of appropriate resources allocation aimed at knowledge transfer. For instance, "low quality staff assigned to alliances or dependence on the partner for staffing will cripple any future learning attempt" (Simonin, 1999b). In this sense, the absorptive capacity of the firm tends to determine the firms' learning intention.

On the other hand, learning intention could influence the absorptive capacity of the firm instead. According to Hamel (1991), receptivity seemed to thrive as long as top management continued to express an active interest in what was being learned. Likewise, Cohen and Levinthal (1990) argued:

Absorptive capacity is more likely to be developed and maintained as a by-product of routine activity when the knowledge domain that the firm wishes to exploit is closely related to its current knowledge base. When however, a firm wishes to acquire and use knowledge that is unrelated to its ongoing activity, then the firm must dedicate effort exclusively to creating absorptive capacity. In this case absorptive capacity may not even occur to the firm as an investment alternative.

Thus, the development of absorptive capacity is largely linked with the learning intention of the firm. Calantone et al. (2002) found that a firm's learning orientation determines its innovation capability. Therefore, given that innovation itself is a learning activity, a firm's intention to learn determines its capability to generate and implement new knowledge. There is empirical evidence revealing that higher learning intention will in turn enhance the learning capacity of Japanese firms (Mody, 1993; Crossan and Inkpen, 1995). The rationale behind this is that firms tend to value learning differently, so they will employ different levels of resource and energy in learning related activities. Firms with a higher learning intention tend to have higher levels of ability to learn and will be more ready to accept external knowledge.

In addition, the characteristics of interfirm relationships also tend to affect the learning intention of the firm. As Inkpen (1998) argued, “if alliance partners are competitors or potential competitors it seems reasonable to suggest that a firm would have a limited incentive to share knowledge”. Likewise, Dyer and Singh (1998) suggested that trust-based interfirm relationship will provide partners with an appropriate incentive to share valuable knowledge with each other. For instance, lack of trust between partner firms is very likely to diminish firms’ intention to share knowledge, due to the fear that the other firm will make their core competencies obsolete. Moreover, Love et al. (2002) argued that factors such as honesty, trust, openness to new ideas, and commitment from senior management are all critical to learning culture development. Modi and Mabert (2007) concluded that mutual understanding between a firm and its supplier concerning the expected continuing business relationship would provide an incentive for the supplier to open their facilities to the scrutiny of the customer. In this sense, partner firms’ attitudes toward each other could affect their intentions to learn.

Overall, the review of previous studies on interfirm knowledge transfer and related theoretical models has shown that:

- There is generally a lack of theoretical model development when supply chain partnership is the main relationship focus;
- Most of the theoretical models do not disclose the dynamic process of knowledge transfer, and regard the knowledge transfer as a black box;
- There is a lack of comprehensive consideration of the factors that affect the interfirm transfer of knowledge;
- In particular, there is a lack of a comprehensive analysis of the characteristics of particular interfirm relationships to define the boundary of the study and form the context within which certain organizational factors are playing more important roles in determining interfirm knowledge transfer success.

Despite the fact that various organizational factors have been covered in the previous studies, when carrying out the study in the context of supply chain partnership, very few studies have paid attention to the particular characteristics of supply chain partnerships, thus few studies have provided sufficient discussion on how supply chain partnership

characteristics determine what organizational factors are more likely to affect knowledge transfer effectiveness. Given that the characteristics of a partnership tend to be determined by a unique set of factors (as shown in section 3.6), few scholars have provided a systematic understanding of multiple determinants of supply chain partnerships and their impact on knowledge transfer success. Bearing in mind that types of interfirm relationship determine the relationship factors that influence knowledge transfer, the current research attempted to unfold the supply chain partnership characteristics, and provide a more detailed analysis on how partnership characteristics could determine knowledge transfer success.

The following section concentrates on the characteristics of supply chain partnerships, and presents the main theoretical framework of the study. It concentrates on the relationship factors and the process of knowledge transfer and seeks to provide a more systematic analysis of the role of partnership characteristics. With the support of prior research findings, the theoretical model helps to develop the hypotheses to be tested in the later stage of the study.

### **5.3 Theoretical Framework of Knowledge Transfer in Supply Chain Partnership**

It was demonstrated in section 4.4 that knowledge transfer in supply chain partnerships has particular characteristics, which give rise to a number of relationship factors which determine knowledge transfer success: namely trust, commitment, interdependence, shared meaning and balanced power. To illustrate the potential influence of these factors on the process of knowledge transfer between supply chain partners as well as the potential benefits of knowledge transfer to firm performance, a theoretical framework of knowledge transfer in supply chain partnerships was established. The model attempts to provide a more holistic understanding of the nature of knowledge transfer between supply chain partners, and also paves the way for the empirical study in the later part of the research. The theoretical model is presented in figure 5-2.

Instead of looking at knowledge transfer across the network of suppliers and buyers in the supply chain, as Dyer and Nobeoka (2000) did in their work, this model depicts the knowledge transfer processes from a focal firm's perspective. This is because to

examine knowledge transfer between the focal firm and its supply chain partners will result in a more detailed understanding of the process of knowledge transfer in the supply chain. Moreover, a similar knowledge transfer process could be repeated upstream and downstream in the supply chain, so that the transfer of knowledge across the supply network is the combination of multiple bilateral knowledge transfers.

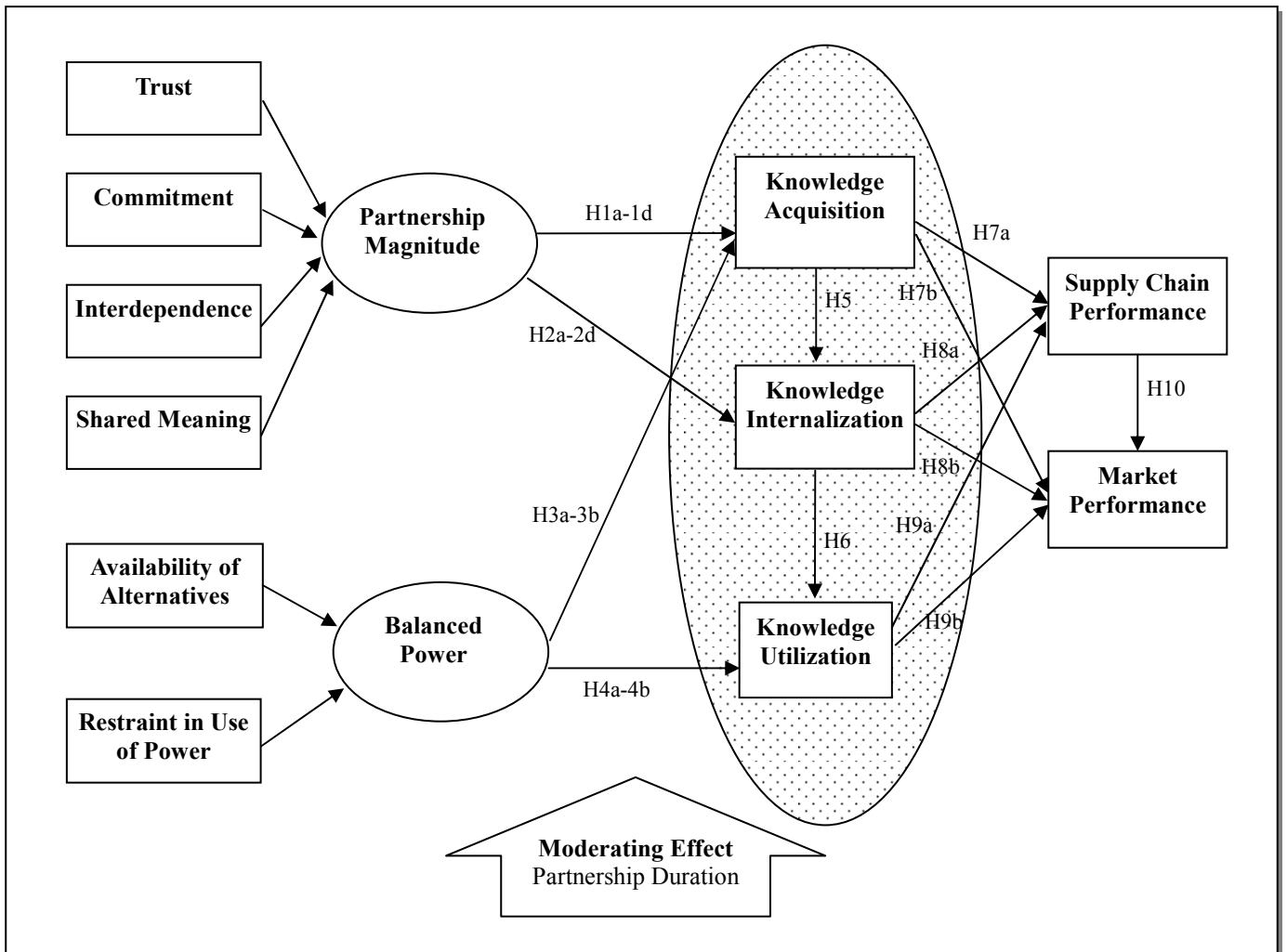


Figure 5-2 Theoretical Model of Knowledge Transfer in Supply Chain Partnership

The model illustrates the process of knowledge transfer and the influential factors that could affect the knowledge transfer processes. Based on the discussion in section 4.4, a dynamic knowledge transfer process is presented in this model, which consists of three main stages: knowledge acquisition, knowledge internalization, and knowledge utilization. Specifically, the focal firm acquires different types of knowledge held by its supply chain partner through various acquisition mechanisms. The acquired knowledge

can be absorbed and internalized in the buyer firm's internal systems or capabilities. Then, the buyer firm can apply the internalized knowledge in its production or operations process to generate performance benefits.

This theoretical model mainly focuses on the characteristics of supply chain partnership which are expected to influence knowledge transfer effectiveness. As has been discussed in section 3.6, three dimensions of factors have roles in determining the characteristics of supply chain partnerships, namely partnership strength (or magnitude), balanced power, and partnership duration. All of these factors tend to have independent but varied influence on interfirm knowledge transfer. Attributes of partnership strength (including trust, commitment, interdependence, and shared meaning) and attributes of balanced power (including restraint in the use of power and availability of alternatives) are expected to have direct effects on the knowledge transfer process. Furthermore, given that knowledge transfer is defined as a dynamic process, the model examines how the buyer-supplier relationship affects each stage of the knowledge transfer. Partnership duration is expected to have a moderating effect on supply chain knowledge transfer.

Supporting literature and the corresponding research hypotheses are presented in table 5-2. The table presents the authors, relationship focus on which the study has been conducted, type of the study, and relevant findings that support the establishment of research hypotheses. The intention of this table is to help the author to determine the possible links and causal relationships between constructs and to determine the signs of effect based on existing literature within similar research disciplines. Detailed discussion of how these factors could affect the knowledge transfer, and hence an explanation of each hypothesis contained in the model, is presented in sections 5.4 to 5.8.

Table 5-2 Research Hypotheses and Supporting Literature

Hypotheses	Author(s)	Relationship Focus	Type of Study	Relevant Findings
H1a Trust and knowledge acquisition	(Kale, Singh, & Perlmutter, 2000)	Strategic alliance	Questionnaire survey of 212 firms in multiple industries	Relational capital based on mutual trust and interaction at the individual level between alliance partners creates a basis for learning and know-how transfer across the exchange interface. Simultaneously, it curbs opportunistic behaviour of alliance partners, thus preventing the leakage of critical know-how between them.
	(McEvily et al., 2003)	Intra-organizational relationship in general	Literature review and theory development	Trust encourages knowledge sharing by increasing the disclosure of knowledge to others and by granting others access to one's own knowledge. From the knowledge sender's point of view, trust in a receiver reduces concerns about knowledge appropriation and misuse.
	(Soekijad and Andriessen, 2003)	Competitive learning alliance	Case study of 2 learning alliances	Inter-organizational conditions at alliance level, such as relationship strength, mutual trust, need for cooperation, shared goals can facilitate knowledge sharing.
	(Chen, 2004)	Strategic alliance	Questionnaire survey of 137 High-tech firms	Trust and adjustment have positive effects on knowledge transfer performance.
	(Ramasamy et al., 2006)	Interfirm relationship in general	Questionnaire survey of 215 firms in China	Results show that trust and communication are the two main channels of knowledge transfer.
	(Becerra et al., 2008)	Interfirm alliance	Questionnaire survey of 65 firms in multiple industries	The results show that the transfer of tacit versus explicit knowledge has very different trust and risk profiles. Whereas explicit knowledge is closely associated with the firm's willingness to take risk, tacit knowledge is intimately related to high trustworthiness. The results support the important role of trust and the transfer of tacit knowledge on the success of learning alliances.
H1b Commitment and knowledge acquisition	(Heide and Miner, 1992)	Buyer-supplier partnership	Questionnaire survey of 215 partner firms in manufacturing industry	Relationship extendedness and frequency of contact are associated with joint cooperation, which is indicated, by flexibility, information exchange, shared problem solving, and restraint in the use of power.
	(Dyer and Nobeoka, 2000)	Supply chain network	Case study of a automobile firm's supply chain network	Interconnected strong tie network is effective at the transfer of tacit knowledge.
	(Kale et al., 2000)	Strategic alliance	Questionnaire survey of 212 firms in multiple industries	Learning especially the acquisition of difficult to codify competencies is best achieved through wide-ranging, continuous and intense contact between individual members of the alliance partners.

	(Modi and Mabert, 2007)	Buyer-supplier relationship	Questionnaire survey of 114 firms	Firms develop suppliers with whom they expect to continue doing business should communicate that expectation to the supplier. This provides an incentive for the supplier to open their facilities to the scrutiny of the customer.
	(Krause et al., 2007)	Buyer-supplier relationship	Questionnaire survey of 370 firms in automobile and electronics industry	Commitment between the two firms is an important complementary condition to establishing performance goals, and provides value to buying firms that seek social capital accumulation with suppliers.
H1c Interdependence and knowledge acquisition	(Mowery et al., 1996)	Strategic alliance	Archival based analysis of 792 firms in multiple industries	Higher levels of knowledge transfer occur in bilateral non-equity arrangements than in unilateral contracts.
	(Dussauge et al., 2000)	Strategic alliance	Archival based analysis of 227 manufacturing firms	Link alliances (in which partners contribute differently, e.g. buyer-supplier partnership) are more likely to lead to capability transfers between partners than scale alliances (in which partners contribute similarly, e.g. joint manufacturing).
H1d Shared meaning and knowledge acquisition	(Mowery et al., 1996)	Strategic alliance	Archival based analysis of 792 firms in multiple industries	Distance, cultural differences could place obstacles to interfirm knowledge transfer.
	(Beecham and Cordey-Hayes, 1998)	Supply chain partnership	Case study of 27 automotive manufacturing firms	One of the main reasons why partnerships fail is due to managerial rather than technical reasons, i.e. inconsistent managerial attitudes toward partnership.
	(Dyer and Nobeoka, 2000)	Supply chain network	Case study of a automobile firm's supply chain network	Network can be superior to a firm as organizational learning unit, if network can create a strong identity and coordinating rules; rules are imposed to prevent knowledge hiding and free riding problem.
	(Awazu, 2004)	Interfirm relationship within global context	Literature review and propositions development	Aggregation and transfer of knowledge is useless unless sensemaking occurs. Sensemaking is preceded by schemas that are developed by common habits and shared experiments among individuals.
	(Buckley et al., 2006)	International joint venture	Multiple case study of 4 international joint ventures	Mutual trust was created based on a shared mindset for making the JV a competitive operator in the Chinese market.
H2a Trust and knowledge internalization	(Rich, 1991)	N.A	Literature review and theory development	The trustworthiness and the credibility of the data source are essential for understanding utilization.
	(Cummings and Teng, 2003)	Strategic alliance	Questionnaire survey of 69 high-tech firms	Contextual dimensions need to be aligned to facilitate knowledge transfer, while organizational distance negatively related with internalization.

	(McEvily et al., 2003)	Intra-organizational relationship in general	Literature review and theory development	Trust also reduces the screening of knowledge received from others. From the standpoint of receiver, trust affects the perceived veracity of knowledge, i.e. receiver is less likely to verify the knowledge for accuracy and is more inclined to accept the knowledge at face value.
H2b Commitment and knowledge internalization	(Dyer and Nobeoka, 2000)	Supply chain network	Case study of a automobile firm's supply chain network	Existence of relationship capital consist of trust, commitment and share goals between partners encourages firms to set up idiosyncratic knowledge-sharing routines to further facilitate the learning of specified and agreed-upon information and know-how between them.
	(Spekman, Spear, & Kamauff, 2002)	Supply chain partnership	Questionnaire survey of 160 firms in 22 supply chains	Commitment ensures longer-term interaction and continuous input from partners, so that it encourages learning between partners.
H2c Interdependence and knowledge internalization	(Dyer and Nobeoka, 2000)	Supply chain network	Case study of a automobile firm's supply chain network	Perception of interdependence fosters strong network identity, which facilitates knowledge internalization across the network.
	(Cummings and Teng, 2003)	Strategic alliance	Questionnaire survey of 69 high-tech firms	Interaction between learning parties promotes knowledge transfer success, indicated by knowledge internalization.
H2d Shared meaning and knowledge internalization	(Mowery et al., 1996)	Strategic alliance	Archival based analysis of 792 firms in multiple industries	Absorptive capacity, which is determined by the pre-alliance experience in related technological areas, influences the extent of knowledge transfer.
	(Lane and Lubatkin, 1998)	R&D alliance	Questionnaire survey of 31 alliances in biotech industry	One firm's ability to learn from another firm is argued to depend on the similarity of both firms' (1) knowledge bases, (2) organizational structures and compensation policies, and (3) dominant logics.
	(Cummings and Teng, 2003)	Strategic alliance	Questionnaire survey of 69 high-tech firms	Norm distance and knowledge distance between source and recipient of knowledge have negative influence on the transfer success, indicated by knowledge internalization.
	(Hult et al., 2004)	Supply chain partnership	Questionnaire survey of 58 supply chain in transportation industry	The study showed that information distribution activities shaped shared meaning. It concluded that shared meaning provides a common frame of reference and that it had a positive favourable relationship with the cycle time.
H3a Availability of alternatives and knowledge acquisition	(Anderson and Weitz, 1989)	Supply chain partnership	Questionnaire survey of 690 relationship dyads	When one party possesses inordinate leverage over the other, the weaker party becomes mistrustful, i.e. apprehensive about the stronger party's intentions.



	(Maloni and Benton, 2000)	Supply chain partnership	Questionnaire survey of 180 first tier suppliers of two automotive firms	Power created dependence can lead to opportunism by partners and subsequently dissolve many of the relational elements necessary for the development of effective buyer-supplier relationships.
H3b Restraint in use of power and knowledge acquisition	(Provan and Skinner, 1989)	Dealer-supplier relationship	Questionnaire survey of 226 farm and power equipment dealers	When supplier has control over dealer's decision, dealers are more likely to take opportunistic behaviour to resist.
	(Albino et al., 1999)	Regional interfirm network	Archival based analysis of a regional firm network	Leader firm could choose to control the knowledge transfer process by either promote or restrict knowledge transfer in the industrial district in particular along the supply chain.
	(Buckley et al., 2006)	International joint venture	Multiple case study of 4 international joint ventures	Personal trust can also be established from a situation where equal power sharing made personal trust essential to keep the company functioning.
	(Muthusamy et al., 2008)	Supply chain partnership	Literature review and propositions development	Reciprocal commitment, inter-organisational trust, power sharing, and socialisation are identified as essential for collaborative behaviour for successful learning and knowledge transfer between alliance partners
H4a Availability of alternatives and knowledge utilization	(Makhija and Ganesh, 1997)	Learning related Joint-venture	Literature review and propositions development	JV partner with a greater distribution of power would be more able to affect the design and use of control systems. Because control mechanisms are the means through which capabilities are transferred, partners with less bargaining power would not be assured of achieving their goals through the JV.
H4b Restraint in use of power and knowledge utilization	(Albino et al., 1999)	Regional interfirm network	Archival based analysis of a regional firm network	Leader firm could choose to control the knowledge transfer process (including application) by either promote or restrict knowledge transfer in the industrial district in particular along the supply chain.
	(Kim et al., 2004)	Industrial group	Secondary data analysis of 295 manufacturing firms	Keiretsu member firms that have stronger power in their keiretsu are likely to use their power in their favour and focus more on the growth benefits, while those that have weaker power are constrained by the keiretsu into focusing more on the profitability benefits so as to support the competitiveness of the keiretsu.
H5 Knowledge acquisition and knowledge internalization	(Huber, 1991)	Intra-firm learning	Literature review and theory development	Many organizational members and units that serve as knowledge acquirers also have as part of their role, sharing what they have acquired with other organizational components.

H6 Knowledge internalization and knowledge utilization	(Hult et al., 2004)	Supply chain partnership	Questionnaire survey of 58 supply chain in transportation industry	Knowledge acquisition activities shape information distribution activities.
	(Dyer and Hatch, 2006)	Supply chain partnership	Questionnaire survey of 42 US suppliers in auto industry	In a sample of U.S. automotive suppliers selling to both Toyota and U.S. automakers, it was found that greater knowledge sharing on the part of Toyota resulted in a faster rate of learning within the suppliers' manufacturing operations devoted to Toyota.
	(Molina et al., 2007)	Supply chain partnership	Questionnaire survey of 197 large Spanish firms	Positive relationship exists between the presence of external knowledge transfer and internal knowledge transfer.
	(Cohen and Levinthal, 1990)	Interfirm relationship in general	Archival based analysis of 1719 manufacturing organizations	While some of the external knowledge a firm acquires may be acted on immediately, it is more likely that it will have to be adapted and disseminated internally before it can be commercially utilized.
	(Lane et al., 2001)	International joint venture	Questionnaire survey of 78 firms in multiple industry	The IJV's strategy and training competence are suggested to shape its ability to apply the assimilated knowledge.
H7a Knowledge acquisition and supply chain performance	(Crossan and Berdrow, 2003)	Intra firm organizational learning	Case study of a firm in post industry	Activities associated with exploitation are well articulated and considered logical, having emerged through the processes of exploration – intuition, interpreting, integrating, and institutionalizing.
	(Wu and Hsu, 2001)	OEM subcontracting relationship	Case study of high-tech industries	Variety and quantity of knowledge acquired bring innovativeness, which would gradually transform into firm effectiveness.
	(Kotabe et al., 2003)	Supply chain partnership	Questionnaire survey in automotive manufacturing	High-level technology transfer is positively related with supplier performance improvement; link duration has positive moderating effect on the relationship between higher-level technology transfer and supplier performance improvement, but has no effect on the relationship between ordinary technical exchanges and supplier performance improvement.
	(Modi and Mabert, 2007)	Buyer-supplier relationship	Questionnaire survey of 114 firms	Collaborative inter-organizational communication is identified as important supporting factor in transforming an organization's efforts to develop suppliers into supplier performance improvements.
	(Lawson et al., 2009)	Buyer-supplier relationship	Questionnaire Survey of 111 firms	Interorganizational knowledge sharing is positively associated with supplier contribution to development outcomes, which, in turn, improves buyer product development performance.

H7b Knowledge acquisition and market performance	(Dyer and Singh, 1998)	Strategic alliance	Theoretical review	A firm's alliance partners are in many cases the most important source of new ideas and information that result in performance-enhancing technology and innovations. Alliance partners can generate rents by developing superior interfirm knowledge-sharing routines.
	(Li et al., 2006)	Supply chain partnership	Questionnaire survey of 196 firms	Supply chain management practices including information sharing with supply chain partners may directly improve an organization's competitive advantage as well as its financial and marketing performances in the long run.
	(Molina et al., 2007)	Supply chain partnership	Questionnaire survey of 197 large Spanish firms	Knowledge transfers from suppliers and customers were highly and significantly related to the firm's performance.
	(Cousins et al., 2008)	Supply chain partnership	Questionnaire survey of 142 UK firms	Socialization mechanisms fully mediate the effects of supplier performance measures (communication and operational-based) on firm performance.
	(Lawson et al., 2009)	Buyer-supplier relationship	Questionnaire Survey of 111 firms	Interorganizational knowledge sharing is positively associated with supplier contribution to development outcomes, which, in turn, improves buyer product development performance and, ultimately, financial performance.
H8a Knowledge internalization and supply chain performance	(Hult et al., 2004)	Strategic supply chain partnership	Questionnaire survey of 58 supply chain partnerships	The study showed that chains possessing more memory sought new knowledge more than chains possessing less memory. The study showed that information distribution activities shaped shared meaning. It concluded that shared meaning provides a common frame of reference and that it had a positive favourable relationship with the cycle time.
	(Hult et al., 2007)	Strategic supply chain partnership	Questionnaire survey of 201 firms	Synergies exist between a culture of competitiveness and knowledge development (knowledge acquisition, information distribution, shared meaning, and achieved memory): their interaction has a positive association with performance.
H8b Knowledge internalization and market performance	(Argote and Ingram, 2000)	Intra-organizational processes	Theoretical review	Knowledge transfer within firms could enhance competitive advantage of firms.
	(Molina et al., 2007)	Supply chain partnership	Questionnaire survey of 197 large Spanish firms	Internal knowledge transfers were highly and significantly related to the firm's performance.
H9a Knowledge utilization and supply chain performance	(Droge et al., 2003)	Supply chain relationship and intra-organizational processes	Questionnaire survey of 208 manufacturers	Adopting a knowledge-based, contingency view of the firm and assuming that strategy's locus is knowledge creation and application, a positive relationship between applied knowledge and financial performance was found. It is also found applied knowledge completely mediated the impact of context on performance.

H9b Knowledge utilization and market performance	(Teece et al., 1997)	Intra-organizational processes	Theoretical review	The competitive advantage of firms is seen as resting on distinctive processes (ways of coordinating and combining), shaped by the firm's (specific) asset positions (such as the firm's portfolio of difficult-to-trade knowledge assets and complementary assets), and the evolution path(s) it has adopted or inherited.
	(Soekijad and Andriessen, 2003)	Competitive alliances	Case study of knowledge sharing groups in alliances	Learning occurs during the application and use of knowledge, which enhances competitive advantage of firm.
	(Williams, 2007)	Interfirm relationship	Questionnaire survey of 60 firms	Firms replicate more when knowledge is discrete and adapt more when they understand the interactions between different areas of knowledge. Replication and adaptation lead to successful knowledge transfer, which leads to improved performance of the receiving unit.
H10 Supply chain performance and market performance	(Tan et al., 1998b)	Supply chain relationship	Theoretical review	The short-term objectives of SCM are primarily to increase productivity and reduce inventory and cycle time, while the long-term objectives are to increase market share and profits for all members of the supply chain.
	(Li et al., 2006)	Supply chain partnership	Questionnaire survey of 196 firms	Higher levels of SCM practice can lead to enhanced competitive advantage and improved organizational performance. Also, competitive advantage can have a direct, positive impact on organizational performance.
	(Lawson et al., 2009)	Buyer-supplier relationship	Questionnaire Survey of 111 firms	Interorganizational knowledge sharing is positively associated with supplier contribution to development outcomes, which, in turn, improves buyer product development performance, ultimately, financial performance.
H11 Moderating effect of partnership duration on the relationship between partnership strength and knowledge transfer	(Anderson and Weitz, 1989)	Conventional industrial channel dyads	Questionnaire survey of 690 dyadic relationships	The understandings that develop over time permit efficiencies in communicating, which constitute a significant experience-based asset. Older relationships appear to be more stable than newer ones. These older dyads do not seem to need high communication level, suggesting that communication efficiencies accrue over time.
	(Heide and Miner, 1992)	Purchasing relationship between industrial suppliers and OEMs	Questionnaire survey of 155 firms	Interaction over time may lead to commitment and to relationship-specific assets such as partners' knowledge of each other's procedures and values, which in turn encourage attachment.
	(Parkhe, 1993)	Strategic alliances in general	Questionnaire survey of 111 firms	Duration boost trust-willingness to take risk, and reliance on other and mutual understanding.
	(Simonin, 1999b)	Strategic alliances in high-technology industry	Questionnaire survey of 147 firms	Knowledge ambiguity is a full mediator of tacitness, prior experience, complexity, cultural distance, and organizational distance on knowledge transfer; ambiguity is negatively related with knowledge transfer; effect of

				ambiguity is moderated by the firm's level of collaborative know-how, its learning capacity, and the duration of the alliance.
	(Dyer and Nobeoka, 2000)	Supply chain partnership in automotive manufacturing sector	Case study of supply chain network of a large firm	Network can be superior to a firm as organizational learning unit, if network can create a strong identity and coordinating rules; interconnected strong tie network is effective at the transfer of tacit knowledge; it takes time for the firm to develop capabilities and processes necessary to facilitate knowledge transfer.
	(Squire et al., 2008)	Buyer-supplier relationship	Questionnaire survey of 104 manufacturing firms	In moving away from adversarial relations towards greater cooperation firms begin to forge a shared understanding through which the transfer of knowledge becomes possible. In particular, increased levels of communication and a sustained dialogue (socialization processes) are required for the transfer of tacit knowledge that cannot be shared in a codified form.
H12 Moderating effect of partnership duration on relationship between balanced power and knowledge transfer	(Inkpen and Beamish, 1997)	International Joint Ventures	Theoretical review	Knowledge acquisition by either partner has the potential to shift the balance of power that in turn could lead to the initiation of changes in the partner relationship. As the duration of an IJV increases, structural attachments will likely continue to develop.
H13 Moderating effect of partnership duration on relationship between knowledge transfer and firm performance	(Larsen, 1985)	n.a.	Observation and interview of 39 mental health centres	Information utilization takes time.
	(Kotabe et al., 2003)	Buyer-supplier partnership in automotive manufacturing	Questionnaire survey of 202 firms across two countries	Link duration has positive moderating effect on the relationship between higher-level technology transfer and supplier performance improvement, but has no effect on the relationship between ordinary technical exchanges and supplier performance improvement.

---

## **5.4 Relationship Strength and Knowledge Transfer**

Previous scholars considered relationship strength as one of the most important factors that influence knowledge transfer across firm boundaries (Wijk et al., 2008). Mowery et al. (1996) suggested that closer linkage between strategic alliance firms tends to enhance interfirm technology transfer. Kraatz (1998) suggests that strong ties are more likely to promote in-depth communications and to facilitate the exchange of detailed information between organizations. In this sense, given that effective communication is a precondition for the transfer of knowledge, firms with stronger relationships could be expected to have an intensified interface for knowledge transfer. The result of Dyer and Nobeoka's (2000) study supports the view that a strong buyer-supplier relationship is good for exploitation of existing knowledge around the supply network. The authors conclude that a stronger relationship between supply chain partners tends to encourage firms to engage in more varieties of mechanisms to transfer knowledge and best practices between themselves. Cavusgil's (2003) study provides further evidence of the positive relation between relationship strength and extent of knowledge transfer. The author argues that close relationship tends to enhance the opportunities for people in partner firms to share feelings, emotion, and collaborative experiences, and mental models through physical face-to-face contacts. Other researchers suggest that cooperation generates a reflective and mutual learning environment, encouraging the effective transfer of knowledge (Love et al., 2002). It seems obvious that closeness of interfirm relationship tends to enhance the transfer of knowledge. It is reasonable to argue that supply chain partner firms in stronger relationships tend to have more alternative and intensified ways to exchange knowledge. Nevertheless, it is still necessary to look at how various attributes of partnership strength could influence the different stages of the knowledge transfer process.

### **5.4.1 Partnership Strength Influence on Knowledge Acquisition**

With respect to knowledge acquisition, the partnership strength tends to determine the

employment of mechanisms through which buyer or supplier firms acquire knowledge from their partners. As discussed in section 3.6 a stronger relationship tends to exhibit higher levels of trust, commitment, interdependence, and shared meaning, which enhances the communication and interaction between partner firms. It is worth looking at how these attributes determine the effectiveness of knowledge acquisition.

#### ***5.4.1.1 Trust and Commitment***

Trust and commitment were commonly considered to be positively related to the interfirm knowledge transfer (e.g. Mody, 1993; Kraatz, 1998; Kale et al., 2000; Johnson and Sohi, 2003; Becerra et al., 2008). For instance, Mody (1993) argues that trust can augment the capability to search for and share new knowledge between alliance firms. Dyer and Singh (1998) suggest that trust-based interfirm relationships will provide alliance partners with an appropriate incentive to share valuable knowledge with each other. Becerra et al. (2008) gained evidence about the important role of trust and the transfer of tacit knowledge in the success of learning alliances.

Nevertheless, the non-targeted nature of knowledge transfer and more concerns over unwanted spillover involved in supply chain knowledge transfer have made trust and commitment more significant. The loosely bounded nature of supply chain partnership implies that knowledge transfer will take place more informally (Awazu, 2004). Both trust and commitment replace the functions of a written contract as key factors to secure the supply chain partnership. Although they are much less fixed in term, substantial trust and commitment are necessary to maintain the ongoing collaboration of partners.

At the stage of knowledge acquisition, a high level of trust and commitment will ensure that supply chain partners have lower concerns over knowledge leakage (McEvily et al., 2003; Inkpen and Tsang, 2005). It was found that commitment between firms is an important complementary condition to establishing performance goals, and provides value to buying firms that seek social capital accumulation with suppliers (Krause et al., 2007). Operationally, firms will be more willing to share information about future plans

and designs, competitive forces, and R&D (Anderson and Weitz, 1992). According to Kale et al. (2000) mutual interaction and trust that engender relational capital will not only enable value chain alliance partners to work more unitedly, but also facilitate an easier flow of information and skills between them. Similarly, Wu and Hsu (2001) suggested that development of mutual trust between a firm and an OEM buyer will be positively associated with the diversity and the quantity of knowledge transferred. Hence, barriers to information and knowledge access will be lowered and more forms of knowledge exchange will be allowed to take place. Therefore,

Hypothesis 1a: The level of knowledge acquisition of a focal firm from its supply chain partner is positively related to the level of trust in this supply chain partnership.

Hypothesis 1b: The level of knowledge acquisition of a focal firm from its supply chain partner is positively related to the level of commitment in this supply chain partnership.

#### ***5.4.1.2 Interdependence***

Since the vertical complementarities are the most important source of the interdependence between supply chain partners (Harland, 1996; Aulakh and Kotabe, 1997), the level of interdependence becomes a major determinant of the exchange of knowledge and information. The influence becomes even more obvious when knowledge exchange activities are not bounded by contract.

At the stage of knowledge acquisition, the more interdependent the partners are, the more necessary the exchange of information and knowledge is to the completion of value chain tasks. According to Dussauge et al. (2000) link alliances (where partners contribute differently, e.g. buyer-supplier partnership) are more likely to lead to capability transfers between partners than scale alliances (partners contribute similarly, e.g. joint manufacturing). When contributions from partner firms to the value chain process are more different, partners tend to consider each other's knowledge to be more important to



their own business. A high level of interdependence also ensures that opportunistic behaviour will be ruled out by the recognition from both sides of the importance of the other party in completing the supply chain tasks. In addition, the knowledge of mutual dependence makes the partner firms believe that they may carry on the cooperation in the future. The anticipated future interaction or extendedness will reinforce the cooperation of the partner firms (Heide and Miner, 1992). Thus, the management may regard knowledge sharing to be more beneficial than safeguarding it. Therefore,

Hypothesis 1c: The level of knowledge acquisition of a focal firm from its supply chain partner is positively related to the level of interdependence in this supply chain partnership.

#### ***5.4.1.3 Shared Meaning***

The fact that supply chain partners usually have different specializations suggests that the level of shared understanding of procedures and tasks is likely to be limited. However, shared meaning is necessary to allow knowledge transfer to occur between supply chain partners. A significant level of shared meaning ensures partner firms have a common vision of the necessity of knowledge sharing (Beecham and Cordey-Hayes, 1998), and enhances mutual trust between partners (Buckley et al., 2006), such that barriers to knowledge acquisition can be lowered. Moreover, a certain level of common language between organizations fosters the communication between individual agents such as boundary spanners (Doney and Cannon, 1997; McEvily et al., 2003). As such, the chance of grasping new knowledge by boundary spanners, who act as major knowledge acquisition agents, also increases (Awazu, 2004). Similarly, Lawson et al. (2009) suggested by providing a “common language” and creating shared understanding, socialization mechanisms facilitate the transfer of both codified and tacit knowledge across organizational boundaries. Therefore,

Hypothesis 1d: The level of knowledge acquisition of a focal firm from its supply chain partner is positively related to the level of shared meaning in this supply chain

partnership.

#### **5.4.2 Partnership Strength Influence on Knowledge Internalization**

To fully exploit the knowledge acquired from external sources, a firm has to internalize the external knowledge into its own knowledge base and procedures. At this time stronger partnership also tends to enhance a firm's ability to absorb the knowledge. In their case study of the Toyota supplier network, Dyer and Nobeoka (2000) pointed out that strong ties between Toyota and its suppliers not only facilitate the access to knowledge but also promote the internalization of the knowledge. Likewise, Cummings and Teng (2003) argued that strength of social ties, free flow of communication, consistency in administrative controls and level of trust between source and recipient of knowledge tend to be positively associated with knowledge internalization. Therefore, under stronger supply chain partnership, new knowledge is more likely to be diffused, so firms will be likely to have more opportunities to internalize and adopt more knowledge acquired from external sources.

##### ***5.4.2.1 Trust and Commitment***

At the stage of knowledge internalization, trust and commitment between supply chain partners are necessary to build the confidence of management about the source and value of knowledge acquired. Dyer and Nobeoka (2000), for example, found that Toyota not only promotes activities to help its suppliers to access the new knowledge, but also provide in-depth means of assistance to help its suppliers to actually adopt the new knowledge into their own systems. A stronger relationship based on trust and commitment will facilitate partner firms' investment in more knowledge transfer activities (Dyer and Nobeoka, 2000), which in turn will facilitate internalization of knowledge (Cummings and Teng, 2003). Cummings and Teng (2003) argued that level of trust between source and recipient of knowledge was positively associated with knowledge transfer success indicated by knowledge internalization. In a committed relationship, which is prolonged and more stable, individuals are more willing to

maintain a working relationship or interaction with the knowledge and are willing to put in extra effort to work with the knowledge (Mowday et al., 1979). Consequently, a higher extent of acquired knowledge will be absorbed into the existing system. Therefore,

Hypothesis 2a: The level of a focal firm's internalization of knowledge which is acquired from its supply chain partner is positively related to the level of trust in this supply chain partnership.

Hypothesis 2b: The level of a focal firm's internalization of knowledge which is acquired from its supply chain partner is positively related to the level of commitment in this supply chain partnership.

#### ***5.4.2.2 Interdependence***

At the internalization stage, the level of interdependence between supply chain partners also has potential influence. A higher level of interdependence means that partner firms need more coordination or ongoing adjustment (Beecham and Cordey-Hayes, 1998; Handfield et al., 1999; Dyer and Nobeoka, 2000). Such interaction between learning parties is found to promote internalization of knowledge (Cummings and Teng, 2003). Moreover, a higher level of interdependence due to functional complementarities implies that knowledge from the partner firm tends to have higher marginal value to the recipient firm (Ethiraj et al., 2005). When the perceived value of new knowledge is high, knowledge commitment will be developed among individuals in the recipient firm (Leonard-Barton, 1995). Such commitment to new knowledge promotes more effort to work with and absorb new knowledge. Therefore,

Hypothesis 2c: The level of a focal firm's internalization of knowledge which is acquired from its supply chain partner is positively related to the level of interdependence in this supply chain partnership.

#### ***5.4.2.3 Shared Meaning***

At the internalization stage, the presence of shared meaning reduces the uncertainty and ambiguity involved in learning external knowledge. According to Cummings and Teng (2003) a lower level of norm distance and knowledge distance not only increases the level of knowledge commitment among individuals, but also facilitates knowledge satisfaction, which can reduce the recipient's stress and resistance levels in adapting and using the knowledge (Leonard-Barton and Deschamps, 1988), as well as reduce the likelihood of the not-invented-here syndrome occurring (Katz and Allen, 1982; Menon and Pfeffer, 2003). Moreover, absorptive capacity is a function of prior experience (Mowery et al., 1996), thus the higher level of previously built common understanding to tasks and procedures also increases the level of absorptive capacity of the recipient firm. Therefore,

Hypothesis 2d: The level of a focal firm's internalization of knowledge which is acquired from its supply chain partner is positively related to the level of shared meaning in this supply chain partnership.

### **5.5 Balanced Power and Knowledge Transfer**

Albino et al. (1999) suggested that the leader firm in an industrial district, which tends to have larger power, can also affect the knowledge transfer between buyer-supplier firms, in that the leader firm can affect the structure of interfirm relationships, and use knowledge transfer as a tool to reinforce interfirm relationships. According to Albino et al. (1999), the district leader firm can reduce the number of possible knowledge transfer channels, creating a taller hierarchy in their supply relationships, so that the power will affect the way that knowledge transfer is practised. As noted by Beecham and Cordey-Hayes (Beecham and Cordey-Hayes, 1998), balanced power tends to enhance interfirm partnership. Failure of technology partnering could be because of the unbalanced power in the relationship (Beecham and Cordey-Hayes, 1998). It seems reasonable to argue that balanced power in the supply chain partnership would tend to

enhance the effectiveness of knowledge transfer. However, as revealed by previous studies, unbalanced power can sometimes also promote the transfer of knowledge across firm boundaries (Dyer and Nobeoka, 2000). Although the role of relative power is an important factor to be considered in understanding the nature of interfirm knowledge transfer, previous researchers did not provide sufficient and consistent empirical evidence on how the power relationship can affect knowledge transfer between partner firms. Obviously, the influence of balanced power is a complicated issue, which needed to be addressed in the current research.

### **5.5.1 Influence of Balanced Power on Knowledge Acquisition**

In an asymmetric supply chain partnership, exploitation rather than cooperation plays a more important role, such that reciprocal knowledge transfer may be limited (Maloni and Benton, 2000). The supply chain partnership becomes vulnerable, especially when there is no explicit contract or the contract is loosely defined, since there is more chance for the more powerful party to exploit the less powerful one. The more powerful partner could be more capable of restricting the flow of knowledge to protect its core proprietary assets or market position. Similarly, it may request more knowledge contribution from the less powerful party (e.g. Albino et al., 1999). On the other hand, the protectiveness of the weaker party may limit the exposing of valuable information to the more powerful party to avoid exploitation and making itself obsolete (Anderson and Weitz, 1989; Provan and Skinner, 1989). In some cases, the less powerful party may be ignored for valuable knowledge exchange, due to the lack of recognition of its knowledge and information (Beecham and Cordey-Hayes, 1998). However, it could be argued that where there is more balanced power, partners are more likely to be open with each other, as the fear of obsolescence could be lower. Therefore,

Hypothesis 3a: The level of knowledge acquisition of a focal firm from its supply chain partner is positively related to the availability of alternatives in their supply chain partnership.

In reality a perfectly balanced relationship is often very rare. There are always cases where one partner is more influential than the other. Whether or not the relationship is of a dominant nature, also depends on how the powerful partner intends to use its power. It is suggested that different levels of intention to use power may contribute to different levels of technology partnering between supplier and buyer from “uninvolved” to “integrated” (Beecham and Cordey-Hayes, 1998). For example, in the case of Toyota’s knowledge transfer with its suppliers (Dyer and Nobeoka, 2000), the powerful position of Toyota against its suppliers tends to have a positive impact on effective knowledge transfer. This is because Toyota can place sanctions on its suppliers to prevent the “free rider” problem. Toyota could also act as a leader firm to promote knowledge transfer practices among its suppliers, to ensure the knowledge is diffused and applied by its suppliers effectively. In this sense the use of power in a healthy way, or restraint in excessive power use will facilitate knowledge sharing between firms. Buckley et al. (2006) gained evidence from international joint ventures in China that personal trust can also be established from a situation where equal power sharing between parent companies made personal trust essential to keep the company functioning. Similarly, Muthusamy (2008) found that power sharing between alliance partners is essential for successful learning and interfirm knowledge transfer. Therefore,

Hypothesis 3b: The level of knowledge acquisition of a focal firm from its supply chain partner is positively related to the restraint in use of power in their supply chain partnership.

### **5.5.2 Influence of Balanced Power on Knowledge Utilization**

When there is presence of a power imbalance, the more powerful partner may have a high propensity to convert the potential power into actual power and to produce changes in favour of itself (Ramsay, 1996). Where one partner dominates the relationship, the activities of a weaker partner are more likely to be constrained in favour of the stronger party (Albino et al., 1999; Kim et al., 2004). Hence, knowledge utilization of the weaker

partner will be more passive and constrained, and the learning goals of the weaker partner may not be assured (Makhija and Ganesh, 1997). Consequently, the weaker party may not voluntarily implement the new practices which are only beneficial to the counterpart, or even have the intention to resist the allocated new practices to avoid being overly dependent. On the other hand, when there is a balanced distribution of influence between partners, the utilization of knowledge is also expected to be more balanced between partners. Therefore,

Hypothesis 4a: The level of a focal firm's utilization of knowledge which is acquired from its supply chain partner is positively related to the availability of alternatives in the supply chain partnership.

When a powerful partner uses its influence in its own favour, it is also likely that the activities of weaker partners will be restricted to certain goals (Kim et al., 2004). Likewise, even if the utilization of knowledge has potential benefits for the partner firms, it is likely that firms may not have resources or freedom to do so (Albino et al., 1999). On the contrary, when the more powerful partner restricts its use of power or uses the power in a more catalytic way, the power differences can be neutralized or changed into a more favourable form (Yilmaz et al., 2005b). For instance, Dyer and Nobeoka (2000) demonstrated where a strong partner was not using power to exploit others, but to create appropriate routines and climate to exchange and apply beneficial knowledge. Therefore,

Hypothesis 4b: The level of a focal firm's utilization of knowledge which is acquired from its supply chain partner is positively related to the restraint in use of power in the supply chain partnership.

## **5.6 Interrelationship between the Knowledge Transfer Stages**

As mentioned in section 4.4, acquisition, internalization, and utilization of knowledge are

sequential processes with lag between each stage. Although the three stages of knowledge transfer forms a continuous process, each stage is considered to be distinct in terms of learning related activities.

Vertical complementarities between supply chain partners suggest that knowledge from the partner contains higher marginal value to the firm (Ethiraj et al., 2005). Concerns over information overload will be less significant (Hult et al., 2004). As Huber (1991) suggested, organizational members and units that serve as knowledge acquirers also have as part of their role, sharing what they have acquired with other organizational components. Based on a sample of U.S. automotive suppliers selling to both Toyota and U.S. automakers, Dyer and Hatch (2006) found that greater knowledge sharing on the part of Toyota resulted in a faster rate of learning within the suppliers' manufacturing operations devoted to Toyota. Consistently, Molina et al. (2007) argued that once the organization has applied resources to achieve the transfer of useful knowledge from suppliers and customers, this knowledge has a lower internal transfer cost than the cost incurred for its external transfer. Therefore, as new knowledge has been acquired from the supply chain partner, some (if not all) of the valuable knowledge can be disseminated internally within the firm. In this sense, the amount of knowledge internalized by the firm largely depends on the amount of knowledge the firm has acquired from the supply chain partner. Therefore,

Hypothesis 5: The level of a focal firm's internalization of knowledge which is acquired from its supply chain partner is positively related to the level of its knowledge acquisition activities.

Secondly, according to Cohen and Levinthal (1990), although some of the external knowledge a firm acquires may be acted on immediately, it is more likely that it will be adopted and disseminated internally before it can be commercially utilized. Thus, the extent of knowledge that the firm could use depends upon the extent of knowledge it has



absorbed. The absorptive capacity of the firm also shapes the application of external knowledge (Lane et al., 2001). How well the firm is able to internalize external knowledge will affect its capability to utilize the knowledge. Therefore,

Hypothesis 6: The level of a focal firm's utilization of knowledge which is acquired from its supply chain partner is positively related to the extent of its knowledge internalization activities.

## **5.7 Knowledge Transfer and Performance Improvement**

As discussed in section 4.4.7, effective knowledge transfer can benefit firms both tangibly and intangibly. Nevertheless, the essential goal of knowledge transfer practice is to improve the performance of the firm. Given that knowledge transfer in supply chain partnership involves several stages, it is important to see how each stage of knowledge transfer will influence the improvement in supply chain performance as well as business performance of the partner.

### **5.7.1 Knowledge Acquisition and Performance Improvement**

Prior researchers commonly agree that acquisition of external knowledge is beneficial to the performance of firms (Calantone et al., 2002; Cavusgil et al., 2003; Modi and Mabert, 2007; Molina et al., 2007; Lawson et al., 2009). Wu and Hsu (2001) suggested that the variety and quantity of knowledge acquired brings innovativeness, which will gradually transform into firm effectiveness. Technical and technology transfer was found to benefit the supplier performance (Kotabe et al., 2003). For supply chain firms, knowledge acquired from supply chain partners is expected to bring in operational best practices which the focal firm may not previously have encountered. The supply chain operational efficiency is therefore likely to be improved through active learning and knowledge sharing activities. Moreover, knowledge acquisition activities themselves are expected to generate some "dynamic learning capabilities" (Dyer and Nobeoka, 2000) or "client-specific capabilities" (Ethiraj et al., 2005). Such capabilities make the firm have

the potential to improve supply chain performance in the long term. Therefore,

Hypothesis 7a: The supply chain performance of a focal firm is positively related to the level of knowledge acquisition from its supply chain partners.

Getting access to the supply chain partner's knowledge and best practices ensures that the focal firm will obtain new ideas and valuable know-how, which are very likely to result in performance-enhancing technology and innovations (Dyer and Singh, 1998). In the long term, such innovation and technologies will enable firms to gain market competitiveness (Li et al., 2006). Molina et al., (2007) concluded that, within the context of Spanish supply chain partnerships, knowledge transfers from suppliers and customers were highly and significantly related to the firm's performance. Cousins et al. (2008) provided evidence that socialization practices allow buyer and supplier firms to establish common norms, and inter-personal linkages, which facilitate joint problem solving and informal integration, and in turn, lead to improved business performance. Moreover, Lawson et al., (2009) suggested that inter-organizational knowledge sharing is positively associated with supplier contribution to development outcomes, which, in turn, improves buyer product development performance, and ultimately, financial performance. Therefore,

Hypothesis 7b: The market performance of a focal firm is positively related to the level of knowledge acquisition from its supply chain partners.

### **5.7.2 Knowledge Internalization and Performance Improvement**

Obviously, effective internalization of external knowledge enriches a focal firm's knowledge base, which is ready to be deployed by the firm. Moreover, successful internalization also facilitates the development of shared meaning between supply chain partners (Hult et al., 2004). It is, therefore, reasonable to propose that higher levels of shared meaning harmonize the cooperation between supply chain firms and consequently

improves supply chain efficiency. The empirical study of Hult et al. (2007) suggested that the interaction between a culture of competitiveness and knowledge development (as indicated by knowledge acquisition, information distribution, shared meaning, and achieved memory) has a positive association with cycle time performance of the firm. Therefore,

Hypothesis 8a: The supply chain performance of a focal firm is positively related to the level of internalization of knowledge acquired from its supply chain partners.

Previous study suggested that internal knowledge transfers were highly and significantly related to the firm's performance (Molina et al., 2007). According to Argote and Ingram (2000), knowledge can be embedded in basic elements of the organization, i.e., members, tools, and tasks, as well as in various sub-networks formed by combining or crossing the basic elements. Firms can vary in possession of knowledge resources, which contribute to the differing performance of the firm (Spender and Grant, 1996). It is believed that the extent of embedded knowledge within the organization determines the competitive advantage of firms (Argote and Ingram, 2000). Therefore,

Hypothesis 8b: The market performance of a focal firm is positively related to the level of internalization of knowledge acquired from its supply chain partners.

### **5.7.3 Knowledge Utilization and Performance Improvement**

The resource-based view of the firm has highlighted the importance of a firm's effective deployment of resources in gaining competitive advantage (Barney, 1991). According to Grant (1996a), the firm is a knowledge creation/application organization that integrates explicit or implicit knowledge through products, processes, or routines. Thus, it is expected that the acquired supply chain knowledge will be used directly in improving the effectiveness and efficiency of supply chain processes which enhance the competitive advantage of the firm in the long term (Droge et al., 2003). Therefore,

Hypothesis 9a: The supply chain performance of a focal firm is positively related to the level of utilization of knowledge acquired from its supply chain partners.

The resource-base view of the firm (Barney, 1996) and the knowledge-based view of the firm (Grant, 1996b) regard inimitable organizational knowledge as a key resource to the competitive advantage of the firm. According to Teece et al. (1997) the competitive advantage of firms is seen as resting on distinctive processes (ways of coordinating and combining), shaped by the firm's (specific) asset positions (such as the firm's portfolio of difficult-to-trade knowledge assets and complementary assets), and the evolution path(s) it has adopted or inherited. Although possession of knowledge is believed to contribute to the different performance of firms, differences in the deployment of knowledge resource is also believed to differentiate the performance of firms (Argote and Ingram, 2000). Williams (2007) found that replication and adaptation of knowledge lead to successful knowledge transfer, which leads to improved performance of the receiving unit. Thus, whether a firm will be able to deploy knowledge effectively and make the best use of knowledge will to an extent explain the varied market performance of firms. Therefore,

Hypothesis 9b: The market performance of a focal firm is positively related to the level of utilization of knowledge acquired from its supply chain partners.

#### **5.7.4 Relationship between Supply Chain Performance and Market Performance**

Ho et al. (2002) acknowledged that supply chain management initiatives should ultimately lead to the enhanced supply chain performance of the firm. Nevertheless, the essential goal of any supply chain management activity is to enhance competitive advantage and the business performance of the firm (Bowersox et al., 2002). It has been mentioned in section 2.4.1 that the short-term goals of supply chain management practices are to achieve operational efficiencies, for example in terms of productivity, inventory levels and cycle time. These objectives are actually means to achieve

long-term performance objectives, for example in terms of market share and financial performance (Tan et al., 1998b). Evidence has been gained that supply chain management practices actually benefit the competitive advantage of the firm and also the market performance of the firm (Li et al., 2006). The study of Lawson et al. (2009) on knowledge transfer in buyer-supplier relationships also suggested the positive association between buyer product development performance and the higher levels of financial performance. Therefore,

Hypothesis 10: The market performance of a focal firm is positively related to the level of supply chain performance of this firm.

## **5.8 Moderating Effects of Partnership Duration**

Strong partnership between supply chain firms is by no means an automatic result of cooperation initiatives. It takes time for partners to harmonize the relationship, and build up the common language. The understandings that develop over time permit efficiencies in communicating, which constitute a significant experience-based asset (Anderson and Weitz, 1989). Interaction over time may lead to commitment and to relationship-specific assets such as partners' knowledge of each other's procedures and values, which in turn encourage attachment (Heide and Miner, 1992). According to Simonin (1999b), as firms' alliances are sustained over time, distance decreases, trust intensifies, attachment between partners develops and the partners become more familiar with each other's expertise and idiosyncrasies. Elements of a strong relationship actually build up through repeated successful cooperation between partners.

Previous studies generally support the view that longer partnership will enhance the interfirm learning activities. For instance, Love and Gunasekaran (1999) argue that short-term alliances tend to inhibit learning, so that long-term alliances are needed to stimulate learning. According to Simonin (1999b) ambiguity is negatively related with knowledge transfer; and the effect of ambiguity is moderated by the firm's level of

collaborative know-how, its learning capacity, and the duration of the alliance. Ambiguity declines in longer alliances and knowledge transfer become easier. The empirical study of Kotabe et al. (2003) revealed that relationship duration between buyers and supplier tends to enhance the transfer of higher-level technological capabilities. Other researchers highlighted the role of collaborative experience in interfirm knowledge transfer, which is enhanced as the relationship continues. Simonin (1997) argues that collaborative experience that is growing over time tends to enhance the collaborative know-how of the firm, which determines the performance of interfirm collaboration and the learning capacity of the firm. The empirical study of Cavusgil (2003) supports the view that collaborative experience is positively related to tacit knowledge transfer. Overall, a higher extent of knowledge transfer between partners is expected in a more mature partnership.

Specifically, Powell et al. (1996) argued that experience with collaborative networks proves a fertile ground for both further formal partnerships and an expanding array of informal relationships. Moreover, Mody (1993) suggested that past experience and a history of the network have influence on contractual forms in firm alliances, which tend to affect the interaction between firms and the way firms acquire knowledge from others. Dyer and Nobeoka's (2000) study of Toyota also showed that the network identity and knowledge transfer mechanisms built up over a certain period of time, before its supplier could effectively acquire knowledge from other partner firms. In this sense, as the relationship lasts longer, partner firms tend to establish more intensified mechanisms to acquire knowledge, which tend to result in a greater extent of knowledge being acquired.

Similarly, as the relationship continues over time, supply chain firms tend to gain more experience of interacting with their partners and absorbing knowledge acquired from external sources (Kale et al., 2000). To internalize knowledge more fully, firms need to assess their acquired knowledge to ensure valuable knowledge is being adapted. Therefore, as the partnership lasts longer, supply chain partners will have more opportunities to continuously assess and adjust their learning behaviour and be able to

institutionalize more knowledge (Levinson and Asahi, 1996).

When a firm has a durable partnership with its supplier or buyer, it tends to have more opportunities to implement external knowledge in its operations. Given a sufficient relationship duration with its partners, the firm will be able to access more external knowledge. Moreover, the firm will also be able to assess its learning activities and adjust its existing behaviour to use the new knowledge (Levinson and Asahi, 1996). The firm will also have enough time to recombine existing knowledge with new knowledge to generate new applications (Kogut and Zander, 1992). The evidence, therefore, suggests that a long lasting partnership will allow the firm to utilize external knowledge more effectively and extensively. Based on the above considerations:

Hypothesis 11: The longer the partnership duration, the stronger the relationship between partnership magnitude and knowledge transfer of a focal firm.

Similar to the effect on the partnership magnitude, continued relationship also has effects on the balanced of power between partners. According to Inkpen and Beamish (1997), knowledge acquisition by either partner has the potential to shift the balance of power which in turn can lead to the initiation of changes in the partner relationship. Taking international joint ventures as an example, the authors suggest that as the duration of an IJV increases, structural attachments are more likely to continue to develop. Distribution of power could migrate from one partner to another, or the intention of power use will be changed. According to Heide and Miner (1992), firms can be either cooperators or defectors, and it takes time for partners to find out which is which. For instance, an initially unbalanced relationship can be moderated due to concerns over mutual benefits, which encourages the stronger party to restrain its power use. On the other hand, for partnership established by counterparts with equal influence, over time the relationship becomes asymmetric due to uneven knowledge contributions by the partners or disparities in interfirm learning (Mohr and Sengupta, 2002). In the current research it is interesting to find out how partnership duration moderates the influence of balanced

power on knowledge transfer. Therefore, the following hypothesis is developed.

Hypothesis 12: The longer the partnership duration, the stronger the relationship between balanced power in a supply chain partnership and the knowledge transfer of a focal firm.

As Crossan and Inkpen (1995) pointed out, learning is an incremental process. It takes time for organizations to build up appropriate mechanisms to transfer knowledge. It also takes time to put acquired knowledge into applications to generate expected outcomes (Larsen, 1985). Even if the new knowledge is put into application very quickly, there will be a time lag for results to be observed. According to Kotabe et al. (2003) link duration has a positive moderating effect on the relationship between higher-level technology transfer and supplier performance improvement. In another word, the longer the partnership duration, the stronger the positive effect of technology transfer on supplier performance improvement. Similarly, it also takes time for the positive influence of interfirm knowledge transfer on market performance to take effect. Therefore,

Hypothesis 13: The longer the partnership duration, the stronger the relationship between the knowledge transfer of a focal firm and its performance.

## **5.9 Summary**

Based on the review of previous studies of interfirm knowledge transfer, this chapter establishes the main theoretical framework and the research hypotheses. The influential factors of knowledge transfer which have been covered by prior researchers, including characteristics of interfirm relationship, nature of knowledge, absorptive capacity, and learning intention, were reviewed. Given that supply chain partnership tends to be determined by relationship magnitude, balanced power relationship, and partnership duration, the effects of these relationship factors on different stages of knowledge transfer were examined. Moreover, the effects of knowledge transfer on supply chain



performance as well as market performance of the focal firm were examined. The development of all the research propositions was based on prior related studies. This practice was followed to generate more plausible and more relevant research hypotheses, the testing of which is discussed in later chapters (Chapters 9 and 10).

## **CHAPTER 6 RESEARCH METHODOLOGY**

### **6.1 Preamble**

An appropriate research methodology is the key to answering the research questions and achieving the research objectives. This chapter presents the research methodology that was followed in this research. A careful design of research methodology is essential to serve as a guideline for the conduct of the whole study. In this chapter, the decision on the main methodological approach is discussed. The research strategies and initial design of the fieldwork are introduced. Moreover, issues about general research design, validity, and reliability are addressed. Lastly, some ethical issues that needed to be considered are discussed.

### **6.2 Methodological Approach**

According to Hughes (2003), methodology refers to the approach or paradigm that underpins the research. However, given that there are multiple research methodologies being used in business and management studies, the choice of research methodology in the current research needed to be justified. The discussion in this chapter concentrates on two of the social research methodologies that are most relevant to this research, namely positivism and post-positivism.

#### **6.2.1 Positivism vs. Post-positivism**

Positivism, which is referred to by Robson (2002, p.19) as the “standard view” of science, is backed by the assumption that there is an objective truth existing in the world which can be revealed through the scientific methods where the focus is on measuring relationships between variables systematically and statistically (Cassell and Symon, 1994). According to positivism, the world and the universe are deterministic - they operate by laws of cause and effect that we can discern if we apply the unique approach

of the scientific method (Trochim, 2000). Science is to develop universal causal laws through finding “constant conjunctions” of events (Robson, 2002, p.20). Positivist research generally has explanation as the central aim (Robson, 2002, p.20), in the following sense: to explain, one should be able to relate an event, observation, or phenomenon to a “covering law”. The “covering law”, therefore, can make predictions. According to positivism, facts can only be gained from direct experience, so that the unobservable is rejected (Robson, 2002, p.21). All scientific propositions are founded on facts, thus hypotheses are tested against facts (Robson, 2002, p.20). The purpose of science is simply to stick to what we can observe and measure (Trochim, 2000). In the positivist view, scientific investigation is value-free, in that the researchers are objective analysts, coolly making detached interpretations about those data that have been collected in an apparently value free manner (Saunders et al., 2000).

However, given the natural science background of positivist methodology, the appropriateness of positivism for research in social science has been critiqued (Robson, 2002). The researchers’ values and perspectives cannot be excluded from the research, as researchers’ perception and meanings penetrate the research process in many ways (Hughes, 2003). Furthermore, as Robson (2002, p.23) mentioned, the methods in natural science are not appropriate to social research, as people are not natural elements but social persons and acting individuals with their own wishes, perceptions and interests. In the positivist view, respondents are treated as *objects* and as producers of data. But social sciences are different from natural science, respondents are partners and “experts” whose views are sought (Robson, 2002, p.23).

Post-positivists recognize the critiques of positivism and advocate that the theories, hypotheses, background knowledge and values of researchers can influence what is observed (Robson, 2002). The post-positivist believes that all observations are theory-laden and that scientists (and everyone else, for that matter) are inherently “biased” by their cultural experiences, world views, and so on (Trochim, 2000). Post-positivists believe that a reality does exist, but advocate that it can be known only

imperfectly and probabilistically because of the researcher's limitations. Post-positivists therefore recognize that all observation is fallible and that all theory is revisable (Trochim, 2000). Because all measurement is fallible, the post-positivist emphasizes the importance of multiple measures and observations, each of which may possess different types of error, and the need to use *triangulation* across these multiple sources to try to get a better understanding of what's happening in reality (Trochim, 2000). In the post-positivist view, perfect objectivity can never be achieved, but can be approached or approximated by doing research within the context of a broader contentious community of truth-seekers (including other scientists) who criticize each other's work.

### **6.2.2 Adopting Post-positivism as the Methodology**

It will be remembered that this research aims to explore the current practices of knowledge transfer by supply chain partners, and to find out the mechanisms of knowledge transfer in supply chain partnerships, and the impact of relationship factors on the interfirm knowledge transfer between supply chain partners. Post-positivism is found to be a suitable methodology in answering the research questions. Compared to positivism, post-positivism has the following advantages, which could justify its appropriateness to this research.

First of all, to carry out the research in a positivist perspective, the researcher needs to collect data in a value-free manner and objectively interpret those data. However, as this research may involve a great amount of analysis on knowledge transfer activities, which could be quite implicit and embedded in the social context in which knowledge is being transferred, purely objective data collection and interpretation may be impossible. On the other hand, the post-positivist methodology admits the importance of the value and perception of researchers in the research process. According to Buchanan and Bryman (2007) the choice of research methods, although shaped by aims, epistemological concerns, and norms of practice, is also influenced by organizational, historical, political, ethical, evidential, and personal factors, and these factors constitute a system of

inevitable influences. This contextualization of methods choice has three implications:

First, it is difficult to argue that methods choice depends exclusively on links to research aims; choice involves a more complex, interdependent set of considerations. Second, it is difficult to view method as merely a technique for snapping reality into focus; choices of method frame the data windows through which phenomena are observed, influencing interpretative schemas and theoretical development. Third, research competence thus involves addressing coherently the organizational, historical, political, ethical, evidential, and personal factors relevant to an investigation. (Buchanan and Bryman, 2007)

The perception and value of the researcher within the social context will certainly be involved when the researcher attempts to interpret issues such as explicit and tacit knowledge transfer activities, and the benefits of knowledge transfer.

Second, the post-positivist view admits that observations are theory-laden rather than simply “factual”, such that existing theories may influence what is being observed. Given that there is a paucity of existing examinations of knowledge transfer in supply chain partnerships, the current research needs to extend the theories of interfirm knowledge transfer into the context of supply chain partnership. Therefore, the way the researcher is generating the hypotheses and collecting the data is largely affected by the existing theories. In this sense, post-positivism is more appropriate to underpin the data collection of this research.

Third, the positivist view highlights science’s function to reveal law-like generalizations from observations. As this research is based on the analysis of knowledge transfer practice in a certain social context – supply chain partnership – the research may result in context specific theories but not universal causal laws. Therefore, the post-positivist perspective is considered to be more suitable to the current research purposes.

Fourth, given that the post-positivist view legitimates the use of multiple observations and measurements to improve the quality of data collection, this methodology may

benefit the current research through generating a more holistic analysis of knowledge transfer in the supply chain partnership, and may thus be more appropriate in answering the designated research questions. For the above reasons, this research will rely on post-positivism as the main methodology to guide the research process.

## **6.3 Research Design**

Before deciding on the research strategy, researchers need to be careful about the relationship between research strategy, research methods, and the research question. The tension between these issues needs to be handled in a consistent and systematic manner. According to Robson (2002, p. 80), “The general principle is that the research strategy or strategies, and the methods or techniques employed, must be appropriate for the questions you want to answer”. This research acknowledged Robson’s (2002) principle and sought to design the research in a way that fitted the research methods as well as research strategy to the research purpose and the research questions to be answered.

### **6.3.1 Research Purpose**

This research has both explanatory and exploratory purposes. According to Robson (2002, p.59) explanatory research has the following characteristics: (1) it is to seek an explanation for a situation or problem, traditionally but not necessarily in the form of causal relationships; (2) it explains patterns relating to the phenomenon being researched; (3) it is to identify relationships between aspects of the phenomenon. This research had an explanatory purpose since it sought to examine the relationship between supply chain partnership characteristics, interfirm knowledge transfer, and firm performance. The author wanted to find out how these constructs relate to each other.

Nevertheless, this research was not purely explanatory, because it also sought to have new insights about knowledge transfer using supply chain partnerships as the main conduit. Exploratory research is mainly used when research is to find out what is happening, particularly in little-understood situations - to seek new insights; to assess

phenomena in a new light, and to generate ideas and hypothesis for future research (Robson, 2002, p.59). Given that limited prior research was conducted systematically on issues of knowledge transfer between supply chain partners, the current research sought to find out more about the particular characteristics of knowledge transfer in supply chain partnerships. Using prior research in other interfirm relationship contexts as benchmarks, it also sought to explore the alternative mechanisms and influential factors of knowledge transfer in supply chain partnerships as compared to knowledge transfer in other interfirm contexts.

### **6.3.2 Fixed Design Strategy**

The current research followed fixed design as the main research strategy, which means that a substantial amount of pre-specification about the purpose and content of the research and proposed method should take place before the researcher undertakes the main part of the research study (Anastas and MacDonald, 1994). Robson (2002) highlighted the notions of fixed design and flexible design as alternative classification criteria of research strategy to quantitative and qualitative research. According to Robson (2002, p.96), the fixed design is “theory driven” in that the researcher should develop a conceptual framework or theory in advance of the research process. Thus researchers are supposed to have a substantial amount of conceptual understanding about a phenomenon before the fieldwork. On the other hand, flexible design is much less pre-specified, in that it evolves, develops and unfolds as the research proceeds (Robson, 2002, p.5).

In the current research, fixed design was employed to test the conceptual framework developed based on an extensive review of literature. The theoretical framework developed earlier was used to guide the data collection, and the data collected was used in turn to examine the relationship presented in the theoretical framework. Thus, this study also had a deductive nature to test the conceptual framework. The author sought to generate reasonable explanations as to the mechanism and the factors influencing knowledge transfer in supply chain partnerships. This formed the basis of implications

for practitioners and academic researchers to gain a better understanding of current knowledge transfer practices and to seek ways to improve current practice.

However, using fixed design as the main research strategy does not exclude the feasibility of following a more flexible approach in the earlier stages of a study (Robson, 2002, p.87). As knowledge transfer practices may be embedded in the daily transactions between supply chain partners, there might be more complex issues involved in the real supply chain beyond what the literature could possibly reveal. Qualitative data collection methods such as in-depth interviews have the benefit of getting more fruitful information. Hence, in-depth interviews were used to identify the main barriers to knowledge transfer in supply chain partnerships (as discussed in section 4.4). This contributed to the understanding of types of knowledge being transferred, mechanisms of interfirm knowledge transfer, potential influential factors, and what benefits or outcomes knowledge transfer could bring to them. The interview data was used to verify and improve the building of the theoretical framework. Although the qualitative data was not used to a great extent, it was still essential to help the author to gain some enriched understanding of reality and to improve the development of the theoretical framework.

### **6.3.3 Fitting Research Methods to Research Questions**

According to Robson (2002), before the data collection method is decided, the researcher needs to evaluate whether the research method or methods are linked to the research strategy and whether the research methods are suitable for collecting information which is capable of answering the research questions. The selection of the research method is based on what kind of information is sought, from whom and under what circumstances. Moreover, the researcher also needs to be careful about the resources and time available to him/her, in order to make the data collection an achievable task.

It will be remembered that this research sought to examine the process of knowledge transfer in supply chain partnerships, influential factors in knowledge transfer, and the



potential benefits of knowledge transfer. Questions were raised including, what the characteristics of knowledge transfer in supply chain partnership are, what the process of knowledge transfer is, what factors could influence the process of knowledge transfer, and what benefit could be gained by the focal firm. These questions were mainly addressed through a systematic review of literature in the area accompanied by in-depth interviews. At the stage of fixed design, research questions including, whether the characteristics of supply chain partnerships will have effects on knowledge transfer, whether interfirm knowledge transfer could be regarded as a multi-stage sequential process, and how interfirm knowledge transfer benefits the supply chain partners, need to be answered in the context of supply chain partnerships.

To answer these research questions, the author needed to collect information regarding current supply chain operations and knowledge management practices from the perspective of firms and supply chain partnerships, as oppose to individual employees. Moreover, the following issues needed to be addressed carefully:

- (1) The data collected should include all the main research constructs;
- (2) The data collected should reflect/measure the construct in a consistent manner, which allows the testing of the designated causal relationships;
- (3) The analytical results from the data should have a certain level of generalizability into a wider organizational context, as oppose to applicability to only one organization or one partnership;
- (4) The data collection should not commit too much time and cost;
- (5) The data collection should be replicable to a large extent, so that future research could verify the result or extend the analysis into different circumstances.

To properly address these issues, a cross-sectional questionnaire survey was found to be the most appropriate and most feasible data collection method for the current research. Cross-sectional (as oppose to longitudinal study) refers to the research design in which all measures are taken at the same time (or in a relatively short period of time) from a

group of respondents. Cross-sectional study enables the evaluation of relationships between variables and with appropriate controls may allow the establishment of causal links. For this type of study, the survey is the most commonly used data collection method. Thus, statistical analysis could be used to examine the relationships between variables. The next subsection explains the reason why it was considered the most appropriate data collection method.

#### **6.3.4 Questionnaire Survey as Data Collection Method**

Among multiple research methods used by social researchers, such as semi-structured interview, focus groups, and observation, the questionnaire survey is one of the most commonly used for fixed design studies (Robson, 2002). Compared to other data collection methods, questionnaire survey, and in particular self-administered questionnaire survey, was considered to have the following advantages for the conduct of the current study:

- (1) It is a relatively simple and straightforward approach to the study of attitudes, values, beliefs, and motives. Given that knowledge transfer activities could be embedded implicitly in the supply chain operations of firms, measuring knowledge transfer directly could be quite difficult. Thus, the perceptions of a firm's management are important sources of information to indicate the status of supply chain partnerships and knowledge transfer practices.
- (2) It can collect standardized information from a relatively large group of respondents and create generalizable information with less cost and within a shorter time. Therefore, the author could use the relatively large amount of standardized information to examine and compare the knowledge transfer in a group of supply chain partnerships and establish causal relationships between various research constructs in the theoretical framework.
- (3) It is an easy way to retrieve information about past history from a large group of people. Therefore, the author was allowed to examine the status of supply chain

partnerships and past practices of interfirm knowledge transfer.

- (4) It allows anonymity to the individual respondents. This is quite important for the current research, since some sensitive information like firm performance and nature of interfirm relationships was required.

For these reasons, a self-administered questionnaire survey was employed to collect the empirical data, which was used to test the theoretical framework developed in the early stage of the study.

## **6.4 Design of Fieldwork**

Given that the current research intends to examine knowledge transfer between supply chain partners, it was important that the information collected should properly reflect the knowledge transfer practices of supply chain partnerships from the perspectives of supply chain firms. The fieldwork needs to be designed so that a representative research sample was examined by the study and appropriate informants were selected.

The literature review suggests that most previous empirical studies of interfirm knowledge transfer have used a unilateral range of analysis (which means that researchers focus only on one party in the context of interfirm knowledge transfer), even if they intended to study the knowledge transfer taking place between two organizations (He et al., 2006). Far fewer studies have used the dyadic range of analysis (which looks at both counterparts in an interfirm dyad), or the network range of analysis (which examines more than two firms involved in an interfirm relationship simultaneously). A dyadic and/or network range of analysis was preferred because it was more capable of explaining the behaviour involved in interfirm cooperation, and thus more suitable to the study of supply chain knowledge transfer.

#### **6.4.1 Highlights from an Influential Previous Study**

Before the specific research method was chosen, a study of Hult et al. (2004) appeared to be quite significant and provided important implications for the current study. Hult et al. (2004) conducted empirical work of inter-organizational knowledge transfer activities with supply chains of a US Fortune 500 transportation firm. In this study, three types of supply chain nodes were identified: internal users, corporate buyers and external suppliers. Within these supply chain players, 58 supply chains of the focal firm were determined. Data were then collected from all three types of node. The single respondent method was used, in that each respondent was asked to focus on the focal firm's most recent supply chain process. Hult et al.'s (2004) study provided some valuable implications for the conduct of the current research:

- (1) Contextual Factors: To study the supply chains of only one firm ensures that the context of the study is more fixed. According to Hult et al. (2004), "to use the fine-grained approach of studying one firm's supply chains (versus the coarse-grained approach of study chains in diverse firms) allows us (the authors) to avoid the potentially confounding effects of variation in company practices". By collecting data in the same industrial context, researchers ensure that responses will reflect supply chain processes in a more consistent way.
- (2) Relevance of Results: Given that researchers are interested in the knowledge transfer practices between supply chain firms, responses collected from a set of related organizations will increase the possibility of generating relevant information from participants. For instance, respondents from different organizations in the same supply chain are more likely to refer to similar supply chain management practices or knowledge transfer practices. Thus, the information they provide is more likely to reflect real variances in their perception of supply chain management practices. Hence, the responses themselves will form data triangulation to ensure the quality of the analysis.

(3) Accessibility: Getting access is one of the main obstacles to successful empirical study. It is also one of the main reasons for a low response rate (Robson, 2002). One of the main advantages of surveying the supply chains of a large firm is that once the researcher has secured the assistance from the focal firm, it is very likely that the focal firm will provide further assistance to get access to other supply chain firms. The assistance or sponsorship from the focal firm may legitimize the survey and encourage more replies from respondents. Compared to the blind random sampling from a large population of firms, the response rate of this type of survey is likely to be much higher. Moreover, the researcher may also be able to have a clearer idea of the sampling frame, for example from the focal firm's official record, so that the representativeness of the study is more easily established.

(4) Similarity of the Study: The study of Hult et al. (2004) shared the following similarities with the current research. First, both the study of Hult et al. (2004) and this study sought to explore the knowledge management practices of firms. Second, both studies drew on the knowledge-based view of the firm to depict the importance of knowledge generation and acquisition to firms' competitive advantage. Third, both studies sought to explore the management practices in the context of firms' strategic supply chains.

Therefore, acknowledging the research questions and the research strategy, the current study followed a similar approach in collecting research data. Specifically, this research sought to collect data from the supply chain network of a large steel company. Here, the firm was chosen as the unit of analysis, so that a sample of firms which all participated in the supply network of this large company were studied. Therefore, the research population in this study was all the supply chain partners within this focal firm's supply chain network during a certain time period. The reason that the steel-producing sector was chosen is because the supply chain structure is more typical in steel producing companies. Moreover, since the supply chain process is more clearly divided in the sector,

supply chain partnerships could be identified more easily than in other industries.

#### **6.4.2 Sampling Strategy**

A good sample ensures the collection of proper and representative data. The selection of the sample may directly affect the validity of the analytical results. There is a large variety of sampling techniques available to social researchers, either probability based or non-probability. Some frequently used probability sampling techniques include simple random sampling, stratified random sampling, and multistage sampling. Examples of non-probability sampling are quota sampling, convenience sampling, purposive sampling, and snowball sampling. Among all these sampling techniques, snowball sampling was found to be the most appropriate one. “Snowball sampling” is so called because the researcher starts collecting information from one or more individuals from the population, then, by using initial respondents as key informants, further respondents in the population are identified (Robson, 2002). Although snowball sampling lacks the feature of random selection, which may limit the representativeness of the sample from the statistical point of view, it has some advantages that were considered beneficial to the execution of this research:

- (1) Snowball sampling doesn't require a predefined sampling frame, so it is useful when there is difficulty in identifying members of the population (Robson, 2002, p.267). Because the supply chain of a large firm may extend into a huge network of participants, it is difficult to determine the boundary of this network. Thus, a fixed population frame may not be achievable in this research, and even if a sampling frame was available, it may not exclusively include the whole population.
- (2) Once initial collaboration is gained from respondents, snowball sampling is more likely to ensure a better response rate. In this sense, the author was able to use snowball sampling to reach as many relevant respondents as possible to build up a reasonable sample size.
- (3) Third, snowball sampling ensures that all the respondents in the sample are

interrelated and relevant to the same context. As this research is concerned with supply chain partnership, the author needed to get information from firms that have closer relationships with each other rather than normal. Snowball sampling was used to reach supply chain partners from some initial respondents and extend the partnership to the second tier or third tier. Hence, partnerships which are more relevant could be reached through this sampling process.

- (4) Snowball sampling avoids the complexity involved in stratified random sampling and keeps out the confounding effects of industry sectors. Since the sample was collected from a group of related firms with respect to the same supply chain, those firms were more likely to report on related information about the supply chain in the same industry sector. Thus it ensured that data collected were more consistently presented.

In addition to the sampling technique, the key informant method was used, in that the respondents in this research were chosen to be the top managers of sample companies (Phillips, 1981). One top manager in each company was chosen who is considered as the representative of the corresponding company. According to Simonin (1999a), the top managers are the ones most able to observe and to determine the impact of specific alliances on the rest of organization's activities. Furthermore, they are best qualified to direct the questionnaire to other individuals in the organization, who may be more competent on the subject.

Although snowball sampling is a sound technique for the current study, there were several issues that needed to be considered when carrying out the snowball sampling:

- (1) The first respondent or the focal firm, which serves as the start point of sampling, needed to be carefully selected. Such an organization needed to be big and cooperative and have a large network of supply chain relationships.
  - (2) To ensure that the respondents provide information about their supply chain operations, influence from the focal firm could be used. Here the influence should not be coercive, which might play a negative role in collecting honest responses.
- Nonetheless, it is important to give sufficient information about the study, and the

benefit this study may bring to the respondents. Thus the focal firm could be used as a medium to pass such information to the potential respondents.

- (3) Given that knowledge transfer practices are usually implicitly embedded in the daily supply chain process, different organizations may have different experiences and viewpoints regarding the issue. Information regarding the knowledge transfer may be presented in various forms, so that the interpretation and analysis of the survey data may be difficult. Although the survey would be conducted in the same industry context (or more precisely, in the same supply chain network), the researcher still needed to take account of this effect through consistent and systematic design of the questionnaire.

## **6.5 Issues in Research Design**

To ensure the validity and reliability of the research, issues in research design had to be considered before the conduct of the fieldwork. Research design is mainly to do with the handling of the theory and data, which further determines the validity and reliability of the research. The following discussion will clarify the issues of general research design, validity, and reliability of the research.

### **6.5.1 General Research Design**

A good design of the research involves the systematic and effective handling of theory and data. As Evans (1983) suggested, the theory-data relationship could be expressed in three tensions, namely concept-indicator, causation-correlation, and generality-particularity.

First of all, the tension of *concept-indicator* refers to the measurement of research concepts by appropriate indicators. For instance, the concept of supply chain partnership is determined by the partnership magnitude, balanced power, and partnership duration (see Chapter 3). These constructs could be further determined by other sub-constructs.



For example, partnership magnitude is determined by trust, commitment, shared meaning, and interdependence, whilst balanced power is determined by availability of alternatives and restraint in use of power. Measurement of all these constructs needed to be backed by a substantial review of the literature.

Secondly, the tension of *causal relationship-correlation* refers to the explanation of causal relationships possibly between different concepts by controlling intervening variables. As a fixed design was followed, this research sought to form statistical relationships (if not causal) between characteristics of supply chain partnerships and supply chain knowledge transfer based on the survey data. Although relationships would be established after the statistical analysis, substantial support needed to be gained at the literature review stage to build the potential relationships between constructs. It is important to note that alternative factors rather than supply chain relationship characteristics, such as learning intention and absorptive capacity, could also affect the practice of knowledge transfer (see section 5.2). Thus, the researcher needed to take account of these factors by attempting to control for them when interpreting the results. However, because the current research mainly concentrated on the partnership characteristics when examining the knowledge transfer practice, the examination of learning intention and absorptive capacity were left for future research. Other contingency factors such as partnership contract status and location in the supply chain needed to be controlled during the statistical analysis to examine the relationship between supply chain partnership characteristics and interfirm knowledge transfer.

Thirdly, the tension of *generality-particularity* refers to the sampling procedure that results in the research sample that aims to adequately represent the target population, so that conclusions can be made about the population based on the sample data. Previously it has been shown that the target population was all the supply chain partners within the chosen focal firm's supply chain network. Moreover, a cross-sectional survey was used to examine the supply chain knowledge transfer of a group of firms within the same supply chain network. By using snowball sampling the author sought to achieve a

reasonably large sample size and to ensure that the sample was sufficiently representative of the population.

### **6.5.2 Validity and Reliability**

To ensure the trustworthiness of the research it is necessary to evaluate the validity and reliability of the research at the design stage. Validity is concerned with whether the findings are really about what they appear to be about, while reliability is concerned with the consistency or stability of the procedure and measurement. According to Robson (2002), validity consists of three aspects, namely construct validity, internal validity and external validity. Given that there are three tensions between theory and data (concept-indicator, causation-correlation, and generality-particularity), these three criteria of the validity are linked with those three tensions respectively (Evans, 1983).

*Construct validity* refers to the fit between concepts and indicators. For instance, in this study, the concepts of supply chain partnership characteristics needed to be measured by different indicators. This raised the potential threat to construct validity, in that the indicators might not be appropriate to measure the concepts correctly. To deal with construct validity, substantial literature review and the pilot study could serve as means to ensure *face validity* and *content validity* of the indicators. Moreover, the empirical data needed to be and was subjected to various statistical tests (e.g. Confirmatory Factor Analysis) to help to ensure all the indicators were measuring what they intended to measure.

*Internal validity* refers to the establishment of a causal or explanatory relationship between research concepts with alternative explanations being ruled out. As has been mentioned in section 6.5.1, statistical control was used in the modeling stage to ensure that alternative factors influencing the knowledge transfer practice rather than the characteristics of supply chain partnerships were ruled out. Moreover, since the empirical data was collected from respondents from the same supply network, there would be a

greater chance for respondents to reflect on similar issues involved in the supply chain knowledge transfer (actually this was enhanced by giving explicit instructions in the questionnaire). Thus, some level of data triangulation was achieved within respondents. This ensured that the relationships between constructs were more consistently formed.

*External validity* is concerned with the generalizability of the research, in that a description or explanation of the research can be applied to other actors, and to other contexts. The threat of a low response rate should be considered seriously, so that efforts should be made to increase the response rate of the survey. In this study the snowball sampling gave a bigger chance that a larger sample size could be achieved, which ensured the statistical generalizability of the survey results to the target population. Cross-validation tests needed to be carried out wherever possible to ensure analytical results are applicable to other research samples as well. Moreover, although this research was conducted within only one supply chain network, because few prior studies have examined knowledge transfer within large supply chain networks, this study still generated some useful implications for the understanding of interfirm knowledge transfer in other similar supply chains or in other industry contexts.

Reliability of the research is concerned with repeatability of the measurements used in the study. The reliability in the fixed design is mainly concerned with the use of standardized instruments, such as formal test or scale to ensure the consistency and stability of the result. In this sense, this research referred to the instruments validated in previous interfirm knowledge transfer studies to a large extent to help design the research instrument. In addition, the author sought to provide a detailed and consistent report on issues such as survey design, data collection procedures, context under which data was collected, validation procedures, analytical strategy, and analytical methods, to ensure replicability of the study and enable future researchers to trace back the research easily.

## **6.6 Potential Ethical Issues**

To ensure that this research was ethically feasible, the following points needed to be considered. First, when carrying out the in-depth interviews and questionnaire survey, the respondents were informed in advance to obtain their agreement before the interview was conducted or the questionnaire was delivered. Second, use of a tape recorder or other recording device needed to be with the agreement of the interviewees. Third, participants needed to be fully informed about the purpose of the study and the potential use of their information. Fourth, the anonymity and confidentiality of interviewees and questionnaire respondents needed to be ensured, so that their individual information cannot be identified and will not be revealed to any third parties. Fifth, since the research may have acquired sensitive or confidential information about target organizations, the author needed to be careful in designing the questions of the interview and questionnaire, and also in reporting the results. Hence, the confidentiality of the target organizations was not violated. Sixth, although the selected focal firm was used to promote the survey wherever necessary, the author needed to ensure that no coercive influence was used. The participation in the survey needed to be based on individual interests and the understanding of the potential benefits of the study.

## **6.7 Summary of the Research Process**

Figure 6-1 illustrates the main research strategies and research process to be followed throughout the study and was used as a road map when carrying out the research. As was discussed in the previous chapters, the extensive review of literature and in-depth interviews helped the author to identify the unique characteristics of supply chain knowledge transfer (see section 4.4.1 to 4.4.5) and the obstacles to the knowledge transfer process (see section 4.4.6). The main constructs were identified and the initial theoretical framework was developed based on prior empirical studies in the area. The understanding of the characteristics of knowledge transfer in supply chain partnerships that was generated and a further examination of the main findings from prior studies

helped to establish the main theoretical framework. Since a fixed design strategy was followed, the theoretical framework guided the design and execution of the questionnaire survey. After the instrument was developed and pilot tested, a cross-sectional survey was carried out in the target supply network. This was followed by a systematic process of data validation. Empirical data was then tested using justified statistical methods. After a complete process of data analysis and interpretation, conclusions and recommendations could finally be drawn out.

## **6.8 Summary**

This chapter justified the choice of research methodology. Post-positivism was chosen as the basic methodological approach to direct the conduct of the fieldwork. This research has both explanatory and exploratory purposes. A fixed design study was chosen as the main research strategy. A cross-sectional questionnaire survey was chosen as the main method to collect data from the supply chain network of a large steel producer. The research population and sampling technique were defined. The more detailed procedures are discussed in the next chapter. Issues of validity and reliability of the research were also addressed based on the initial design of the fieldwork. Finally, some potential ethical issues involved in the fieldwork study were discussed briefly.

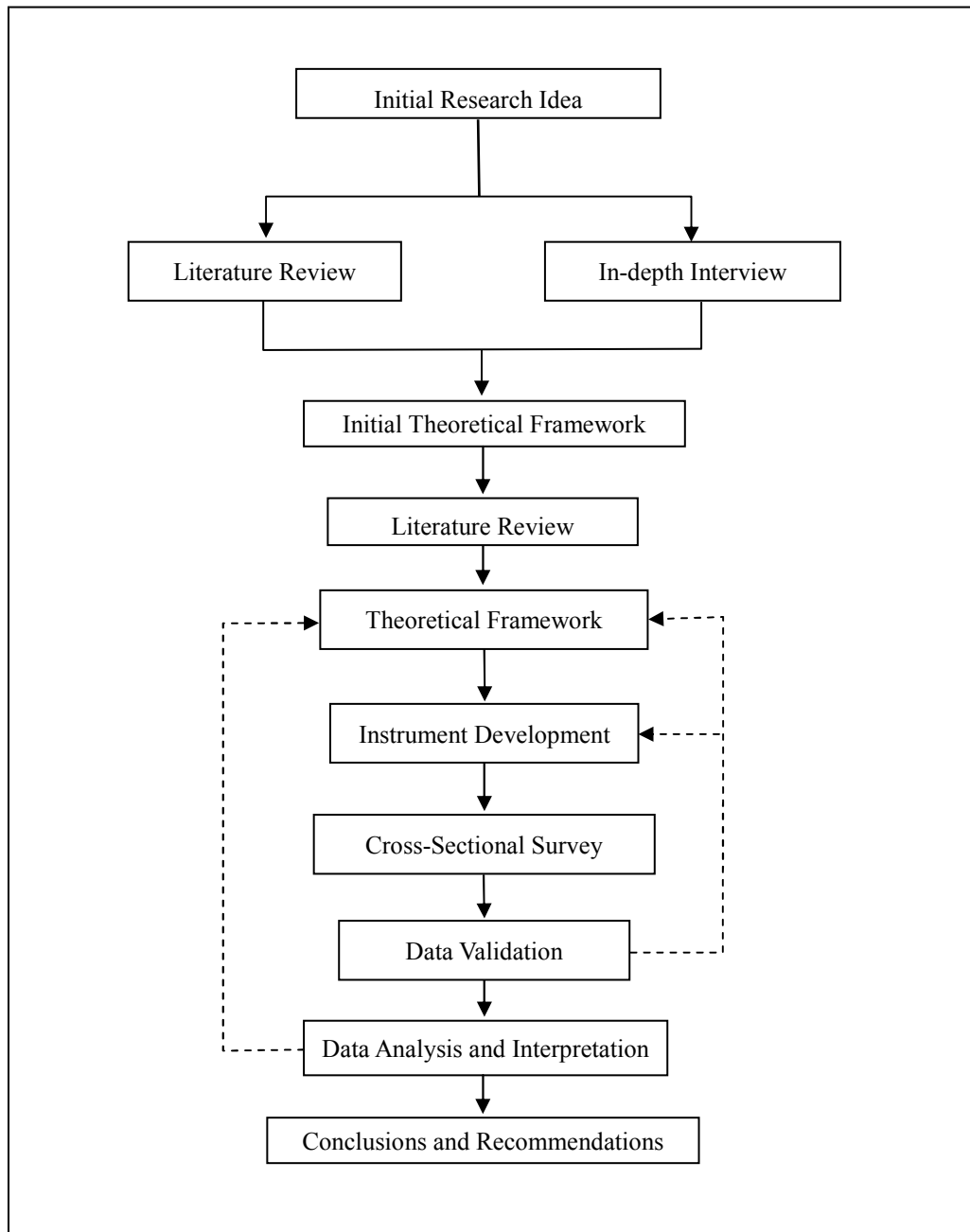


Figure 6-1 Summary of Research Process and Methods

## **CHAPTER 7 SURVEY CONSTRUCTION AND EXECUTION**

### **7.1 Preamble**

To collect primary data on knowledge transfer in supply chain partnerships, a well-constructed survey instrument was needed. As was presented in Chapter 5, the theoretical framework involves eight main constructs. These are partnership magnitude, balanced power, partnership duration, knowledge acquisition, knowledge internalization, knowledge utilization, supply chain performance, and business performance. Some of these concepts have sub-dimensions of constructs. Partnership magnitude is determined by trust, commitment, interdependence, and shared meaning. Balanced power has two sub-dimensions, availability of alternatives and restraint in use of power. Because knowledge transfer in supply chain partnerships is a relatively new issue covered in the literature, there was a lack of a systematic instrument available to be used. Based on the review of related literature in areas of organizational learning, supply chain management, strategic management, and relationship marketing, this chapter reviews the operationalization of survey constructs in prior studies and builds up the survey instrument of this research. The first part of this chapter details the process of survey instrument construction, and the second part explains the administration of the fieldwork.

### **7.2 The Total Design Method**

How to collect quality data with an acceptable level of validity and reliability with limited resources, and at the same time increase the response rates are key issues which need to be handled by researchers. It was believed that a systematic and logical approach to survey development and conduct would enable the author to collect valuable information capable of answering the research questions.

One of the most highly relied-on survey design methods in the area of business and management studies, called Total Design Method, was developed by Dillman (1978). As with the later version of Tailored Design Method (TDM) (Dillman, 2000), Total Design Method is based upon social exchange theory to develop various ways to encourage survey responses. TDM takes into consideration how to increase perceived rewards for responding, decrease perceived costs, and promote trust in beneficial outcomes from the survey. The method relies upon the effort taken in designing and administering of the questionnaire in a more careful and systematic way to increase the response rate and attract valuable information from respondents. More importantly, TDM takes account of features of the survey situation and has its goal the overall reduction of survey error. Successful TDM seeks to reduce survey errors from coverage, sampling, measurement, and non-response (Dillman, 2000, p.27).

The key aspects of TDM highlight the importance of establishing trust, for example through providing sponsorship by legitimate authority, making the task appear important, and invoking other exchange relationships. TDM also highlights the importance of increasing rewards through practices such as showing positive regard, asking for advice, supporting group values, making questionnaires interesting, and giving social validation. TDM also attempts to reduce the social costs of responding through avoiding subordinating language, avoiding embarrassment, avoiding inconvenience, making questionnaires short and easy, and minimizing requests to obtain personal information. Researchers also need to be more careful in the appearance and presentation of the questionnaire.

One of the main contributions of Tailored Design Method is the emphasis on situation in questionnaire design. TDM attempts to sharpen elements of design and implementation in ways that take into account critical differences in survey populations, sponsorship, and content. It then builds on those differences in order to shape the most effective method for achieving a response (Dillman, 2000, p. 25). Thus, the designer



should develop a questionnaire which fits into the research context and matches the target population, rather than develop a one-size-fits-all model. This approach ensures that the social elements of trust, reward, and cost can be communicated to the respondents in a more efficient manner, as well as encouraging a higher response rate. Given the advantages of TDM, the current research mainly followed the recommendations of Tailored Design Method in designing and administering the survey questionnaire.

### **7.3 Target Research Sample**

Taking the recommendations of Tailored Design Method, researchers need to have knowledge of the context of the survey before the survey is constructed. The nature of the target respondents and the sampling procedure need to be clarified before the questionnaire is developed. This approach ensures that researchers design the questionnaire to suit the potential respondents.

#### **7.3.1 Getting Access to the Research Sample**

As discussed in Chapter 6, this research intends to study the supply chain network of a large steel company. Effort, therefore, was made to identify and gain access to a large focal firm. The intention was that once the initial access was gained, the author could seek further assistance from the focal firm to identify the potential respondents in its supply chain network and to deliver the survey. A large Chinese steel company was finally identified in year 2006, after several months of negotiating access to the organization. The company expressed interest in giving support to the conduct of fieldwork and in reviewing the result of the study.

The reasons for selecting this firm were fourfold:

- (1) The steel industry represents one of the most typical supply chains among other industries. A firm's location upstream or downstream in the supply chain is

more explicit. Researchers are more able to identify upstream or downstream firms in this industry, so that the implications from the location within the supply chain and the interfaces of the supply chain relationship are more easily reached.

- (2) It is more likely for a large steel producer to have an extended network of supply chain partners. This ensures the potential sample size of the study.
- (3) China is currently the world's most successful country in manufacturing. Its steel producing capability is already the highest in the world but is still booming. To study a rising industry is more likely to generate meaningful and lasting implications for academia and practitioners.
- (4) Steel production mainly represented the "upstream" of supply chains compared with other sectors such as assembly and retail. Classical supply chain management researchers have taken more effort to study the downstream in the supply chain. To look at the upstream in the value chain is expected to generate some new insights into the supply chain management process and knowledge management practices.

### **7.3.2 Assistance and Sponsorship Gained from the Target Organization**

Assistance was gained from the top management of Baogang Group, after they expressed interest in the purpose and the content of the study. The top management asked the personal assistant of Baogang's CEO to help identify respondents and deliver the survey. Specifically, the assistance Baogang management provided was as follows:

- (1) Identifying the number and name of all Baogang's subsidiaries surrounding the main business of steel and rare-earth, as well as the contact details of all the subsidiaries.
- (2) Identifying the rough number, and nature of business, of firms doing business both upstream and downstream in Baogang's supply chain. The assistant was unable to provide a full list of all the supply chain firms Baogang has. This is because

suppliers and purchasers were changing all the time, so they didn't have a full list. Nevertheless, a significant list was available.

- (3) Naming a number of firms in the supply chain of Baogang and providing the details of those firms, which are located upstream and downstream in the supply chain. These could be first tier and second tier suppliers, or first tier and second tier purchasers.
- (4) Helping distribute questionnaires to the management team of subsidiaries and the indicated first tier suppliers and purchasers of Baogang.
- (5) Collecting the questionnaires in person and by postal mail from the respondents.

Although significant cooperation was obtained, an important issue needed to be considered. The upstream suppliers and downstream purchasers of Baogang are changing all the time. Moreover, not all of the suppliers and purchasers could be considered as partners. Therefore, it was considered difficult to obtain a consistent and stable sampling frame, and hence this prevented the use of traditional probability sampling techniques, such as random sampling (Robson, 1993). An alternative sampling approach had to be considered. As discussed in section 6.4, a 'snowball sampling' approach was followed instead. Through snowball sampling, the "researcher identifies one or more individuals from the population of interest. After they have been interviewed they are used as informants to identify other members of the population, who are themselves used as informants, and so on" (Robson, 2002, p. 265). According to Robson (2002), snowball sampling is useful when there is difficulty in identifying members of the population.

### **7.3.3 Introduction to the Target Supply Chain Network**

The target company, Baotou Iron & Steel (Group) Co., Ltd., China (simplified as Baogang Group or Baogang) was located in Baotou City, Inner Mongolia, China. According to the company report as well as the telephone interview with a senior manager of Baogang, the company was established in 1954. The company was

reorganized in 1998 with two listed companies, Baogang Share and Rare-earth Hi-tech. It is nowadays one of the most important iron and steel industrial bases in China and the largest rare-earth industrial base in China. It is also the biggest industrial enterprise in the Inner Mongolia Autonomous Region with total assets of 37.1 billion Yuan (or 2.6 billion GBP) and a turnover of 28 billion Yuan (or 1.87 billion GBP) by the end of 2005.

For the steel industry, Baogang has the capability to produce 8.5 million tons of steel annually. Baogang can produce 56 varieties and 6573 specifications of steel products such as hot rolled strip, cold rolled strip, seamless tube, heavy rail, and high-speed wire rod. It is one of the top three rail producing bases in China and a seamless pipe producing base with the greatest range of varieties and specifications in China. The products of Baogang are used in a large variety of other industry sectors, including appliance, construction, and automobiles. Baogang has been listed as the first batch cycling economy trial enterpriser in China and is now constructing the Eco-Friendly Industry Park.

For the rare-earth industry, Baogang can produce 100,000 tons of concentrate and over 55,000 tons of oxide is converted annually. There are 53 varieties and 180 specifications of rare-earth products such as rare-earth concentrates, rare-earth compounds, rare-earth metals, Nd-Fe-B permanent magnetic products, and MH-Ni batteries. The output of functional material makes up 20% and rare-earth oxide 40% of the domestic market.

Surrounding the main business of steel and rare-earth products, Baogang has established or attracted thousands of other firms and businesses over the last few decades. These firms have various lines of businesses (such as mineral, construction, appliances, assembly, automobile, machinery, inventory control, logistics, recycling, electronics, design, and consultancy), which supply materials, facilities, and services to Baogang, and also purchase products or services from Baogang. A great number of

these firms are established around the area. Many of them are located within Baotou city. The business relationship between these firms and Baogang has made Baotou city a huge industrial district, which consists of a large extended supply chain network.

Figure 7-1 depicts a general mapping of Baogang’s supply chain network, which is developed based on both published company reports and the in-depth telephone interview with a senior manager of Baogang. By the time of the survey, there were roughly 65 solely owned subsidiaries of Baogang, working in the areas of mining, rolling mill, machinery, mechanical engineering, construction and installation, R&D, ICTs, Trading, Logistics, and Transportation. The majority of subsidiaries were doing business with both upstream suppliers and downstream purchasers of the products and services of Baogang.

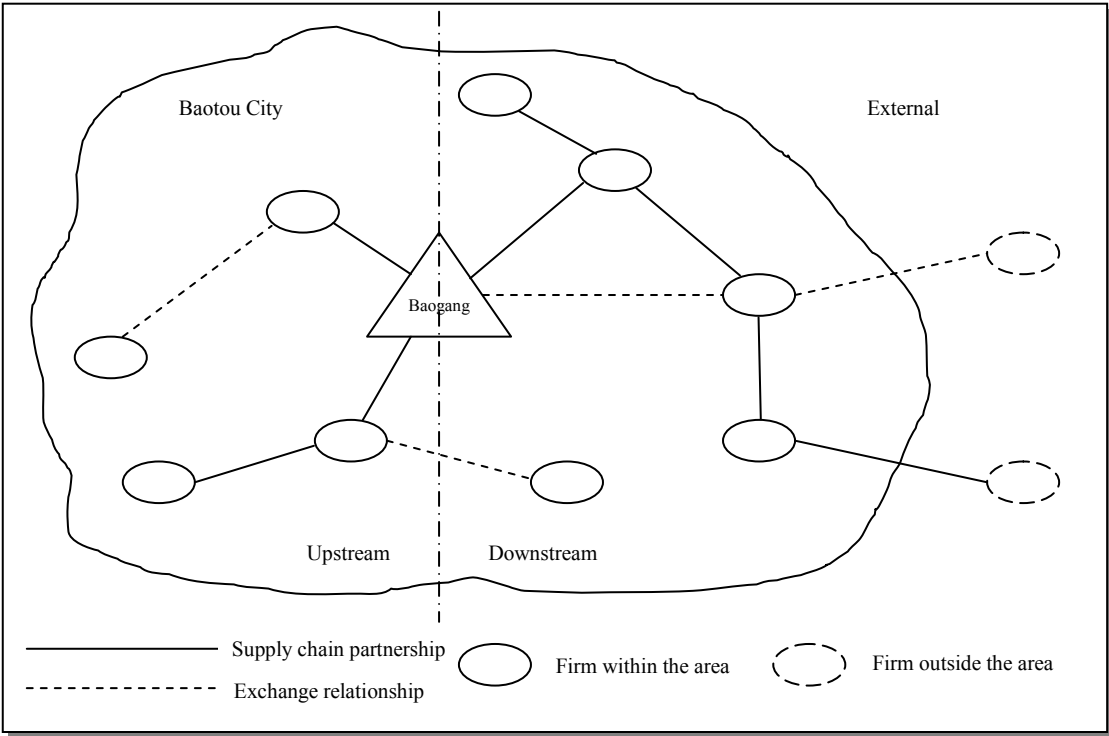


Figure 7-1 An Illustration of Extended Supply Chain Network of Baogang Group

As shown in table 7-1, among the total of approximately 2570 upstream firms, around 900 firms are providing raw materials to Baogang, around 1404 are providing

machinery and components to Baogang, and around 270 firms are providing various services to Baogang. Around 1275 of the upstream firms are located within Baotou City or in nearby regions. There are around 1650 upstream firms which have stable or longer term relationships with Baogang, around 825 of these firms are located within Baotou city or in nearby regions. Downstream in the Baogang's supply chain there are a total of approximately 300 recognizable firms which purchase products or services directly from Baogang. Around 60 of those firms are located within Baotou City or in nearby regions. 130 of the downstream firms have stable or long term business relationships with Baogang, around 40 of those firms are located within Baotou city or in nearby regions.

Table 7-1 Characteristics of Firms in Baogang's Supply Chain Network

	Upstream Suppliers	Downstream Purchasers
Total number of firms	2570	300
<i>Within the area</i>	1257	60
Firms with partnerships	1650	130
<i>Within the area</i>	825	40
Business Sectors	Mining, Metal Processing, Chemicals, Coal, Fire resistance, Machinery, Electronics, R&D, Environment, Electrics, etc.	Trading, Chemicals, Appliances, Motor vehicles, Real estate, Machinery, Oil, Railway, etc.

Note: All numbers are approximate at the time of the fieldwork.

As table 7-1 confirms, Baogang is a large steel producer with a large number of subsidiaries. The size of its supply chain network is very considerable, and contains a large number of upstream and downstream firms. Within those firms there are a large number of firms with partnering relationships. Drawing a sample from these organizations ensured a reasonable sample size. The following sections detail the development of the survey instrument which is based on not only the theoretical framework of the study, but also the characteristics of the target research samples.

## **7.4 Rationale of Constructs Operationalization**

For empirical research using a questionnaire as research instrument, it has been a common practice to borrow items from other related research to form the research instrument. This is especially the case when the research is at an explorative stage and lacks a well-established instrument. Due to the restraint in time and capability of the single researcher, it is not realistic to construct a totally new set of survey items.

Nevertheless, simply borrowing from other research may not result in a valid and reliable instrument. Researchers have to be cautious about: relevance to the research question, capability of collecting accurate data, suitability to the target sample, and capability to meet resource constraints.

Despite the fact that there are limited empirical studies in the area of supply chain knowledge transfer, plenty of prior research could be found in other related areas of research, such as strategic management, relationship marketing, organizational learning, and operations management. A number of these studies provided survey instruments which contained operationalized constructs that the current study might possibly use. To make sure that the adoption of prior survey items was of good quality, the following criteria were followed:

- (1) Items should have been used in a similar research scenario to this study, i.e. in the field of supply chain management and/or knowledge management. This was to make sure the feasibility of the prior derived instrument to measure the concepts of the current research.
- (2) Wherever possible, multiple-indicator measures were considered first. Multiple-indicator measures were believed to be more capable of capturing full concepts, and making finer distinctions between responses (Bryman and Bell, 2003). Moreover, it also allowed various tests of validity and reliability.
- (3) Items should have been subjected to various tests on construct validity and reliability by prior scholars (e.g. Discriminant validity, Convergent validity,

Composite reliability, and Cronbach's Alpha), and have reached an acceptable level of validity and reliability.

- (4) Items should have been published in highly regarded peer-refereed journals in the field. This ensured that adopted items were already subject to rigorous reviews by experts in the area. First, the strict peer review procedures of these journals means that the published papers have been scrutinized for the rigour and quality of their theoretical underpinning, propositions, arguments, data collection, and data analysis. Second, the works published in these journals are more likely to represent the cutting edge of the current normative research.
- (5) Wherever possible, research items which have been used repeatedly by prior research would have priority for adoption. This would enhance the replicability of the study.
- (6) To improve the potential response rate, items which are more simple and explicit in wording would be considered first.

However, the adoption of previously tested survey items does not exclude the need to test the instrument for validity and reliability. Given that the research items were used in a new area of study, the items brought together still needed to be pilot tested before the formal execution, and be tested for validity and reliability after the data collection. The pilot testing is discussed in section 7-11. The tests of validity and reliability, which formed part of the systematic data analysis process, are discussed in Chapter 9.

## **7.5 Operationalization of Supply Chain Partnership Characteristics**

As depicted in the main theoretical model of the study, the supply chain partnership characteristics are determined by eight main factors, trust, commitment, interdependence, shared meaning, availability of alternatives, restraint in use of power, and partnership duration. Following the discussion and definitions of these concepts in Chapter 3, the operationalization of measurement of these concepts is discussed in detail below.



### 7.5.1 Level of Trust

Trust is a fundamental relationship model building block and is included in most relationship models (Wilson, 1995). In this research it is defined as “willingness to rely on an exchange partner in whom one has confidence” (Moorman et al., 1993).

However, trust is also a complex concept, for which limited consensus has been reached in defining an effective measure of trust. Despite the various trust measurements that have been developed to capture the multi-dimensional nature of trust (e.g. Moorman et al., 1992; Doney and Cannon, 1997; Krause and Ellram, 1997; Miyamoto and Rexha, 2004; Suh and Kwon, 2006), the multiple-item scale developed by (Doney and Cannon, 1997) and (Krause and Ellram, 1997) attracted the attention of the author.

Table 7-2 Measures of Trust

Item Label	Original Measures	Adopted Measures
TRUST1	This supplier keeps promises it makes to our firm	This partner keeps promises it makes to our firm
TRUST2	We believe the information that this vendor provides us	We believe the information this partner provides us
TRUST3	The supplier is not always honest with us (Reverse coded)	This partner is not always honest with us (Reverse coded)
TRUST4	This supplier is genuinely concerned that our business succeeds	This partner is genuinely concerned that our firm's business succeeds
TRUST5	We trust this vendor keeps our best interests in mind	We trust this partner keeps our best interests in mind
TRUST6	When making important decisions, this supplier considers our welfare as well as its own	When making important decisions, this partner considers our welfare as well as its own
TRUST7	This supplier is trustworthy	This partner is trustworthy
TRUST8	We find it necessary to be cautious with this supplier (Reverse coded)	We find it necessary to be cautious with this partner (Reverse coded)

Note: original measures were adopted from (Doney and Cannon, 1997) and (Krause and Ellram, 1997).

The 8-item measures of Doney and Cannon (1997) tapped the credibility and benevolence aspects of trust, along with some global measures of trust. Using a 7-point likert-type scale, the measures were developed for the purpose of measuring the nature of trust in buyer-supplier relationships, which is quite similar in scenario with the current study. These measures are outstanding not only because they have been tested by rigorous validity and reliability tests, but also because of their simplicity in wording. Krause and Ellram (1997) developed similar trust items when examining supplier development activities. This stream of trust measures has been recognized and adopted by a number of other scholars in measuring trust in supply chain relationships (e.g. Moberg and Speh, 2003; Humphreys et al., 2004). Therefore, due to the similarity and relevance of the research context, the current research adopted these measures. This research largely kept the original eight items, although some slight modifications were made to make the expression more suitable to the target respondents. See table 7-2 for a list of those items.

### **7.5.2 Level of Commitment**

In this study, commitment to a relationship is defined as “an enduring desire to maintain a valued relationship” (Moorman et al., 1992). Nevertheless, the commitment concept is much harder to operationalize than to define. The difficulties in capturing the commitment concept have been acknowledged by the empirical research (Couchman and Fulop, 2007). Similarly to the measures of trust, various measurements of inter-organizational commitment have been used by prior researchers (e.g. Kumar et al., 1995; Geyskens et al., 1996; Moberg and Speh, 2003). Moberg & Speh (2003) adopted the 5-point likert-type commitment measures from Wilson and Vlosky (1997) to evaluate the strength of supply chain partnerships. The measures were designed to examine the partnering activities, including information exchange, in manufacturer-distributor relationships. These measures, as shown in table 7-3, intend to capture the positive expectations of firms concerning the partnership and the willingness to continue the relationship. Given that knowledge transfer activities in

supply chain partnerships rely on a continuous and stable relationship, these items were deemed to be more suitable to measure the commitment concept in the current study. Thus, they were adopted with slight modifications in wording to make the items more relevant to the research scenario.

**Table 7-3 Measures of Commitment**

<b>Item Label</b>	<b>Original Measures</b>	<b>Adopted Measures</b>
COMIT1	We expect our relationship with this supplier to continue for a long time	We expect the relationship to continue for a long time
COMIT2	We expect our relationship with this supplier to strengthen over time	We expect the relationship to strengthen over time
COMIT3	We expect to increase our purchases from this supplier in the future	We expect to increase our purchases/supplies with this partner in the future
COMIT4	We are willing to put considerable effort and investment into building our business with this supplier	We are willing to put considerable effort and investment into building business with this partner
COMIT5	We have invested a lot of effort in the relationship with this supplier	We have invested a lot of effort in the relationship with this partner
COMIT6	The business relationship with this supplier can well be described as being a “partnership”	The business relationship with this partner firm can well be described as being a “partnership”
COMIT7	We are committed to this trading partner	The parties make plans not only for the terms of current transaction, but also for the continuance of the relationship.
Note: original measures were adopted from (Wilson and Vlosky, 1997).		

### **7.5.3 Level of Interdependence**

Interdependence between partners is defined as the reliance on each other to obtain resources and benefits which otherwise could not be achieved without entering into the relationship. There has been much prior research effort to measure the level of inter-organizational interdependence (e.g. Ganesan, 1994; Mohr and Spekman, 1994; Knemeyer et al., 2003). However, many of the measures overlap more or less with the concept of “Availability of Alternatives”. For instance, Mohr and Spekman (1994) used

two reverse coded measures of interdependence: “If we wanted to, we could switch to another manufacturer’s product quite easily”, “If the manufacturer wanted to, they could easily switch to another seller”. These two scales appear to measure the difficulties for the firm to switch to other partners, which implies the available choices of the firm. Similarly, Knemeyer et al. (2003) used measures that measure more about the reliance of one party on the other due to lack of choice rather than mutual dependence of both parties.

Table 7-4 Measures of Interdependence

Item Label	Original Measures	Adopted Measures
INTDP1	Its design requires contributions from both parties	The design of products requires contributions from both parties
INTDP2	Its production requires ongoing contributions from both parties	The production of products requires ongoing contributions from both parties
INTDP3	It takes a significant amount of time and effort to understand your company’s specific requirements for this component	It takes a significant amount of time and effort to understand our firm’s specific requirements for products
INTDP4	A significant amount of engineering effort is required in designing and developing this component	It takes a significant amount of time and effort to understand this partner firm’s specific requirements for products
INTDP5	Our firm and this customer are heavily reliant on each other for the success of our respective businesses	Our firm and this partner are reliant on each other for the success of our respective businesses
Note: original measures INTDP1, INTDP2, INTDP3, INTDP4 were adopted from (Gulati et al., 2005), INTDP5 was adopted from (Fynes and Voss, 2002).		

Gulati et al. (2005) developed a 5-item measurement to capture the nature of task interdependence between procurer and possible supplier for each component. The items, using 7-point likert-type scales, assessed the degree to which simultaneous contributions from supplier and procurer are required in order to design and produce the component, as well as the need for extensive interactions between the two for the supplier to understand and meet the specific requirements of the buyer. Given that a

supply chain partnership in manufacturing industry is formed mainly for the purpose of completing the value-added process, reciprocal task interdependence is more capable of reflecting the reliance of partners on each other. Nevertheless, to capture the idea of mutual reliance more explicitly, a 7-point likert-type item from Fynes and Voss (2002) was borrowed and combined with the scales of Gulati et al. (2005) to measure the interfirm interdependence in the current study (see table 7-4). Again, slight modifications to the wording were made.

#### 7.5.4 Level of Shared Meaning

Shared meaning is defined as the extent to which partner firms share a common understanding and approach to the achievement of tasks and outcomes. Hult et al. (2004) developed a two indicator scale to measure the shared meaning between supply chain partners based on the theorization of Huber (1991). However, the two items were found to be less than comprehensive. Noticeably, Spekman et al. (2002) examined the impact of interfirm learning on supply chain performance. In this study, shared culture between partners as a precondition of learning was highlighted. The authors used four items in 7-point likert-types scales to measure the concept of shared culture between supply chain partners. Those items were found to be more comprehensive and can serve as a good supplement to the scales of Hult et al. (2004). Therefore, the four indicators of Spekman et al. (2002) were combined with the indicators of Hult et al. (2004). Again some minor modifications were made to the original items.

Table 7-5 Measures of Shared Meaning

Item Label	Original Measures	Adopted Measures
SHAMG1	We develop a shared understanding of the available supply chain information	Our firm and this partner develop a shared understanding of the available supply chain information
SHAMG2	We develop a shared understanding of the implications of a supply chain activity	Our firm and this partner develop a shared understanding of the implications of a supply chain activity

SHAMG3	Our company and this partner have a shared continuous improvement philosophy	Our firm and this partner have a shared continuous improvement philosophy
SHAMG4	We share a similar sense of fair play with this partner	We share a similar sense of fair play with this partner
SHAMG5	We have a high level of shared understanding about key supply chain issues	We have a high level of shared understanding about key supply chain issues
SHAMG6	Within this supply chain we have a shared vision or mission statement	Within this supply chain we have a shared vision or mission statement

Note: original measures for SHAMG1, SHAMG2 were adopted from (Hult et al., 2004), SHAMG3, SHAMG4, SHAMG5, SHAMG6 were adopted from (Spekman et al., 2002).

### 7.5.5 Level of Availability of Alternatives

As one of the key determinants of balanced power, the availability of alternatives is defined as the extent of easiness with which a firm can find or switch to alternative cooperators to complete the same level of production or generate the same level of values. Availability of alternatives aims to measure the objective business circumstances in which the focal firm has additional choices. Ganesan (1994) examined the preconditions of long-term orientation of buyer-supplier partners. In this study, mutual dependence was found to be one of the key determinants of long-term orientation of firms. To measure the mutual dependence, the author has developed two similar sets of measures to indicate the dependence of vendor on retailer, and the dependence of retailer on vendor. These 7-point likert-type scales largely embrace the concept of the irreplaceable role of the partner for the focal firm. Hence, they were adopted with slight changes in wording to fit this study (see table 7-6).

Table 7-6 Measures of Availability of Alternatives

Item Label	Original Measures	Adopted Measures
ALTRN1	If our relationship were discontinued with this resource, we would have difficulty in making up the sales volume in our trading	If our relationship were discontinued with this partner, we would have difficulty in making up the sales volume in our trading

	area	area
ALTRN2	This resource is crucial to our future performance	This partner is crucial to our future performance
ALTRN3	It would be difficult for us to replace this resource	It would be difficult for us to replace this partner
ALTRN4	We are dependent on this resource	We are dependent on this partner
ALTRN5	We do not have a good alternative to this resource	We do not have a good alternative to this partner
ALTRN6	This resource is important to our business	This partner is important to our business
Note: original measures were adopted from (Ganesan, 1994)		

### 7.5.6 Level of Restraint in Use of Power

Restraint in the use of power is the extent to which a more powerful party in a partnership is willing to limit its power use for the sake of partnership maintenance. It is the subjective intention of the partners to limit their excessive influence during cooperation for long-term benefits. Heide and Miner (1992) developed a three-item 7-point likert-type scale of restraint in the use of power to measure respondents' assessments of the degree to which the parties typically refrain from exploiting each other, given the opportunity to do so. Since the study was also conducted in the context of supply chain partnership, and was exploring the nature of supply chain cooperation, the scale was adopted in the current research (see table 7-7). Again minor modifications were made to fit the context of study.

Table 7-7 Measures of Restraint in Use of Power

Item Label	Original Measures	Adopted Measures
RSTPW1	The parties feel it is important not to use any proprietary information to the other party's advantage [sic]	Both parties feel it is important not to use any proprietary information to the other party's <u>disadvantage</u>
RSTPW2	A characteristics of the relationship is that neither party is expected to make demands that might be damaging to the other	A characteristics of the relationship is that neither party is expected to make demands that might be damaging to the other
RSTPW3	The parties expect the more powerful party	Both parties expect the more powerful party

---

to restrain the use of his power in attempting  
to get his way

to restrain the use of its power in attempting  
to get its way

---

Note: original measures were adopted from (Heide and Miner, 1992)

---

### **7.5.7 Level of Partnership Duration**

Taking the experience of prior studies (Heide and Miner, 1992; Ellram and Krause, 1994), the duration of a partnership is measured in terms of the length of time for which the focal firm has been joined in partnership with the counterpart. The duration is measured in five intervals, “less than one year”, “one to three years”, “four to six years”, “seven to nine years”, and “ten years or more”.

## **7.6 Operationalization of Knowledge Transfer Activities**

The main theoretical model included three main constructs of knowledge transfer activities, knowledge acquisition, knowledge internalization, and knowledge utilization. The operationalization of these constructs was largely based on the prior literature and prior developed scales. Some original scales were modified to fit the current context of study. Some new items in knowledge utilization were developed based on the conceptualization of prior research. Since ‘information sharing’ needs to be distinguished from ‘knowledge transfer’ (see section 4.3.1), the author assumed that knowledge transfer takes place in a more implicit manner, which is a by-product of various joint activities, exchange programs, and applications of new technologies. Unlike information sharing, although knowledge transfer could be facilitated by communication technologies, arguably it may not be guaranteed by those technologies. Therefore, to measure knowledge transfer, the author did not seek direct answers to questions like “did you transfer knowledge with your supply chain partner?” or “what kind of technology did you use to transfer knowledge to your supply chain partner?” Rather, the author sought to find out the answer implicitly from information and knowledge transfer enabling activities. This assumption was reflected in the process of measurement development.



### 7.6.1 Measures of Knowledge Acquisition

Knowledge acquisition is the process of getting access to and having an initial understanding of the desired skills and knowledge by members of organizations through direct or indirect contact or interaction with the source of the skills and knowledge (see also in Chapter 4). Hult et al. (2004) adapted the scale of earlier researchers (Jaworski and Kohli, 1993) to measure the level of knowledge acquisition activities in supply chain partnerships. The scale largely captures the joint activities between supply chain partners, which enable the exchange of ideas and knowledge about the running of the supply chain. Given the similarity of the research context, this scale was adopted in the current research. Nevertheless, since the wording of the original items did not explicitly address the relationship between supply chain partners, some changes were made to the original items (see table 7-8).

Table 7-8 Measures of Knowledge Acquisition

Item Label	Original Measures	Adopted Measures
KNACQ1	We meet regularly to find out what products we need in the future	Our firm and this partner meet regularly to find out what products we need in the future
KNACQ2	We do a lot of in-house research on products we may need	Our firm and the partner do a lot of in-house research on products we may need
KNACQ3	We poll participants once a year to assess the quality of our supply chain services	Our firm and this partner poll participants regularly to assess the quality of our supply chain services
KNACQ4	We periodically review the likely effect of changes in the supply chain environment	Our firm and this partner periodically review the likely effect of changes in the supply chain environment
KNACQ5	Formal routines exist to uncover faulty assumptions about the supply chain	Formal routines between our firm and this supply chain partner exist to uncover faulty assumptions about the supply chain

Note: original measures were adopted from (Hult et al., 2004).

### 7.6.2 Measures of Knowledge Internalization

Knowledge internalization is the process of storing, disseminating and combining existing knowledge with new knowledge in the organization. Because internalization of knowledge is normally implied in the internal process of the organization, it is difficult to capture the extent directly from the perspective of respondents. As has been discussed in Chapter 4, knowledge is more likely to be internalized or absorbed, when the focal firm is actively engaged in distributing and circulating the knowledge across the organization. Noticeably, Hult et al. (2004) employed the concept of information distribution activities to indicate the extent of the knowledge absorbed by supply chain partners. This approach is highlighted and adapted in the current study, because information distribution and dissemination indirectly measure the level of knowledge internalization and can be measured more explicitly.

Table 7-9 Measures of Knowledge Internalization

Item Label	Original Measures	Adopted Measures
KNDST1	Information about supplier performance is disseminated to other departments regularly	Information about a supply chain partner's performance is disseminated to other departments regularly
KNDST2	We discuss any new developments in our supplier relationships with other departments	We discuss any new developments in our supply chain relationships with other departments
KNDST3	We openly discuss supplier relationship management issues with others	We openly discuss supply chain relationship management issues with others
KNDST4	If something important happens with a supplier everyone involved is quickly informed	If something important happens with the supply chain everyone involved is quickly informed
Note: original measures were adopted from (Johnson and Sohi, 2003).		

Among various measures of information distribution developed by prior studies (e.g. Vazquez-Casielles et al., 2001; Calantone et al., 2002; Hult et al., 2004; Santos-Vijande et al., 2005), the scale of Johnson and Sohi (2003) was outstanding. The authors used a four-indicator 7-point likert-type scale to measure the level of information

dissemination in the context of interfirm partnership. The scale captures the learning activities within the firm. Given that knowledge internalization is an activity that largely takes place within the organization, the scale was adopted in the current study (see table 7-9). To be consistent throughout the thesis, the term “knowledge distribution” was used to represent knowledge internalization. In the following testing of the theoretical model, the term “knowledge distribution” was also used to replace the original concept of knowledge internalization.

### **7.6.3 Measures of Knowledge Utilization**

It has been previously stated that knowledge utilization is defined as the process of getting acquired skills and knowledge institutionalized into the organization’s internal processes and implementing such skills and knowledge into appropriate operations areas. The operationalization of knowledge utilization is an important task for the survey development. Unfortunately, an extensive literature review suggested that there is generally a lack of existing measures of knowledge utilization in the area of supply chain management and interfirm knowledge transfer. As was suggested in section 4.4.5, Research Use literature advocates three main dimensions of knowledge utilization, including instrumental use of knowledge, conceptual use of knowledge, and symbolic use of knowledge. The scales developed in this school of literature were adopted in developing the survey instrument in the current research.

#### ***7.6.3.1 Measures of Instrumental Use of Knowledge***

Instrumental use of knowledge refers to using knowledge in specific and direct ways to solve problems or applying it to commercial ends (see section 4.4.5). To operationalize instrumental use, a combination of scales developed by prior researchers and scales developed based on the conceptualization of prior studies were used (Deshpande and Zaltman, 1982; Menon and Varadarajan, 1992; Amara et al., 2004). To make the scale fit the current research context of supply chain partnership, the original items were reworded (see table 7-10).

Table 7-10 Measures of Instrumental Use of Knowledge

Item Label	Original Measures	Adopted Measures
INSTU1	Without the research information, the decisions made would have been very difficult	Without the information from supply chain partners, some of the decisions made in our company would have been very difficult
INSTU2	The majority of research information from this project was not used (Reverse coded)	The majority of information about the supply chain partner was ignored (Reverse coded)
INSTU3	How successful would you say that this research project was in resolving the key issues for which the project was designed	Knowledge generated from supply chain processes has been used in resolving some key issues of our company
INSTU4	The use of university research led to concrete action in my field of work	Knowledge from supply chain partners has been used in improving the performance of our company
INSTU5	The use of university research led to concrete action in my field of work	Knowledge gained from supply chain processes has been used in the daily operation of our company
INSTU6	No decision would have been made without this research information	Some of the decisions made in our company were based on information from supply chain partners
Note: original measures INSTU1, INSTU2, INSTU3, and INSTU6 were adopted from (Deshpande and Zaltman, 1982); INSTU4 and INSTU5 were developed based on the scale from (Amara et al., 2004).		

### 7.6.3.2 Measures of Conceptual Use of Knowledge

Conceptual use involves a firm's use of knowledge for general enlightenment, in other words, results influence actions, but in less specific and indirect ways (see also in section 4.4.5). The operationalization of the conceptual use of knowledge was developed based on the scales in prior studies (Beyer and Trice, 1982; Menon and Varadarajan, 1992; Amara et al., 2004). Some new items were based on the existing scales. For instance, items CNCPU1, CNCPU2, and CNCPU3 were extended from the single item scale of Amara et al. (2004). Other items were developed based on the conceptualization of conceptual use in prior studies (Beyer and Trice, 1982; Menon and Varadarajan, 1992). As shown in table 7-11, in all five conceptual use items were developed.

Table 7-11 Measures of Conceptual Use of Knowledge

Item Label	Original Measures	Adopted Measures
CNCPU1	The use of university research served to shed light on situations and problems in my field of work	The use of knowledge acquired from supply chain partners served to shed light on problems in our firm
CNCPU2	The use of university research served to shed light on situations and problems in my field of work	Our firm uses knowledge from supply chain partners to make situations more clear
CNCPU3	The use of university research served to shed light on situations and problems in my field of work	Our firm highlights the importance of knowledge generated from supply chain processes in making decisions
CNCPU4	Much of the use that provides for general enlightenment can be considered as developing the managerial knowledge base	Knowledge from supply chain partners is used to enrich the knowledge base of our firm
CNCPU5	Projects and studies provide concepts, assumptions, models and theories which can enter into a manager's orientation toward priorities, the manner in which they formulate problems, the range of solutions they convey and the criteria of choice they apply	Actions taken in our company have been influenced by information from supply chain processes

Note: CNCPU1, CNCPU2, and CNCPU3 were developed based on the scale from (Amara et al., 2004); CNCPU4 and CNCPU5 were developed based on (Menon and Varadarajan, 1992).

### 7.6.3.3 Measures of Symbolic Use of Knowledge

Symbolic use involves a firm's use of knowledge to legitimate and sustain a predetermined position, for example using knowledge selectively or otherwise distorting it to justify actions taken for other reasons (see also in section 4.4.5). Four items were developed based on the scales from (Amara et al., 2004), or the conceptualization of prior studies (Beyer and Trice, 1982; Menon and Varadarajan, 1992; Rich, 1997). As shown in table 7-12, four items were developed.

Table 7-12 Measures of Symbolic Use of Knowledge

Item Label	Original Measures	Adopted Measures
SYMBU1	The use of university research served to confirm choices already made in my field of work	The use of knowledge acquired from supply chain partners served to confirm choices already made in our company
SYMBU2	The use of university research served to confirm choices already made in my field of work	Information gained from supply chain partners has been used to confirm decisions already made in our company
SYMBU3	Symbolic use could be the partisan use of research findings to legitimize and sustain previously held dispositions	Knowledge from supply chain partners reinforces prior decisions of our company
SYMBU4	Symbolic use involves using research results selectively or otherwise distorting them to justify actions taken for other reasons	Knowledge from supply chain partners have been used to legitimize decisions of our company
Note: SYMBU1 and SYMBU2 were developed based on the scale from (Amara et al., 2004); SYMBU3 and SYMBU4 were developed based on (Beyer and Trice, 1982; Menon and Varadarajan, 1992; Rich, 1997).		

## 7.7 Operationalization of Performance Measures

Researchers in strategic management view performance improvement as the key issue to be addressed, given that performance is the centre and the ultimate goal of strategic management and of any business strategies (Venkatraman and Ramanujam, 1986).

Accordingly, the essential objective of supply chain knowledge transfer is to improve the performance of the supply chain and that of the partner firms. The organizational performance itself is an independent research discipline, which is largely beyond the remit of the current research. Despite that, this section mainly clarifies the performance measurement in the context of supply chain partnerships and the operationalization of both supply chain performance and market performance of the firm, as depicted in the theoretical framework developed in Chapter 5.

### 7.7.1 Market Performance Measurement

Literature in strategic management and managerial accounting suggests that, compared

to the traditional financial based performance measurements, it is better to employ a diverse set of measures to indicate firms' business performance. This is due to the concern that diversified measures rather than simply financial based measures are more beneficial in terms of conceptualization richness, measurement comprehensiveness, decision-making support, activity control, and alignment between operations and business objectives (Venkatraman and Ramanujam, 1986; Tan et al., 1998a; Yilmaz et al., 2005a).

Considering the scope of the market performance concept, Venkatraman and Ramanujam (1986) categorized market performance into three layers, namely, *financial performance*, *financial performance plus operational performance* (examples of operational performance measures are market share, new product introduction, and product quality) and *organizational effectiveness*. The three layers of performance domain move from narrow performance conceptualization to broad performance conceptualization. The categorization is regarded as important because different studies may rely on different levels of performance conceptualization to indicate the performance measurement.

Furthermore, by combining the concept of performance coverage layers and the concept of primary and secondary sources of performance data, Venkatraman and Ramanujam (1986) developed ten classifications of performance measurement approach, so that performance measurement employed by researchers could generally fall into one or the other categories. For instance, a measurement could focus on financial performance indicators from primary sources; or else a measurement could focus on financial performance indicators from secondary sources and on operational performance indicators from primary sources (for more details of the classification please refer to the paper of Venkatraman and Ramanujam (1986)). Through extensive review of prior business performance studies, the authors reached the viewpoint that a measurement that is broader than economic performance is better to be adopted, due to concern over the comprehensiveness of performance conceptualization.

Generally, literature from both theoretical and empirical perspectives advocates the importance of using a broader set of performance indicators than purely economic measures to evaluate the firm's performance (Tan et al., 1998a; Yilmaz et al., 2005a). Specifically, both financial and non-financial aspects of performance measures should be indicated in order to have a comprehensive understanding of the performance of a business organization. Due to the above concerns, the current research adopted the more commonly used scale of market performance adopted in previous research in the areas of operations management (e.g. Tan et al., 1998a; Wisner, 2003; Yilmaz et al., 2005a; Li et al., 2006).

Table 7-13 Measures of Market Performance

Item Label	Adopted Measures
MKPRFM1    Market share	
MKPRFM2    Return on total assets	
MKPRFM3    Average annual market share growth (over the past three years)	
MKPRFM4    Average annual sales growth (over the past three years)	
MKPRFM5    Average annual growth in return on total assets (over the past three years)	
MKPRFM6    Overall product quality	
MKPRFM7    Overall competitive position	
Note: measures were adopted from (Tan et al., 1999).	

This stream of market performance measurement not only covers the financial aspects of business performance, such as Return on Investment (ROI) and Return on Assets (ROA), but also business aspects of market performance (such as annual sales growth, market share, competitive position, and customer satisfaction) as well as the growth prospect of the firm (such as market share growth, sales growth, and growth in ROA). Typically, respondents were asked to rate their firms' performance in comparison to major market competitors. Thus, the measures largely captured the relative performance of the firm, which is frequently highlighted by prior researchers in survey studies as an efficient way of indicating a firm's performance (Robinson and Pearce,



1988). To make sure that not too much sensitive information was acquired from the respondents, the scale of Tan et al. (1999) which covers only a number of performance measures was adopted (see table 7-13).

### **7.7.2 Review of Supply Chain Performance Measurement**

It is worth noting that supply chain operations are highly specific to organizations and supply chain relationships, which does not allow researchers to develop general measurement criteria (Bullinger et al., 2002). The measurement that is adopted by each supply chain may differ due to the strategic focus of the firm (Brewer and Speh, 2000). As a result, there is a lack of a commonly agreed performance evaluation system in prior empirical studies. Thus, it is essential to have a clear view on the most appropriate performance indices, which will gain most benefit from the knowledge transfer, and how these performance indices could be measured in the scenario of supply chain knowledge transfer.

The operations of a supply chain exceed the scope of a single organization, since the supply chain consists of a chain or a network of organizations, including suppliers, manufactures, logistic providers, and distributors. Moreover, the supply chain involves the flow of materials, capital, and information across organizations, so the performance of a single organization in the chain is not sufficient to determine the performance of the whole supply chain process. The performance of the supply chain also could not be indicated simply by the aggregation of individual organizations' performance measures. This makes the supply chain performance measurement very different from that of a single organization.

The issue becomes more complicated when there is a lack of a standard measure for supply chain performance. Although various supply chain performance measures are available, they tend to differ significantly in terms of scope and focus (Kotabe et al., 2003). Researchers tend to focus on various aspects of operational goals when studying

the impact of supply chain management practices on the performance related to supply chain operations. Table 7-14 provides a list of supply chain performance measures covered by prior researchers, which provides evidence that various aspects of supply chain performance have been examined.

**Table 7-14 Different Aspects of Supply Chain Performance**

<b>Author(s)</b>	<b>Supply Performance Perspectives</b>
(Beamon, 1999)	Efficiency, customer service, respond effectively to change: Resources (e.g. distribution costs, manufacturing costs, inventory, and return on investment), output (e.g. fill rate, on-time deliveries, backorder/stockout, customer response time, and manufacturing lead time), and flexibility (e.g. volume flexibility, delivery flexibility, mix flexibility, and new product flexibility)
(Jayaram et al., 2000)	SC time performance (new product development time, manufacturing lead time, delivery speed, responsiveness to customers)
(Scannell et al., 2000)	12 measures of flexibility, innovation, quality, and cost
(Gunasekaran et al., 2001)	Competitive Priority (cost, quality, flexibility, delivery) based Supply chain performance (in Operational, tactical, strategic levels)
(Power et al., 2001)	Customer satisfaction
(Salvador et al., 2001)	Performance in punctuality of delivery; operations speed
(Spekman et al., 2002)	Cost reduction (inventory, delivery, shipping costs) Time reduction (cycle time, time to market, order processing time) Revenue (customer focus, customer satisfaction)
(Kotabe et al., 2003)	Supplier Performance Improvement (in product design, process design, product quality, lead time) in 2-3years time frame
(Hult et al., 2004)	Objective and subjective cycle time performance (order fulfillment)
(Humphreys et al., 2004)	Supplier performance improvement, buyer competitive advantage improvement, buyer-supplier relationship improvement

In the case of knowledge transfer studies, previous researchers have focused on varied performance aspects when disclosing the impact of knowledge transfer practices. For example, Kotabe, et al. (2003) examined the impact of link duration on the effect of interfirm technology transfer and technique exchange practices on the supplier performance. In this study, supplier performance is the focus, which captures a supplier's operational performance improvement relative to its earlier position in terms of process design, product design, product quality, and lead time. Moreover, Hult et al. (2004) used objective and subjective cycle times to indicate performance improvement

by knowledge development activities. Despite its contribution to the understanding of the positive impact on knowledge transfer activities, Hult et al.'s (2004) measure was regarded as insufficient because the performance of the supply chain is more than just to do with cycle time. To adequately capture the performance improvement due to knowledge transfer, there needed to be a more comprehensive measurement of knowledge transfer outcomes.

The review of supply chain management literature indicated that there are different performance measurement systems, which follow different theoretical approaches or have focused on different perspectives of supply chain operations. Generally, the existing measurements could be classified according to (1) levels of business management (Dreyer, 2000; Gunasekaran et al., 2001); (2) areas of supply chain operations (Brewer and Speh, 2000; Bullinger et al., 2002); (3) stakeholders involved (i.e., supplier performance, logistic performance, and buyer performance); (4) process of supply chain operations (Gunasekaran et al., 2001).

#### ***7.7.2.1 Level of Management***

Dreyer (2000) identified three supply chain performance measurement levels according to the modeling of the supply chain process, including *Operational*, *Tactical*, and *Strategic*. The operational measures deal with daily operations and processes; the tactical measures address variations in operational performance and examine the condition of achieving planned objectives; the strategic measures support the evaluation of the underlying business strategy and are mainly to do with the long-term progress of the firm. Accordingly, management should keep track of the supply chain performance, which is changing all the time, according to these three measurement levels. This implies that to understand the knowledge transfer and its effect on supply chain performance, it might be necessary to clarify the levels of performance that benefit from interfirm knowledge transfer.

### 7.7.2.2 Areas of Operations

To have a comprehensive measurement of supply chain performance, previous researchers have developed balanced scorecard systems which cover various aspects of supply chain operations and goals (Brewer and Speh, 2000; Bullinger et al., 2002). For instance, Brewer and Speh (2000) emphasized four aspects of Supply Chain Management (SCM) objectives, including SCM goals, customer benefits, financial benefits, and SCM improvement. Through linking these four aspects of supply chain objectives and the four aspects of the balanced scorecard framework (i.e. business process perspective, customer perspective, financial perspective, and innovation and learning perspective), the authors developed a system of supply chain performance measurement. Table 7-15 gives an illustration of items covered by the balanced scorecard. The framework is interesting in the sense that it emphasized the inter-functional and interfirm nature of the supply chain operations and recognized the need to coordinate and integrate between functions and between firms in the supply chain. Moreover, it also gives a balanced measurement between financial and non-financial aspects of the supply chain.

Table 7-15 A Supply Chain Balanced Scorecard Framework

		Goals	Measures
Balanced Scorecard Perspectives	<b>Financial Perspective</b>	<ol style="list-style-type: none"> <li>1. Profit margin</li> <li>2. Cash flow</li> <li>3. Revenue growth</li> <li>4. Return on assets</li> </ol>	<ol style="list-style-type: none"> <li>1. Profit margin by supply chain partner</li> <li>2. Cash-to-cash cycle</li> <li>3. Customer growth &amp; profitability</li> <li>4. Return on supply chain assets</li> </ol>
	<b>Customer Perspective</b>	<ol style="list-style-type: none"> <li>1. Customer view of product/service</li> <li>2. Customer view of timeliness</li> <li>3. Customer view of flexibility</li> <li>4. Customer value</li> </ol>	<ol style="list-style-type: none"> <li>1. Number of contact points</li> <li>2. Relative customer order response time</li> <li>3. Customer perception of flexible response</li> <li>4. Customer values ratio</li> </ol>

	<b>Internal Business Perspective</b>	1. Waste reduction 2. Time compression 3. Flexible response 4. Unit cost reduction	1. Supply chain cost of ownership 2. Supply chain cycle efficiency 3. Number of choices/average response time 4. % of supply chain target cost achieved
	<b>Innovation and Learning Perspective</b>	1. Product/process innovation 2. Partnership management 3. Information flows 4. Threats and substitutes	1. Product finalization point 2. Product category commitment ratio 3. Number of shared data sets/total data sets 4. Performance trajectories of competing technologies
Note: the table is adopted and modified from (Brewer and Speh, 2000).			

Similarly, Bullinger et al. (2002) developed a balanced measurement method to evaluate supply chain performance, which concentrates mainly on logistics organizations. The authors combined the SCOR (Supply Chain Operations Reference) model, developed by the Supply Chain Council, and the balanced scorecards approach. In this method, the traditional balanced scorecards, which are “enterprise internal oriented”, have been transferred and extended to a network capable approach – a supply network scorecard. In this framework, the development stages of supply chains, including *functional excellence*, *process excellence*, and *supply chain integration*, are acknowledged to align with the indicators in the balanced scorecard, including *financial perspective*, *customer perspective*, *organizational perspective*, and *innovation perspective*. See table 7-16 for an illustration of the balanced measurement framework and sample indicators of supply chain performance.

Table 7-16 Combined Balanced Scorecard Supply Chain Performance Indicators

	<b>Financial Perspective</b>	<b>Customer Perspective</b>	<b>Organizational Perspective</b>	<b>Innovation Perspective</b>
<b>Supply Chain Perspective</b>	1. Total supply chain costs 2. Total supply chain inventories 3. Total supply	1. Point of consumption product availability 2. Point of consumption	1. Supply chain relationship quality 2. Productivity loss 3. Perfect order fulfillment	1. Market share 2. New product time-to-market 3. New product time-to-first-make

	chain revenues	product quality		
<b>Process Perspective</b>	1. Return on investment 2. Return on capital employed 3. Cash-to-cash cycle 4. Revenues	1. Customer satisfaction 2. Customer loyalty 3. Customer complaints	1. Forecast accuracy 2. Planning process cycle 3. Schedule changes	1. Percent sales from new product 2. Percent employees in cross-functional teams
<b>Function Perspective</b>	1. Material acquisition cost 2. Inventory costs 3. Work in progress 4. Cost per unit produced 5. Freight costs 6. Picking costs 7. Transportation costs 8. Cash flow	1. On-time delivery 2. Order fill date 3. Order cycle time 4. Invoice accuracy 5. Number of back orders 6. Percent resolution on first customer call 7. Order track and trace performance	1. Incoming material quality 2. Inventory count accuracy 3. Out of stocks 3. Line item fill 4. Inventory turns 5. EDI transactions	1. Number of employee suggestions
Note: adopted from (Bullinger et al., 2002).				

### 7.7.2.3 Stakeholders in Supply Chain Management

Researchers have also classified the performance measure in terms of the main stakeholders in supply chain operations, such as suppliers, purchasers, and customers. Morash (2001) suggested that supply chain strategy could be classified as operational-excellence-focused or customer-closeness-focused. Based on this, supply chain performance falls into four categories: logistical cost, productivity, customer service, and quality. The first two categories are primarily supply-focused performance and the latter two are primarily demand-focused performance (Morash, 2001). Examples of these supply chain performance measures are shown in table 7-17.

Table 7-17 Supply-focused vs. Demand-focused Supply Chain Performance

Performance Measures	Supply-Focused		Demand-Focused	
	Cost Measures	Productivity Measures	Customer service Measures	Quality Measures
1	Total cost	Total productivity	Stockouts	Picking/shipping accuracy

		index		
2	Cost trend analysis	Warehouse labour productivity	Fill Rate	Overall reliability
3	Outbound freight cost	Units shipped per employee	On-time Deliveries	Delivery consistency
4	Cost per unit	Comparison to historical std.	Overall customer satisfaction	Document/Invoicing accuracy
5	Comparison of actual versus budget	Order entry productivity	Customer complaints	Shipping errors
6	Cost as a percentage of sales	Transport labour productivity	Complete orders	Order entry accuracy
7	Direct labour	Equipment downtime	Cycle time	Number of customer returns
Note: This list is not exhaustive. It only gives the top 7 important supply chain performance measurement according to the study of Morash (2001).				

#### **7.7.2.4 Supply Chain Processes**

Taking account of the prior developed supply chain performance measures, Gunasekaran et al. (2001) developed a supply chain performance metric based on the conceptualization of different stages of the supply chain operations process, including planning, sourcing, production, delivery, and customer service. The measurement metric as shown in figure 7-2, combines the three levels of performance in a supply chain, i.e. strategic, tactical and operational level performance, with the four basic links of the supply chain, i.e., plan, source, make/assembly, and deliver. This measurement metric is found to be much more comprehensive. To make the categories of performance more clear, table 7-18 gives an illustration of different measurement across levels of business operations and stages of the supply chain process.

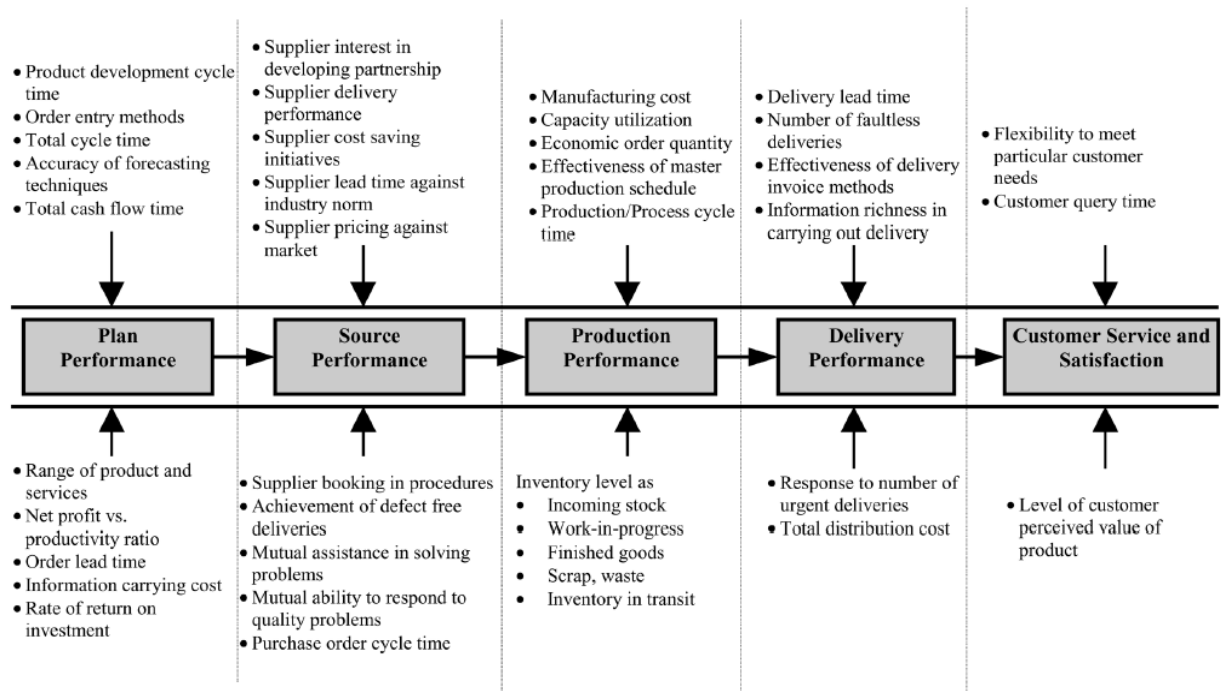


Figure 7-2 Measurement Metric at Four Basic Links in a supply chain

Source: (Gunasekaran et al., 2001)

Table 7-18 Performance measures by Management Level and Supply Chain Processes

Supply Chain Process	Management Level		
	Strategic	Tactical	Operational
<b>Plan</b>	Total cash flow time	Truthfulness of demand	Information carrying cost
	Rate of return on investment	Predictability/forecasting methods	
	Total cycle time	Product development cycle time	
	Order lead time	Accuracy of forecasting techniques	
	Range of product and services		
<b>Source</b>	Supplier delivery performance	Supplier cost saving initiatives	Achievement of defect-free deliveries by supplier
	Supplier lead time against industry norm	Supplier ability to solve quality problems	Purchase order cycle time
		Supplier assistance in solving technical problems	
		Supplier pricing against market	



<b>Production</b>	Production/Process cycle time	Extent of co-operation to improve quality	Manufacturing cost
		Inventory levels	Capacity utilization
		Effectiveness of master production schedule	Inventory carrying cost
<b>Delivery</b>	Delivery lead time	Total transportation cost	Number of faulty deliveries
		Effectiveness of delivery invoice methods	Frequency of delivery
		Information richness in carrying out delivery	Quality of delivery documentation
		Delivery reliability	
		Responsiveness to urgent deliveries	
<b>Customer service</b>	Level of customer-perceived value of product Flexibility to meet particular customer needs Customer query time		

Note: Developed based on (Gunasekaran et al., 2001).

### 7.7.3 Operationalization of Supply Chain Performance

It will be remembered that this research sought to explore the influence of knowledge transfer on supply chain performance. Since prior literature did not reach agreement on which aspects of supply chain performance are more likely to benefit from knowledge transfer activities, there is little reason to exclude one or the other aspect of supply chain performance indicators. Thus, taking account of the comprehensiveness of Gunasekaran et al.'s (2001) framework, the current research will adopt this measurement system to develop the scale of supply chain performance.

However, given that supply chain operations may differ from sector to sector, some performance measures may not be applicable to all firms. Therefore, only a number of supply chain performance indicators were chosen to build up the final scale. During this reduction process, the author also considered the business nature of Baogang and its supply chain partners. Table 7-19 provides a list of adopted supply chain

performance measures. A relative-term scale was used, so that respondents were asked to rate each performance indicator in comparison to major industrial competitors.

Table 7-19 Adopted Measures of Supply Chain Performance

	Performance Measures
Plan (3 items)	Total Cycle Time
	Order Lead Time
	Information Carrying Cost
Source (2 items)	Achievement of Defect Free Delivery
	Purchase Order Cycle Time
Production (3 items)	Production Cycle Time
	Extent of Quality Cooperation
	Capacity Utilization
Delivery (3 items)	Delivery Lead Time
	Delivery Reliability
	Responsiveness to Urgent Delivery
Customer service (3 items)	Customer Query Time
	Flexibility to Meet Particular Needs
	Overall Customer Service
Note: 14 items of supply chain performance adopted from (Gunasekaran et al., 2001).	

## 7.8 Control Variables

To explore whether there are varied effects of supply chain partnership characteristics on knowledge transfer and varied effects of interfirm knowledge transfer on a firm's performance across different sample groups, two control variables were introduced: (1) contract status, and (2) upstream/downstream in the supply chain.

### 7.8.1 Contract Status

As was highlighted in Chapter 3, explicit or formal contractual agreement is neither a sufficient nor necessary condition of strong partnership, due to the particular characteristics of supply chain partnership. However, it is still interesting to find out whether contract status will have an effect on the knowledge transfer process.

Therefore, an item was established to identify whether or not there was a written

contract of cooperation between the responding firm and its supply chain partner.

### **7.8.2 Upstream or Downstream**

Because the nature of its business as well as the nature of its supply chain operations could differ based on its position either upstream or downstream in the supply chain, it is interesting to find out whether the responding partnership is upstream or downstream in Baogang's supply chain. A number of items were introduced to identify the responding firm's position in the supply chain, which will be discussed in detail in section 7.9.1.

## **7.9 Questionnaire Layout**

The design of the layout of the questionnaire largely followed the principle of Tailored Design Method (Dillman, 2000). The questionnaire was designed so that it was as clear and easy to answer as possible. The main questionnaire consisted of four parts: (1) a covering letter, which explained the purpose and content of the questionnaire, and benefits to the business, issues of confidentiality, and so on (see Appendix 1); (2) a cover page, which contained the title of the questionnaire and gave some basic instructions on answering the questionnaire; (3) terms and definitions, which gave some explanation of terms which respondents may not have been familiar with, such as 'knowledge transfer' and 'supply chain partnership'; (4) the main body of questionnaire, which consisted of six sections. At the beginning of each section, some brief instructions were provided on how to answer questions in the corresponding section.

### **7.9.1 Screening Questions**

This research sought to get the information about interfirm activities from a single firm's perspective. The author needed to identify not only the focal firm's situation, but also the situation of its supply chain partnership based on a single questionnaire. Issues

such as how to identify the right supply chain partnership, how to identify the upstream or downstream in the supply chain were addressed carefully. The current research largely consults the practices of prior studies to address these issues, and a number of screening questions were set up. As shown in the questionnaire (see Appendix 1), the first two sections of the questionnaire main body contained a number of screening questions, which helped to identify the supply chain partnership of the focal firm, its location in the supply chain, and the contract status of the partnership.

First of all, because the respondents could be a subsidiary of Baogang or an external firm, a screening question of “Is your firm a part of or a subsidiary of Baogang?” was asked. Thus, if the respondent gave a positive answer, i.e. the firm is a department or a subsidiary of Baogang, the respondent would be lead to section 2 of questionnaire, where he/she would be asked to refer to one of the “most important” supply chain partners his/her firm has direct contact with. On the other hand, if the respondent gave a negative answer, i.e. the firm is an external firm, the respondent would be asked to continue to answer section one.

Secondly, if the respondent is an external firm, he/she would then be asked, “Do you consider the relationship between your firm and Baogang as a supply chain partnership”. If a positive answer was given, i.e. the responding firm has a direct partnership with Baogang, the respondent would be asked to skip section 2, so that he/she would be asked to refer to the relationship with Baogang to answer the following questionnaire. On the other hand, if a negative answer was given, i.e. there is no partnership with Baogang, respondents would be lead to section 2, where he/she would be asked to refer to one of the “most important” supply chain partners his/her firm has direct contact with. Respondents were asked to identify a partner firm in the supply chain, which perform complementary functions in the order fulfillment process in the supply chain, and hence relate their answers to this partner firm. Thus, the context was set for the respondent to answer the questions.

Thirdly, to identify whether the partnership is upstream or downstream in Baogang's supply chain, two screening questions were included at section one and section two. In section 1, the respondent would be asked "Does your firm directly sell products or services to Baogang?" and "Does your firm directly purchase products or services from Baogang?". In section 2, the respondent would be asked to select two options which best describe the business relationship between the responding firm and the chosen supply chain partnership. Bearing in mind that the respondent was now referring to an external partner instead of Baogang. The two options were "This partner SUPPLIES goods and services to our firm" and "This partner PURCHASES goods and services from our firm". Through these questions, the author was able to identify whether the corresponding partnership is upstream or downstream in Baogang's supply chain.

Fourthly, to identify the contractual status of the partnership, two questions "Does your firm have a written contract or agreement with Baogang?" and "Does your firm have a written contact or agreement with this supply chain partner?" were asked at section 1 and 2, respectively.

### **7.9.2 Main Body of Questionnaire**

Section 1 of the main body "Supply Chain Relationship between Your Firm and Baogang" asked for the responding firm's relationship with Baogang. As discussed in the previous section, some screening questions were included.

Section 2 "About an Important Supply Chain Partner of Your Firm" asked for the responding firm's relationship with the chosen supply chain partner, and the profile of that supply chain partner.

Section 3 "Nature of Relationship with This Partner" asked for the nature of the cooperation between the responding firm and its supply chain partner (i.e. either Baogang or a chosen partner). A 7-point likert-type scale was used in all of these

questions, so that respondents would circle from “7 – strongly agree” to “1 – strongly disagree”. To avoid the respondents giving the same answer to every related question, the order of questions was randomized. Thus, there was no clear pattern in the content of the questions.

Section 4 of the main body “Learning and Interfirm Knowledge Transfer Activities” asked about the knowledge management activities of the responding firm and interfirm knowledge transfer with its supply chain partner. Again, a 7-point likert-type scale was used in all of these questions, and the order of questions was randomized.

Section 5 “Firm and Supply Chain Performance” asked for the responding firm’s performance in terms of supply chain performance and general market performance. Respondents were asked to rate the level of performance in comparison with major market competitors. A seven-point scale was used, so that the respondent would rate from “7 – Above average” to “1 – Below average”. Clear titles were given to each category of performance measures, so that respondents would have a clear idea of which performance area they were considering.

Section 6 “About Your Firm and You” included some profile questions of the responding firm and the respondents. This section was placed at the end of the questionnaire to avoid the respondents having a sense of resistance from the beginning. The last question asked whether the respondent was willing to have a summary of the survey results. This was to give respondents a sense of reciprocity, and also increase the chance of having a completed questionnaire.

## **7.10 Translation-back-translation**

Because the questionnaire was developed in English, and the questionnaire was delivered in China, the questionnaire needed to be translated into Chinese. The author needed to be very careful in translation to ensure that the Chinese version of the

questionnaire was consistent in meaning and maintained the same face validity. Following the experience of prior researchers (Maxwell, 1996; Kim and Lim, 1999), a translation-back-translation process was followed.

As can be seen in figure 7-3, the original English version was first translated into Chinese, in which cultural factors were taken into account. The first version of the Chinese questionnaire was then translated back into English by another Chinese researcher. The new English version and the original English version of the questionnaire were compared by a small group of English speaking researchers to make sure that the two English versions were consistent in meaning. If so, it would mean that the translation of the Chinese version was successful. If not, items whose meaning diverted in the first Chinese version needed to be modified (Chinese version 2). It would then be translated into English (English version 2), and be compared again with the original English version to ensure consistency in meaning. The process continued until a satisfactory Chinese questionnaire was reached.

Actually, since the original items are quite simple, after the first round of back translation, most items were found to have consistent meanings. Thus, only a small number of items were modified for the second round of back translation, including TRUST4, COMIT4, SHAMG3, KNACQ5, CNCPU1, and SYMBU4.

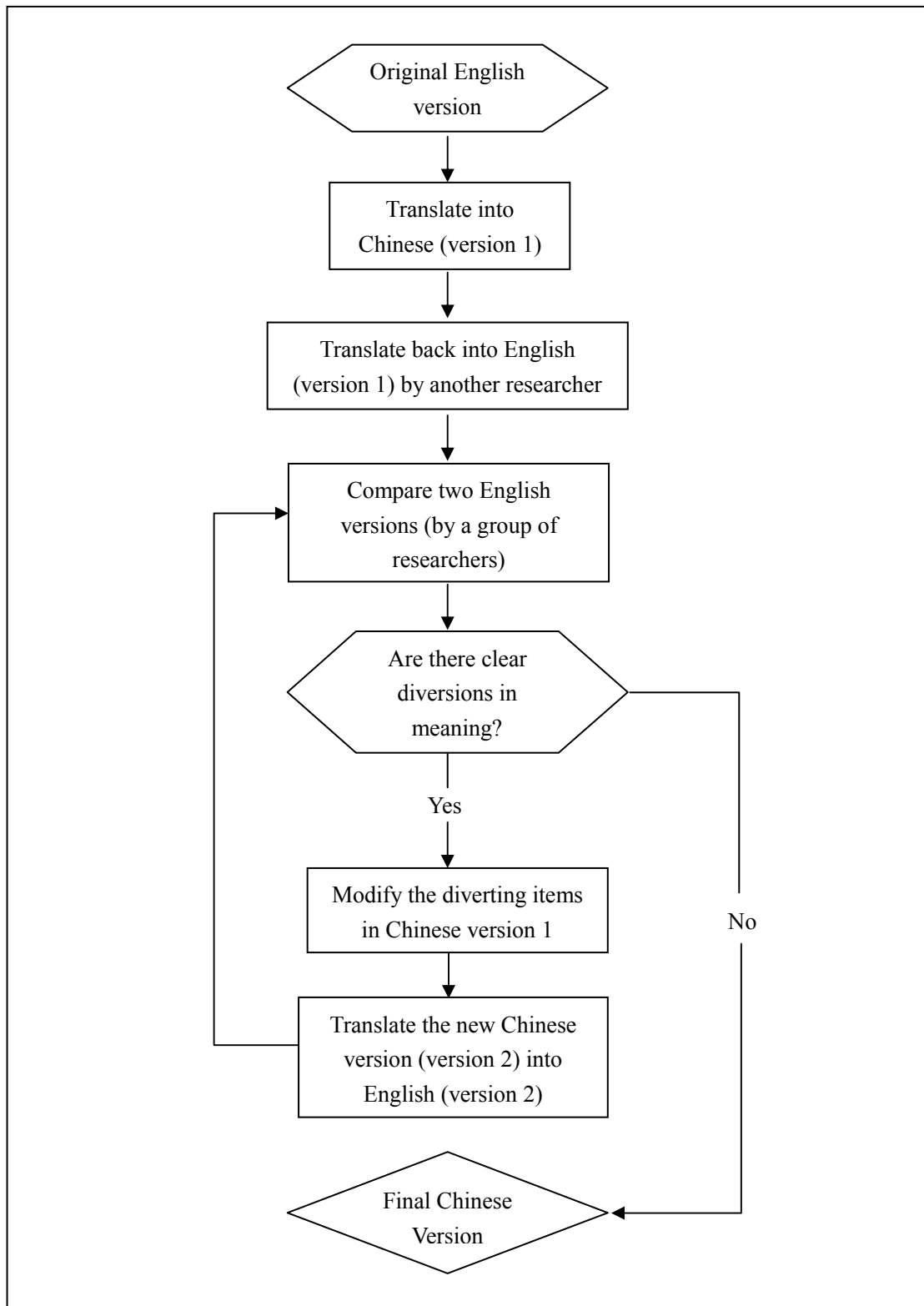


Figure 7-3 Translation-back-translation Process



## **7.11 Instrument Refinement and Survey Execution**

Due to the constraints of time and resources, a large scale pilot study was not carried out. Nevertheless, to ensure the face validity and content validity of the survey instrument, a number of pilot interviews were conducted with expert academics and practitioners in the UK and China. As Creswell (1994, p. 121) mentioned, “face validity refers to whether items appear to measure what the instrument purports to measure”, and “content validity refers to whether items measure the content they were intended to measure.”

First of all, before the back translation process, the English version of the questionnaire was reviewed by three academics in the UK for the feasibility of the questions. Their opinions were used to refine the wording of some questions and the layout of the questionnaire. Secondly, the refined questionnaire was reviewed by two managers in the UK to attract the opinions of practitioners on the feasibility and relevance of the questionnaire, which helped the author arrive at the final English version of the questionnaire. Thirdly, after the back translation process, the Chinese version of the questionnaire was emailed to five senior managers in Chinese companies (three in the steel industry, two in the electronics industry). After they reviewed the questionnaire, telephone interviews were conducted to get their opinions on the feasibility, understandability, and relevance of items with respect to various research concepts, as well as the quality of the questionnaire. Their opinions were also used to modify the wording of the Chinese version of the questionnaire. Therefore, face validity and content validity were gained for both English and Chinese versions of the questionnaire.

As mentioned before, instead of following a random sampling method, a “snowball sampling” approach was followed in this research. Initial agreement on survey execution was gained in early 2006, by which time the management had agreed to provide assistance in identifying respondents and delivering the questionnaire (see also in section 7.3.2). Two rounds of questionnaire delivery were conducted from December 2006 to April 2007. During this period constant telephone calls were made to the coordinator at

Baogang to monitor and assist the delivery process. The first round of the questionnaire delivery started in November 2006. Questionnaires were mainly delivered to the subsidiaries and strategic business units (SBUs) of Baogang. The key informant method was used, so that one senior member of the management team would represent the corresponding organization. In cases where senior managers were not available, the questionnaires were delivered to senior members of staff in the area of purchasing, production, or distribution, who were thought to have considerable experience or knowledge in supply chain operations. By January 2007, a total of 120 questionnaires were received, of which 109 were usable.

Most of the first round questionnaires were collected in person. A rough list of responding organizations was provided by the coordinator from Baogang. Based on this list, the second round survey was conducted in February 2007. The questionnaires were delivered to the first round responding firms. They were asked to pass on the questionnaire to their known supply chain partners outside of Baogang, either upstream or downstream in their supply chain process. Again the key informant method was used.

Table 7-20 Number of Usable Questionnaires

	Received questionnaire	Usable questionnaire	Percentage
First round (Nov 2006 – Jan 2007)	120	109	90.8%
Second round (Feb 2007 – Apr 2007)	336	304	90.5%
Total	456	413	90.6%

In cases where there was no known supply chain partner, they were instructed to deliver the questionnaire to their external business partners with which they have frequent contacts. These contacts would then be instructed to refer to their supply chain partner to answer the questionnaire. The intention was that not only first tier partners but also second tier or third tier partners would be reached by the survey. By April 2007, 336 questionnaires were received, of which 304 were usable. The remainder were discarded, as being incomplete or having clear contradictions. Therefore, there were a total of 413

usable questionnaires received (see table 7-20).

## **7.12 Summary**

This chapter detailed the process of survey development and execution. Total Design Method (Dillman, 2000) was followed to construct the questionnaire. This research largely adopted the existing scales from prior published studies following a consistent approach of adoption. Necessary modifications were made to the original items in order to make them suitable to the current research context. Attention was paid to the layout of the questionnaire, so that it enabled the author to identify different types of supply chain partnership from respondents and also encouraged a good response rate. Since the questionnaire was developed in English, a translation-back-translation process was followed to have a consistent Chinese version of the questionnaire. A small scale pilot study and interviews were conducted with experts and managers to gain face validity and content validity of the questionnaire. Thanks to the cooperation from Baogang's management, the survey was conducted successfully with 413 usable questionnaires collected from subsidiaries and SBUs of Baogang as well as from outside supply chain partners.

## CHAPTER 8 DEMOGRAPHIC ANALYSIS

### 8.1 Preamble

A good understanding of the responding firm paves the way for a more sophisticated analysis. This chapter provides a demographic analysis of the 413 responses. The characteristics of respondents and responding firms are analyzed in detail. The characteristics of the supply chain partnerships in the response are also reported. The demographic analysis enables the author to have a clearer understanding of the respondents and the firms they represented. The information provided by the analysis helps the author further in assessing the quality of respondents, in screening data, as well as carrying out further statistical analysis. Although the demographic data is presented in this chapter, it has been subjected to a process of data preparation beforehand, which is presented in detail in the next chapter.

### 8.2 Status of Respondents

As shown in table 8-1, 11.1% of respondents were at the top management level in their firms. 39% of respondents were senior managers. 23.5% were at the first line management level. Therefore, the majority of respondents (73.6%) were at management level in their firms. It is reasonable to argue that respondents with more management experience should have a better understanding or more knowledge of the operations of their department or firm, and be able to provide relevant answers to the survey questions.

Table 8-1 Position of Respondent

Position	Frequency	Percent (%)
Senior Manager	161	39.0
First Line Manager	97	23.5
Operating Staff	90	21.8
CEO/Chairman/Managing Director	46	11.1
Administrative Staff	19	4.6
Total	413	100.0

Almost half (46.5%) of the respondents' jobs were related with purchasing and procurement or distribution of products (see table 8-2). 13.6% of respondents' jobs were directly related with production. For those who gave "N.A." to the item, most were senior managers or top managers whose job may be related with multiple working areas in their firms. There were also respondents working in areas of customer service, finance, and R&D of their firms.

As shown in table 8-3, the majority of respondents (80.6%) had more than 2 years of working experience at their current position or working area, which ensures that they had sufficient understanding and knowledge to the situation of their department or firm.

Table 8-2 Working Area of Respondent

<b>Working Area</b>	<b>Frequency</b>	<b>Percent (%)</b>
Purchasing and Procurement	113	27.4
Distribution	79	19.1
Production	56	13.6
Customer Service	28	6.8
Finance	20	4.8
Design and Development	18	4.4
N.A	99	24.0
Total	413	100.0

Table 8-3 Duration at Position of Respondent

<b>Duration</b>	<b>Frequency</b>	<b>Percent (%)</b>
Less than 6 months	3	0.7
7 month to 1 year	19	4.6
1 to 2 years	58	14.0
3 to 4 years	128	31.0
More than 5 years	205	49.6
Total	413	100.0

### 8.3 About the Responding Firms

Since the survey was conducted in the supply chain of the steel industry, the responding firms are all directly or indirectly related to the production, distribution or processing of steel or other related products or services. As shown in table 8-4, responding firms covered 31 sectors, which range from raw material to machinery, and from IT to Chemicals. Typical responding sectors include steel processing and associated products, machinery & equipment, round steel, rare-earth production and associated products, and marketing and distribution.

Table 8-4 Industrial Sector of Responding Firms

Sector	Frequency	Percent (%)
Steel Processing and Associated Product	48	11.6
Machinery & Equipment	37	9.0
Round Steel	37	9.0
Rare-earth Associated Product	28	6.8
Marketing & Distribution	26	6.3
Automobile & Motor	25	6.1
Steel Production General	21	5.1
Industrial Chemical	18	4.4
Iron Mining and Extraction	15	3.6
Railway Lorry & Motor	14	3.4
Coal Mining and Processing	13	3.1
Recycling	13	3.1
Accessory & Component	13	3.1
New Material	12	2.9
Storage & Logistics	11	2.7
Seamless Steel Tube	10	2.4
Building & Construction	10	2.4
Metallurgy Assistant Material	8	1.9
International Trade	7	1.7
Rare-earth Production	6	1.5
Railway	6	1.5
Steel Plate	6	1.5
IT & Electronics	5	1.2
Fireproof Product	5	1.2
Crane	4	1.0

Research & Design	4	1.0
Rolling Mill	4	1.0
Cement	3	.7
Labour Protection Product	2	.5
Oil and Petrol	1	.2
Chemical and Technical Services	1	.2
Total	413	100.0

As shown in table 8-5, this survey covered a good number of medium to large organizations with more than 200 employees (55.2%). This is mainly because many firms surveyed are heavy-duty industrial companies, which tend to be larger organizations.

Table 8-5 Numbers of Employees of Responding Firms

Number of Employees	Frequency	Percent
Less than 50 employees	76	18.4
50 to 99 employees	54	13.1
100 to 199 employees	55	13.3
200 to 499 employees	73	17.7
More than 500 employees	155	37.5
Total	413	100.0

## 8.4 Partnership Location in the Supply Chain

Because the survey was delivered to Baogang and its supply chain partners, and the respondents were asked to report on one highly important supply chain partner of their business, the partnerships reported do not necessarily cover only direct partnerships with Baogang, different types of direct or indirect partnership could be included. As shown in table 8-6, eight types of supply chain partnership in Baogang's supply chain were covered by the survey.

For upstream supply chain partnerships (in which firms are supplying goods or services to Baogang), there could be direct or indirect partnerships. For direct partnerships,

surveys were collected from either the direct partner's side or from Baogang's side. In cases where surveys were collected from Baogang's side, those surveys were mainly collected from the departments or subsidiaries of Baogang. For indirect partnerships, surveys were collected from firms that provide goods or services to Baogang but with an exchange relationship. Those firms were reporting on their own partner firms that either supply them or purchase from them.

For downstream supply chain partnerships (in which firms are purchasing goods or services from Baogang Group), there could also be direct or indirect partnerships. Again, surveys were collected from Baogang, Baogang's direct partner, and indirect partners. Here indirect partners are those normally having an exchange relationship with Baogang, but supplying their own partners or purchasing from their own partners.

Table 8-6 Type of Responding Partnership with Respect to Position in Supply Chain

Partnership Type	Frequency	Percent (%)
Upstream direct partnership, partner side	102	24.7
Downstream direct partnership, partner side	95	23.0
Upstream direct partnership, Baogang side	64	15.5
Downstream indirect partnership <sup>a</sup>	53	12.8
Downstream direct partnership, Baogang side	45	10.9
Downstream indirect partnership <sup>b</sup>	19	4.6
Upstream indirect partnership <sup>b</sup>	18	4.4
Upstream indirect partnership <sup>a</sup>	17	4.1
Total	413	100.0
Note: a. purchaser side of an indirect partnership; b. supplier side of an indirect partnership.		

Figure 8-1 gives an illustration of the location of surveyed firms in Baogang's supply chain and the number of responding firms in each category. Overall, the current survey included 201 (or 48.7%) upstream and 212 (or 51.3%) downstream supply chain partnerships. Among the total of 413 responses, 306 (or 74.1%) reported direct partnerships with Baogang and 107 (or 25.9%) reported indirect partnerships with



Baogang. Moreover, among direct partnerships, 166 (or 54.2%) are upstream partners, and 140 (or 45.8%) are downstream partners. Among indirect partnerships reported, 35 (or 32.7%) are located upstream in the supply chain, while 72 (or 67.3%) are located downstream in the supply chain.

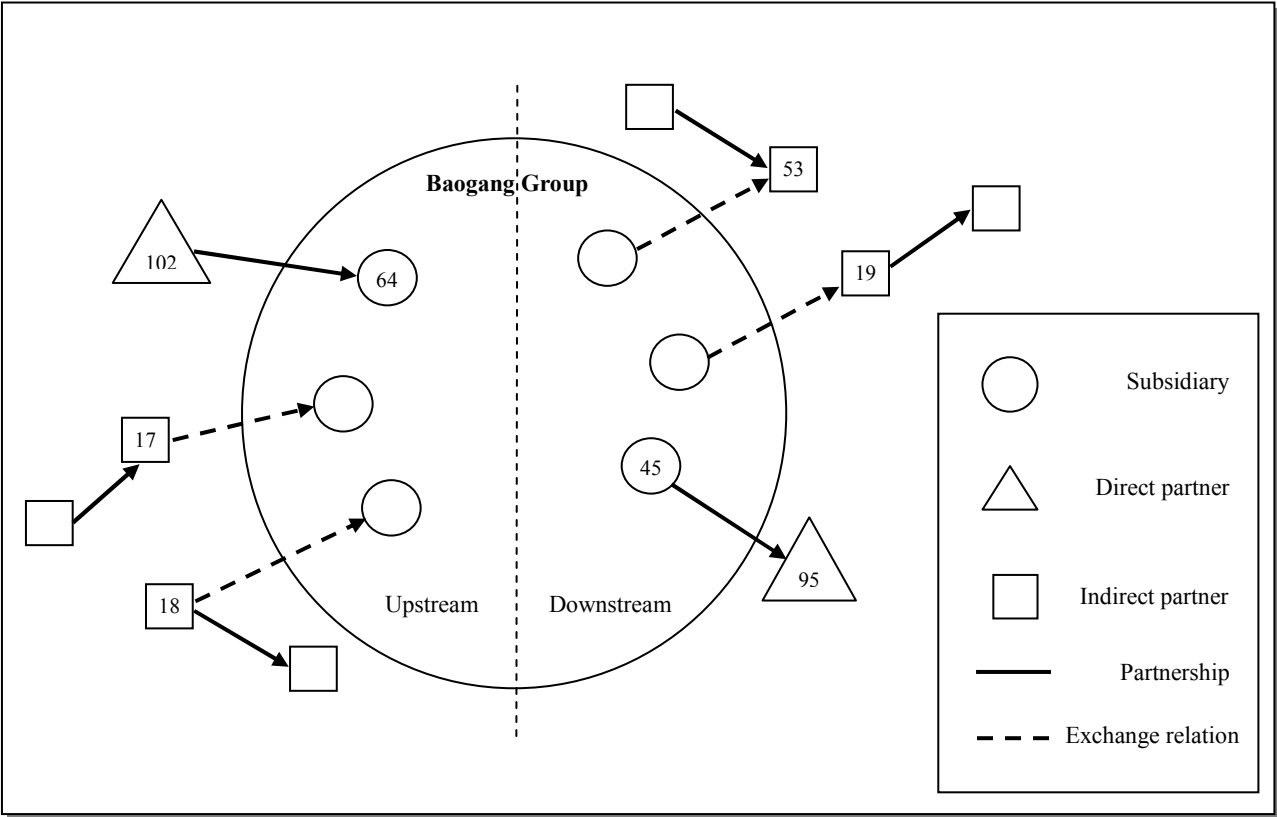


Figure 8-1 Map of Responding Supply Chain Partnerships and Number of Respondents

Table 8-7 and table 8-8 indicate the industrial sectors of responding firms (including subsidiaries of Baogang) upstream and downstream in Baogang’s supply chain respectively. It shows that the four most frequently reported sectors upstream in the supply chain are Machinery & Equipment, Round Steel Production, Rare-earth Production, Iron Mining & Extraction. On the other hand, the four most frequently reported sectors downstream in the supply chain are Steel Processing and Associated Products, Automobile & Motor, Marketing & Distribution, and Railway Lorry & Motor. Overall, upstream responding firms tend to be more concentrated on production of raw materials (in this case, Steel) or equipment in support of the production of raw materials. Downstream responding firms tend to be more concentrated on producing and generating associated products from steel, as well as marketing and distribution of related products.

This difference may be important to note as it makes a difference to the nature of the supply chain knowledge transfer, because different sectors could have different requirements for knowledge and information.

Table 8-7 Sectors of Responding firms Upstream in the Supply Chain

	Frequency	Percent (%)
Machinery & Equipment	26	12.9
Round Steel	24	11.9
Rare-earth Associated Product	16	8.0
Iron Mining and Extraction	15	7.5
Steel Production General	15	7.5
Coal Mining and Processing	13	6.5
Industrial Chemical	11	5.5
Recycling	10	5.0
Steel Processing and Associated Product	9	4.5
New Material	9	4.5
Metallurgy Assistant Material	8	4.0
Marketing & Distribution	5	2.5
IT & Electronics	5	2.5
Fireproof Product	5	2.5
Crane	4	2.0
Research & Design	4	2.0
Storage & Logistics	3	1.5
Rolling Mill	3	1.5
Accessory & Component	2	1.0
Cement	2	1.0
International Trade	2	1.0
Rare-earth Production	2	1.0
Labour Protection Product	2	1.0
Steel Plate	2	1.0
Railway	1	.5
Oil and Petrol	1	.5
Chemical and Technical Services	1	.5
Building & Construction	1	.5
Total	201	100.0

Table 8-8 Sectors of Responding firms Downstream in the Supply Chain

	Frequency	Percent (%)
Steel Processing and Associated Product	39	18.4
Automobile & Motor	25	11.8
Marketing & Distribution	21	9.9
Railway Lorry & Motor	14	6.6
Round Steel	13	6.1
Rare-earth Associated Product	12	5.7
Machinery & Equipment	11	5.2
Accessory & Component	11	5.2
Seamless Steel Tube	10	4.7
Building & Construction	9	4.2
Storage & Logistics	8	3.8
Industrial Chemical	7	3.3
Steel Production General	6	2.8
International Trade	5	2.4
Railway	5	2.4
Rare-earth Production	4	1.9
Steel Plate	4	1.9
Recycling	3	1.4
New Material	3	1.4
Cement	1	.5
Rolling Mill	1	.5
Total	212	100.0

Table 8-9 and table 8-10 illustrate the sector of responding firms involved in direct or indirect partnerships with Baogang. As expected, compared with the business nature of firms in indirect partnerships, businesses of firms in direct partnerships are more closely related to the main business of Baogang, which is the production of steel and rare-earth related products.

Table 8-9 Sectors of Responding Firms Involved in Direct Partnerships

	Frequency	Percent (%)
Round Steel	37	12.1
Steel Processing and Associated Product	32	10.5
Rare-earth Associated Product	25	8.2
Machinery & Equipment	23	7.5
Steel Production General	21	6.9
Marketing & Distribution	19	6.2
Industrial Chemical	16	5.2
Recycling	12	3.9
Railway Lorry & Motor	11	3.6
New Material	11	3.6
Storage & Logistics	11	3.6
Iron Mining and Extraction	10	3.3
Coal Mining and Processing	8	2.6
Metallurgy Assistant Material	8	2.6
International Trade	7	2.3
Steel Plate	6	2.0
Building & Construction	6	2.0
Railway	5	1.6
Rare-earth Production	5	1.6
Automobile & Motor	5	1.6
Fireproof Product	4	1.3
IT & Electronics	4	1.3
Rolling Mill	4	1.3
Research & Design	4	1.3
Seamless Steel Tube	3	1.0
Cement	3	1.0
Accessory & Component	3	1.0
Crane	1	.3
Labour Protection Product	1	.3
Oil and Petrol	1	.3
Total	306	100.0

Table 8-10 Sectors of Responding Firms Involved in Indirect Partnerships

	Frequency	Percent (%)
Automobile & Motor	20	18.7
Steel Processing and Associated Product	16	15.0
Machinery & Equipment	14	13.1
Accessory & Component	10	9.3
Seamless Steel Tube	7	6.5
Marketing & Distribution	7	6.5
Coal Mining and Processing	5	4.7
Iron Mining and Extraction	5	4.7
Building & Construction	4	3.7
Railway Lorry & Motor	3	2.8
Rare-earth Associated Product	3	2.8
Crane	3	2.8
Industrial Chemical	2	1.9
IT & Electronics	1	.9
Recycling	1	.9
Rare-earth Production	1	.9
Chemical and Technical Services	1	.9
Labour Protection Product	1	.9
New Material	1	.9
Railway	1	.9
Fireproof Product	1	.9
Total	107	100.0

## 8.5 Status of the Supply Chain Partnerships

The author was also interested in the contract status between supply chain partners and the duration of supply chain partnerships at the time of the survey. As shown in table 8-11, 69% of supply chain partnerships were reported to have a written contract or cooperation agreement, while 31% of partnerships were reported to have no written contract or a contract which was not recognizable. With respect to partnership duration, table 8-12 showed that almost half of the partnerships (48.4%) have a history of more than 6 years. This suggested that many of respondents tend to indicate relatively more

mature partnerships when answering the survey. Nevertheless, there are still a good proportion (51.6%) of younger partnerships reported.

Table 8-11 Supply Chain Partnership Contract Status

<b>Contract</b>	<b>Frequency</b>	<b>Percent (%)</b>
Yes	285	69.0
No or Unclear	128	31.0
Total	413	100.0

Table 8-12 Supply Chain Partnership Duration

<b>Duration</b>	<b>Frequency</b>	<b>Percent (%)</b>
Less than 1 year	42	10.2
1 to 3 years	82	19.9
4 to 6 years	89	21.5
7 to 9 years	34	8.2
10 years or more	166	40.2
Total	413	100.0

To find out whether there are associations between duration of partnership and contract status, a cross-tabulation was run with the dataset. To retain a reduced but viable number of categories while still ensuring these contained sufficient cases, the duration variable was converted into two categories, either long partnership (7 years or more) or short partnerships (less than 7 years). This combination ensured that each category of partnership duration has around half of the cases (51.6% for short and 48.4% for long). The cross-tabulation shows that there is a slightly higher proportion of older partnerships that have no contract or where the contract is not recognizable (see table 8-13). Meanwhile, a higher proportion of younger partnerships have an explicit partnership contract. The significant Chi-square statistic ( $p=0.033$ ) gives some evidence that there is an association between partnership duration and contract status. This result supported the previous theorization that mature supply chain partnerships tend to rely less on the

written agreement (see section 3.5.2).

Table 8-13 Cross-tabulation of Contract Status and Partnership Duration

		Long or Short Duration		Total
		Short Duration	Long Duration	
Partnership Contract Status	Yes	Count	157	128
		% within Long or Short Duration	73.7%	64.0%
	No or Not Clear	Count	56	72
		% within Long or Short Duration	26.3%	36.0%
Total	Count		213	200
	% within Long or Short Duration		100.0%	100.0%
				413

Note: Pearson Chi-square=4.546, df=1, p=0.033; Continuity Correction=4.104, df=1, p=0.043.

It was also interesting to find out whether the contract status of the supply chain partnership has an association with partnership location in the supply chain. The cross-tabulation gave a significant Chi-square statistic ( $p=0.004$ ), which suggested that there is strong evidence that contract status and location in the supply chain are associated. As shown in table 8-14, a higher proportion of downstream supply chain partnerships tend to have a written contract, whilst a higher proportion of upstream supply chain partnerships tend to have no written contract or a contract which is not recognizable. Given that upstream supply chain partnerships tend to have longer duration, and therefore, are more mature (as shown in the cross-tabulation in table 8-15), it is reasonable to find fewer upstream partnerships having an explicit contract.

Table 8-14 Cross-tabulation of Contract Status and Partnership Location

			Upstream or Downstream Chain		Total
			Up	Down	
Partnership Contract Status	Yes	Count	125	160	285
		% within Upstream or Downstream Chain	62.2%	75.5%	69.0%
	No or Not Clear	Count	76	52	128
		% within Upstream or Downstream Chain	37.8%	24.5%	31.0%
	Total		201	212	413
			100.0%	100.0%	100.0%

Note: Pearson Chi-square=8.511, df=1, p=0.004; Continuity Correction=7.902, df=1, p=0.005.

Table 8-15 Cross-tabulation of Partnership Location and Partnership Duration

			Upstream or Downstream Chain		Total
			Up	Down	
Long or Short Duration	Short Duration	Count	92	121	213
		% within Upstream or Downstream Chain	45.8%	57.1%	51.6%
	Long Duration	Count	109	91	200
		% within Upstream or Downstream Chain	54.2%	42.9%	48.4%
	Total		201	212	413
			100.0%	100.0%	100.0%

Note: Pearson Chi-square=5.279, df=1, p=0.022; Continuity Correction=4.836, df=1, p=0.028.

## 8.6 Summary

This chapter briefly reviewed the characteristics of the survey respondents and responding firms. It reported on the main characteristics of the respondents, the responding firms and the supply chain partnerships that were reported. Factors such as industry sector, location in the supply chain, contract status of the partnership, and duration of partnership were analyzed. Cross-tabulation was used to study associations



between some of these factors. The results provided some useful implications and served as a foundation for the later stage statistical analysis and the interpretation of the results.

## **CHAPTER 9 ANALYSIS STRATEGY AND MEASUREMENT MODEL EVALUATION**

### **9.1 Preamble**

This chapter details the strategy of statistical analysis, which takes account of the nature of the study, the theoretical model, and the nature of data itself. This chapter explains why Structural Equation Modelling (SEM) was used to analyse the data and how it was incorporated into the current research. The statistical analysis consisted of two parts: the measurement model and the structural equation model. This chapter mainly discusses the process of measurement model evaluation, which enabled the author to refine the research instrument and establish the validity and reliability of the data. The next chapter carries on the statistical analysis and discusses the process of structural equation modelling.

### **9.2 Analytical Method and Analysis Strategy**

As described in Chapter 6, this research sought to test the conceptual model developed based on previous theories. The model looked over-complex, as it proposed that supply chain partnership characteristics have various effects on different stages of knowledge transfer activities between supply chain partners, which in turn have effects on a firm's performance. It appeared to the author that the three dimensions of knowledge transfer would be both dependent/response variables and independent/explanatory variables at the same time. Because each variable (i.e. supply chain partnerships characteristics, knowledge transfer, and performance) was measured by a series of corresponding indicators, the model became complex since no available analytical methods are able to treat these many variables at different layers of the relationship at the same time. Moreover, having a large number of parameters involved in the model also required a very large sample size to ensure the model estimation was adequate (Hair et al., 1998).

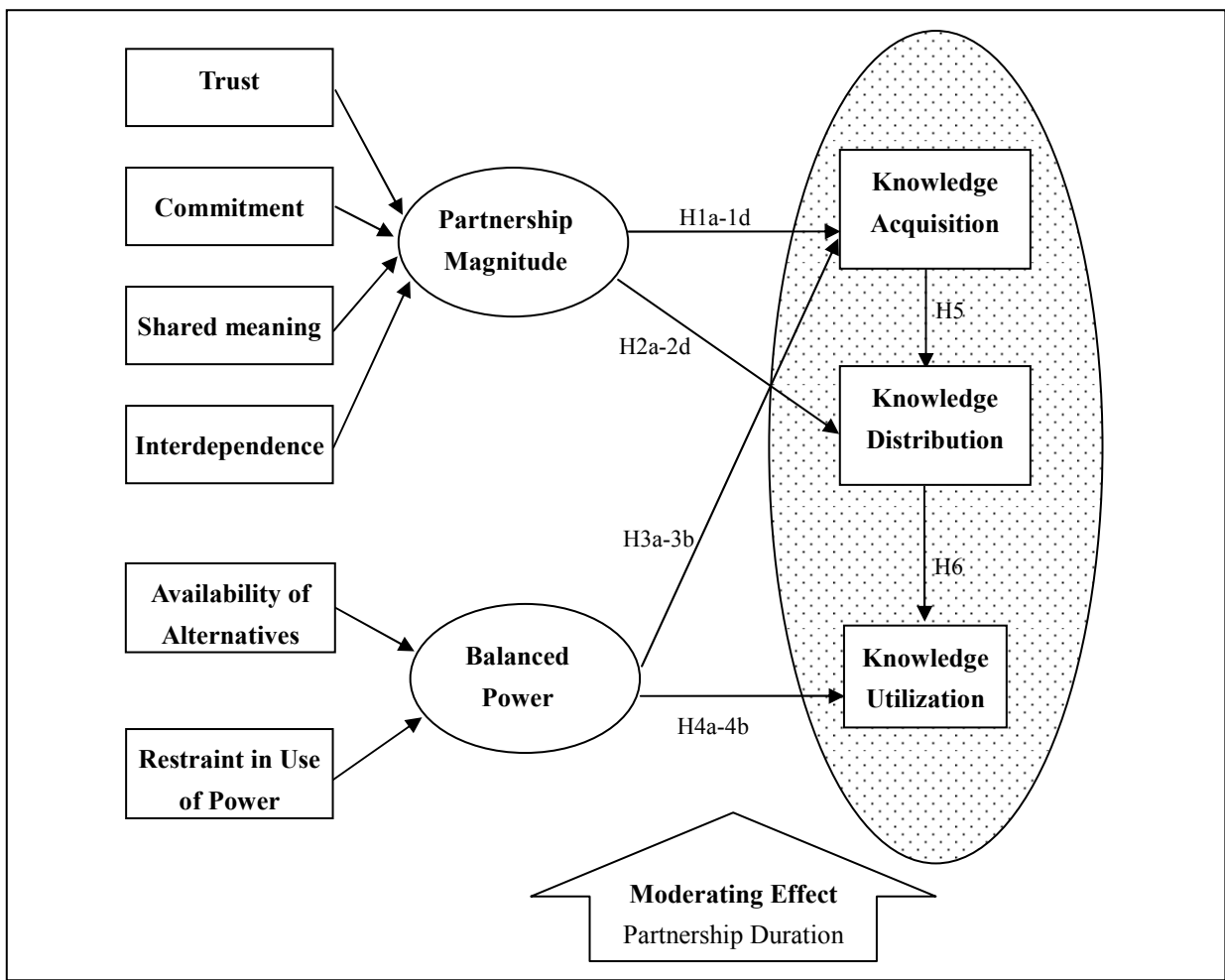


Figure 9-1 Divided Conceptual Model Part One

To deal with this issue and make the model simpler and more analyzable, the main model was split into two parts. In the first part (see figure 9-1), the relationships to be tested are between supply chain partnerships and knowledge transfer activities. In this part, the characteristics of the supply chain partnership are the explanatory variables, and the knowledge transfer activities are the response variables. In the second part of the model (see figure 9-2), the relationship between knowledge transfer activities and the firm's performance was tested. In this case, interfirm knowledge transfer activities were the explanatory variables whilst performance measures were the response variables. In the following sections, the methods and strategy of model testing are discussed. It was believed that a clear plan of analytical process would help the author to carry out the analysis in a more consistent manner and also ensure the quality of the results.

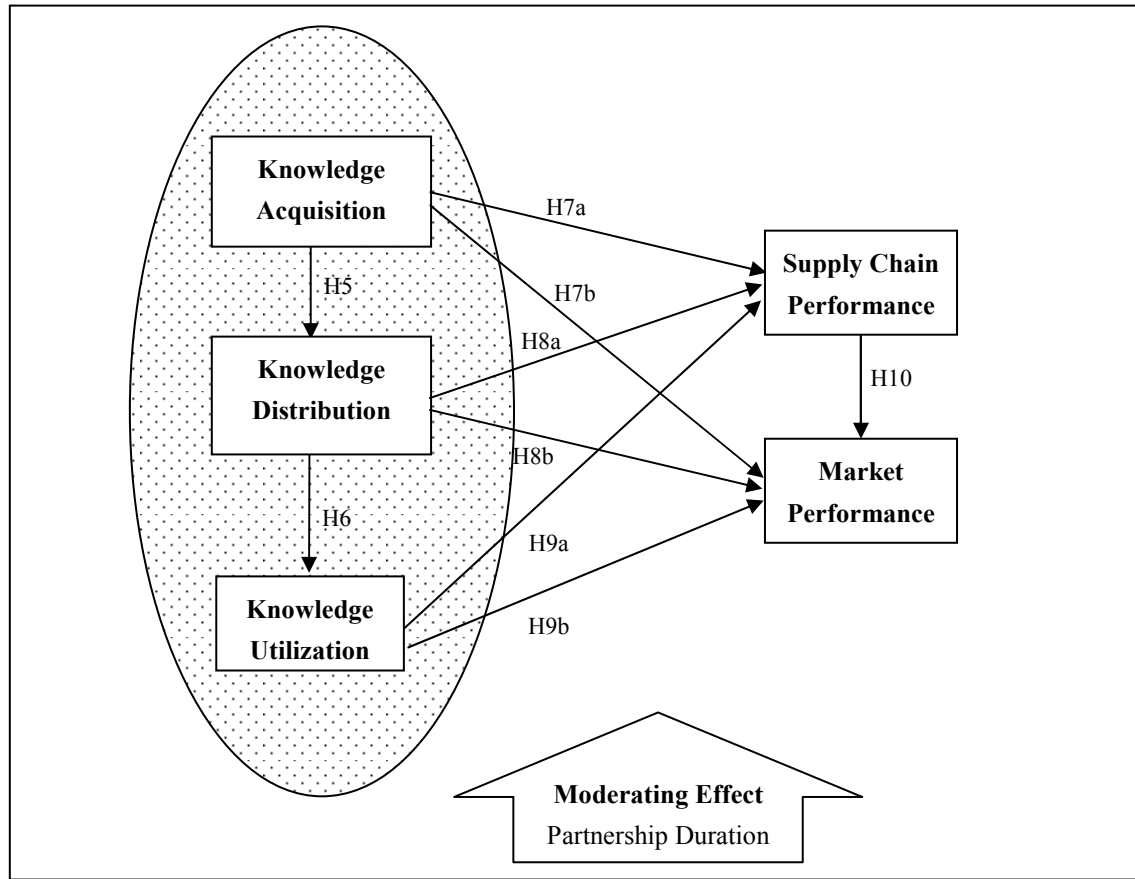


Figure 9-2 Divided Conceptual Model Part Two

### 9.2.1 Structural Equation Modeling and LISREL

As a multivariate statistical method, Structural Equation Modeling (SEM) is adopted by researchers in various social, behavioural, and economic areas. It is commonly understood as an extension of multiple-regression, but estimates a series of separate, but interdependent relationships simultaneously. However, SEM is actually based upon, but goes well beyond conventional regression analysis and analysis of variance (Joreskog and Sorbom, 1989). The advantages of SEM are fourfold (Joreskog and Sorbom, 1989; Hair et al., 1998): (1) it is able to handle a series of dependence relationships simultaneously; (2) it allows the researcher to use several indicators for a single variable, which is not directly measurable or observable; (3) it takes account of measurement errors of observed variables; (4) SEM allows the comparison of alternative models - this allows the researcher to generate the best fitted model, rather than directly draw

inferences from a single model.

SEM was considered to be the most suitable analytical method for the current research for the following reasons. First, because partnership characteristics and knowledge transfer activities are all complex constructs to be measured, using a single indicator or measure is unlikely to reflect the underlying concept adequately. Therefore, several indicators were used to measure each construct, and the construct is represented as a latent variable. Second, by using SEM, measurement error, which is unavoidable when using self-response indicators, is taken into consideration. Third, multiple causal relationships between constructs are included in the model and will be subject to significance tests. SEM enables such multiple relationship tests and provides test statistics for evaluating the relationship. Fourth, since the current study is also exploratory, alternative models or explanations may exist. SEM allows the author to generate alternative explanations from the empirical data, by comparing different alternative models.

To perform SEM analysis LISREL 8.7 was used (Joreskog and Sorbom, 2004), which is one of the most popular software packages used to carry out SEM analysis. Moreover, the LISREL language rather than the simplified SIMPLIS language was used to write the program, because it was believed that the LISREL language enables the researcher to have a clearer idea of the underlying parameter matrices. Moreover, it also allows a freer control in model parameter specification, which was quite beneficial during the model modification process, since once the basic model has been programmed, the researcher can adjust the model specification by changing a small number of parameter inputs.

### **9.2.2 The Two Stage Analysis**

The general form of Structural Equation Modeling consists of two parts: the measurement model and the structural equation model. The measurement model specifies how the latent variables or hypothetical constructs are measured in terms of the observed

variables, and it describes the measurement properties (validities and reliabilities) of the observed variables. The structural equation model specifies the causal relationships among the latent variables and describes the causal effects and the amount of unexplained variance (Joreskog and Sorbom, 1989). Taking account of the properties of the two parts of the model, earlier researchers adopted a two stage modeling strategy, in which the measurement model is validated first, and the structural equation model is fitted in the second stage (Anderson and Gerbing, 1988; Mulaik et al., 1989; Fornell and Yi, 1992). According to Anderson and Gerbing (1988), the measurement model provides an assessment of convergent and discriminant validity, and the structural equation model provides an assessment of predictive validity. In the first stage, researchers are allowed to improve the measurement model for the use in the later stage of structural model fitting. This strategy of improving the measurement model first should result in better estimates of structural parameters and higher overall goodness of fit (Medsker et al., 1994, p.450).

In the current research, the two-stage SEM strategy was adopted (see figure 9-3 and 9-4). As shown in figure 9-3 the analysis started from the model specification. The author specified the initial measurement model based on the conceptual framework developed in Chapter 5. Although data preparation was carried out at the same time, the author screened the original data set (which is not presented in the required order and coding system and also involves a number of missing values) based on the actual model specification. Since the assumption of normality is required for some model estimation methods, the normality of the input data was examined next. The author then decided on the model estimation method and the input matrix. The measurement model analysis was split into two parts. The first part deals with the scale of supply chain partnership characteristics, and the second part deals with the knowledge transfer process scales. For both parts, confirmatory factor analysis (CFA) was carried out. The results helped the author to refine the original scale and test the various validity and reliability measures. To ensure the measurement model was robust and consistent across samples, a cross-validation procedure was followed for both parts of the scale. After this process, the final measurement model was reached. The author then used the refined scale to

move on to the second stage analysis of structural equation modeling.

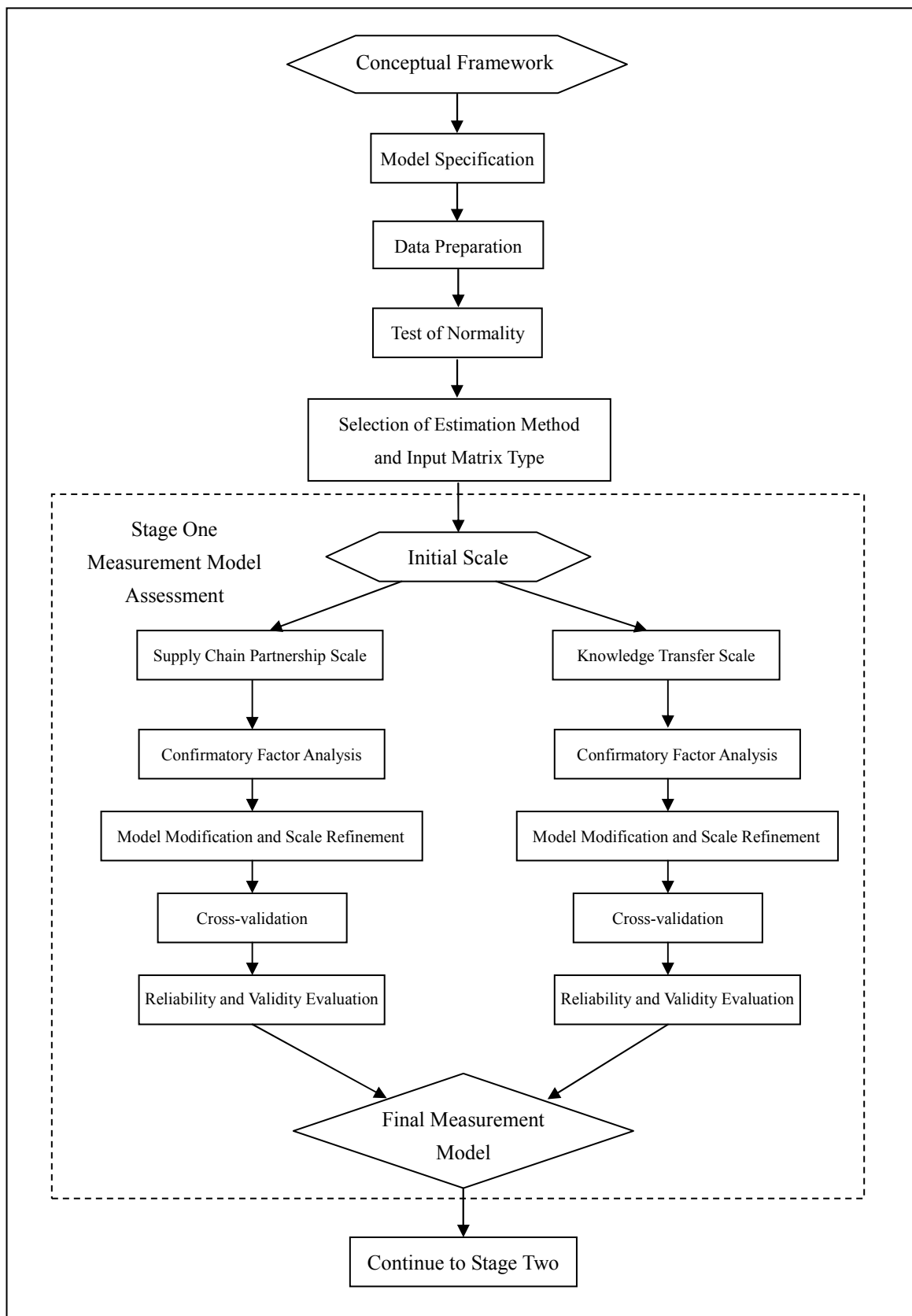


Figure 9-3 Stage One of the Structural Equation Modeling Process



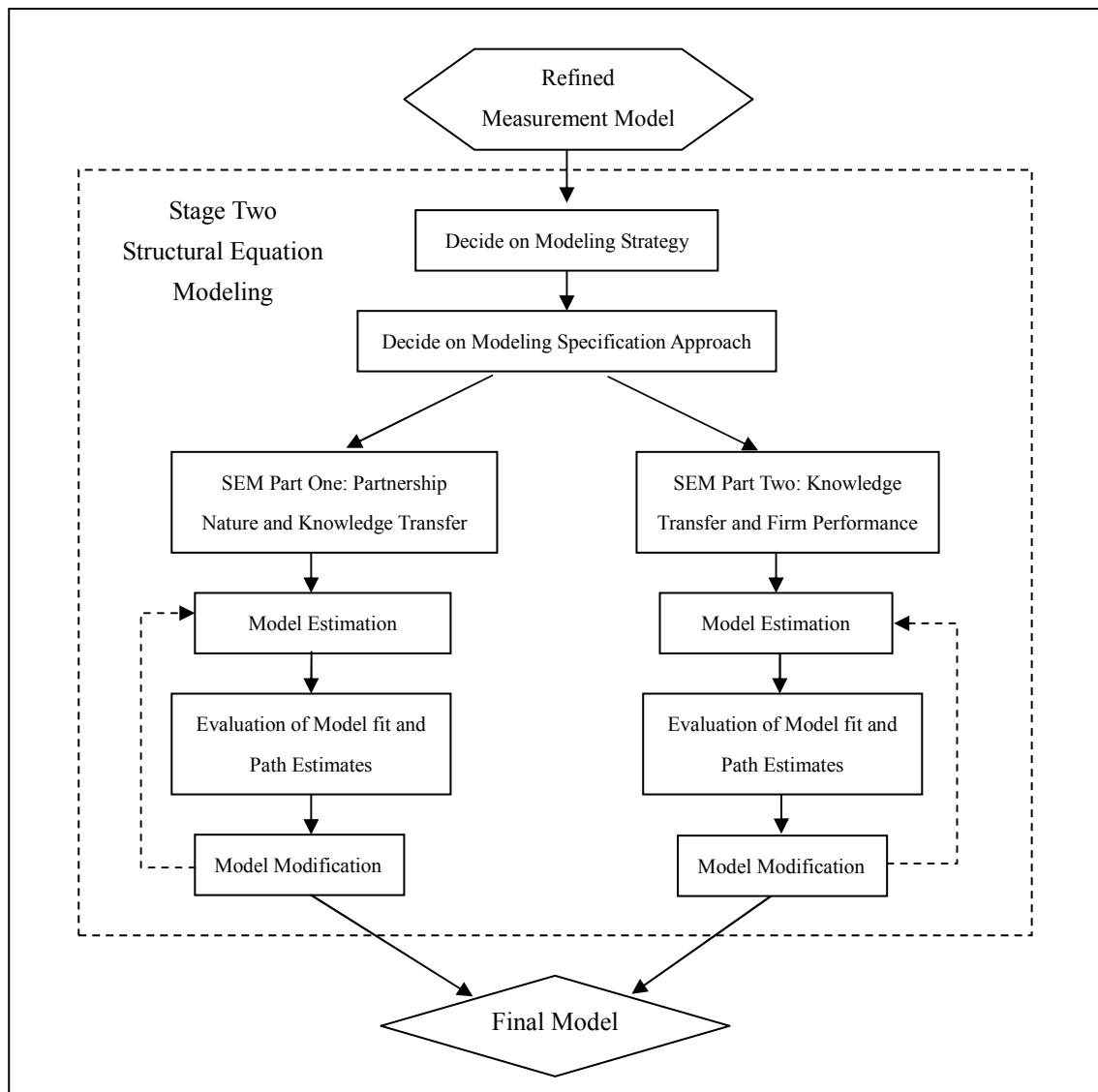


Figure 9-4 Stage Two of the Structural Equation Modeling Process

The second stage of analysis starts from the refined measurement model (see figure 9-4). Based on the original conceptual model, the structural equation modelling strategy (the competing model strategy was followed) and the model specification approach (the model trimming approach was followed) were then decided on. As mentioned before, the structural equation model was estimated in two parts. Part One deals with the relationship between partnership characteristics and knowledge transfer process. Part Two deals with the knowledge transfer process and the firm's performance. For both parts, a consistent process of model estimation, model fit evaluation, path estimates evaluation, and model modification was followed. The processes continued until the

most satisfactory models were reached (see Chapter 10 for detail).

## 9.3 Data Preparation

Before the data could be used for further analysis, the original data set was subjected to a careful process of selection and preparation. The missing values were treated. The normality of the data for main input variables was tested, which is important for the author to decide on the estimation method and the input matrices for SEM analysis.

### 9.3.1 Recoding and Missing Values Imputation

First, the different types of supply chain partnership presented in the response were categorized based on the answers provided by the respondents. Eight types of supply chain partnerships were identified (see table 9-1). Question 1-1, 1-2, 1-3, 1-6 and 2-1 in the questionnaire were used as identifiers. For example, if the Question 1-1 is ‘yes’, and 2-1 is ‘supply’, then the partnership will be coded as “Upstream direct partnership, Baogang side”. This means the respondent is reporting an upstream supply chain partnership from Baogang’s perspective. On the other hand, if Q1-1 is ‘no’, 1-2 is ‘no’, 1-3 is ‘yes’, 1-6 is ‘no’, and 2-1 is ‘purchase’, then the partnership will be coded as “Downstream indirect partnership, Partner side”. This means that the respondent is from an external firm and is reporting a downstream supply chain partnership with outside firms rather than Baogang.

Table 9-1 Coding of Types of Supply Chain Partnership

Types of Partnership	Q1-1	Q1-2	Q1-3	Q1-6	Q2-1	Explanation
Type 1	Yes	-	-	-	Supply	Upstream direct partnership, Baogang side
Type 2	Yes	-	-	-	Purchase	Downstream direct partnership Baogang side
Type 3	No	Yes	No	Yes	-	Upstream direct partnership, Partner side
Type 4	No	No	Yes	Yes	-	Downstream direct partnership, Partner side
Type 5	No	Yes	No	No	Supply	Upstream indirect partnership, Partner side
Type 6	No	Yes	No	No	Purchase	Upstream indirect partnership, Partner side
Type 7	No	No	Yes	No	Supply	Downstream indirect partnership, Partner

Type 8	No	No	Yes	No	Purchase	side Downstream indirect partnership, Partner side
--------	----	----	-----	----	----------	--

Secondly, since the order of items in the main body of the questionnaire was randomized, they were reordered back into the non-randomized order of items with respect to the corresponding constructs. Moreover, reverse coded items were recoded (i.e. by 8-x, so that for example 1 becomes 7, and 7 becomes 1), so that reverse coded items would have a consistent pattern with the rest of the items in the same construct. All the items under availability of alternatives were reverse coded, because all the items under this construct are measuring the irreplaceable role of the partner, so they were negatively related with the level of balanced power.

Thirdly, as shown in table 9-2, two types of missing values are coded in the data set of the main body of the questionnaire: either the respondent has given a ‘Don’t Know’ answer (coded as 9) or no answer (coded as -99). Missing values were counted and the patterns were examined. No clear patterns were found on the missing data, i.e. there is no link between variables and missing data. Therefore, the missing data is largely random. A number of missing value imputation methods have been followed by previous researchers, such as list-wise deletion, replacing with adjacent items, and pattern matching (Allison, 2002). To ensure that enough responses could be retained for the later stage statistical analysis, the author followed an approach of replacing missing values by means of non-missing values in related constructs. This is because a respondent is more likely to give similar answers to questions under the same conceptual category, so replacing missing values by averaging items in the same construct makes more sense (Allison, 2002). For supply chain performance measures, missing values were replaced by the average of the whole group of supply chain performance measures, because the author supposed that any single category of supply chain performance (e.g. planning or sourcing) might not provide sufficient representation of the trend of the entire supply chain performance of a firm.

Moreover, for constructs with seven or more indicators, where the case had more than three missing values for the same construct, that case was discarded; for constructs with five or six indicators, cases with more than two missing values for the same construct were discarded; for constructs with three or four indicators, cases with more than one missing value were discarded. Finally, 413 cases were retained for the later stage analysis. 43 cases were discarded for having more than half the data missing for all indicators, or having too many missing value for the individual construct, or having contradicting answers.

Table 9-2 Summary of Missing Value for Each Indicator

Items	Cases with valid data	Don't know	Percent	No answer	Percent	Total Percent of Missing
INTDP1	394	17	4.1	2	0.5	4.6
INTDP2	410	1	0.2	2	0.5	0.7
INTDP3	368	42	10.2	3	0.7	10.9
INTDP4	381	32	7.7	0	0	7.7
INTDP5	409	3	0.7	1	0.2	0.9
TRUST1	409	2	0.5	2	0.5	1
TRUST2	411	1	0.2	1	0.2	0.4
TRUST3	394	17	4.1	2	0.5	4.6
TRUST4	406	7	1.7	0	0	1.7
TRUST5	404	8	1.9	1	0.2	2.1
TRUST6	372	40	9.7	1	0.2	9.9
TRUST7	408	4	1	1	0.2	1.2
TRUST8	374	34	8.2	5	1.2	9.4
COMIT1	403	9	2.2	1	0.2	2.4
COMIT2	401	10	2.4	2	0.5	2.9
COMIT3	394	15	3.6	4	1	4.6
COMIT4	399	14	3.4	0	0	3.4
COMIT5	372	38	9.2	3	0.7	9.9
COMIT6	401	4	1	8	1.9	2.9
COMIT7	409	1	0.2	3	0.7	0.9
SHAMG1	400	12	2.9	1	0.2	3.1
SHAMG2	396	16	3.9	1	0.2	4.1
SHAMG3	379	33	8	1	0.2	8.2
SHAMG4	404	9	2.2	0	0	2.2
SHAMG5	399	14	3.4	0	0	3.4

SHAMG6	393	16	3.9	4	1	4.9
ALTRN1	396	17	4.1	0	0	4.1
ALTRN2	396	17	4.1	0	0	4.1
ALTRN3	396	12	2.9	5	1.2	4.1
ALTRN4	403	9	2.2	1	0.2	2.4
ALTRN5	389	23	5.6	1	0.2	5.8
ALTRN6	405	5	1.2	3	0.7	1.9
RSTPW1	397	14	3.4	2	0.5	3.9
RSTPW2	404	8	1.9	1	0.2	2.1
RSTPW3	390	21	5.1	2	0.5	5.6
KNACQ1	382	31	7.5	0	0	7.5
KNACQ2	394	19	4.6	0	0	4.6
KNACQ3	354	57	13.8	2	0.5	14.3
KNACQ4	364	47	11.4	2	0.5	11.9
KNACQ5	362	51	12.3	0	0	12.3
KNDST1	363	49	11.9	1	0.2	12.1
KNDST2	386	25	6.1	2	0.5	6.6
KNDST3	388	24	5.8	1	0.2	6
KNDST4	402	11	2.7	0	0	2.7
INSTU1	405	8	1.9	0	0	1.9
INSTU2	388	23	5.6	2	0.5	6.1
INSTU3	398	14	3.4	1	0.2	3.6
INSTU4	402	11	2.7	0	0	2.7
INSTU5	369	43	10.4	1	0.2	10.6
INSTU6	403	9	2.2	1	0.2	2.4
CNCPU1	397	16	3.9	0	0	3.9
CNCPU2	405	8	1.9	0	0	1.9
CNCPU3	410	3	0.7	0	0	0.7
CNCPU4	383	30	7.3	0	0	7.3
CNCPU5	401	11	2.7	1	0.2	2.9
SYMBU1	371	41	9.9	1	0.2	10.1
SYMBU2	393	19	4.6	1	0.2	4.8
SYMBU3	403	9	2.2	1	0.2	2.4
SYMBU4	403	6	1.5	4	1	2.5
Total Cycle Time	348	61	14.8	4	1	15.8
Order Lead Time	363	48	11.6	2	0.5	12.1
Information Carrying Cost	364	48	11.6	1	0.2	11.8
Achievement of Defect Free Delivery	394	17	4.1	2	0.5	4.6
Purchase Order Cycle Time	393	16	3.9	4	1	4.9
Production Cycle Time	385	23	5.6	5	1.2	6.8
Extent of Quality Cooperation	394	15	3.6	4	1	4.6
Capacity Utilization	384	24	5.8	5	1.2	7

Delivery Lead Time	399	13	3.1	1	0.2	3.3
Delivery Reliability	404	8	1.9	1	0.2	2.1
Responsiveness to Urgent Delivery	403	9	2.2	1	0.2	2.4
Customer Query Time	407	6	1.5	0	0	1.5
Flexibility to Meet Particular Needs	410	3	0.7	0	0	0.7
Overall Customer Service	410	3	0.7	0	0	0.7
Market share	398	15	3.6	0	0	3.6
Return on total assets	381	32	7.7	0	0	7.7
Average annual market share growth	389	24	5.8	0	0	5.8
Average annual sales growth	391	21	5.1	1	0.2	5.3
Average annual growth in return on total assets	382	30	7.3	1	0.2	7.5
Overall product quality	404	9	2.2	0	0	2.2
Overall competitive position	401	12	2.9	0	0	2.9

Note: Total of 413 cases included, 43 cases were discarded for having more than half the indicators missing or having too many indicators missing for individual constructs.

Fourthly, since performance items were measuring different aspects of the supply chain or business performance of the responding firm, together they will represent a holistic picture of the performance status of the firm. Thus, after missing values were treated, values in supply chain performance items and business performance items were added together to generate two new variables, supply chain performance (labeled SCPERFRM) and market performance (labeled MKTPERFM). Both of these variables are used as response variables in the later SEM analysis. It is important to note at this point, that each performance measure represents an independent aspect of supply chain or firm performance, for example, for planning performance, total cycle time, order lead-time, and information carrying cost represent three independent aspects of performance. Hence, it makes little sense to assume that there is a common underlying latent variable for these measures. For this reason, the performance measures were not subjected to measurement model assessment as with other constructs of the theoretical model.

Fifthly, to indicate the partnership duration from the original data set, a new variable “Length of Partnership” was coded based on Q1-7 and 2-4. For cases with “direct partnership, partner side” (see table 9-1), Q1-7 was used as the main reference; for cases

with “direct partnership, Baogang side” and with “indirect partnership, partner side”, Q2-4 was used as the main reference.

Sixthly, to indicate the partnership contract status from the original data set, a new variable “Partnership Contract Status” was coded based on Q1-5 and 2-2. For cases with “direct partnership, partner side”, Q1-5 was used as the main reference; for cases with “direct partnership, Baogang side” and “indirect partnership, partner side”, Q2-2 was used as the main reference.

### **9.3.2 Test of Normality**

It has been a common practice in the area to approximate scaled survey data as continuous, thus researchers have followed various analytical methods as with continuous variables. It is worth noting that some commonly used estimation methods of SEM are based on the assumption of multivariate normality for the observed variables, such as Maximum Likelihood (ML), and Generalized Least Squares (GLS) (Joreskog and Sorbom, 1989). Careless use of non-normal data may lead to inflated goodness of fit statistic such as Chi-square, so that the model estimation is biased toward Type I error (rejecting a model which is true). Although the normality condition could be relaxed a little when the distribution of the observed variables is moderately non-normal, skewed or peaked, caution still needs to be taken during interpretation. The uncritical use of non-normal data may provide inaccurate findings (Shook et al., 2004). Despite this warning, many prior researchers often omit the importance of multivariate normality of variables in carrying out adequate model estimation (Shook et al., 2004). Hence, the current research examined the normality of observed variables before estimation methods were chosen.

First of all, a histogram was plotted with normal curve fitted for all the observed variables in the model. It was found that most of observed variables, except that of supply chain performance and market performance, showed a certain level of skewness.

This indicated that non-normality might be a concern.

Secondly, a test of Skewness and Kurtosis was performed using PRELIS software (Joreskog and Sorbom, 2004), and the results are shown in table 9-3 and 9-4. It has been shown that many variables have skewness or kurtosis out of the range of  $-1$  to  $+1$ , which indicate the presence of non-normality (Schumacker and Lomax, 2004). The significant z-statistics of many indicators further supported this view and suggested the violation of normality assumption for most of the indicating variables (Hair et al., 1998).

Table 9-3 Univariate Summary Statistics for Continuous Variables

Items	Mean	St. Dev.	Skewness	Kurtosis	Min	Freq.	Max	Freq.
INTDP1	5.586	1.911	-1.093	-0.063	1	24	7	231
INTDP2	5.893	1.680	-1.364	0.750	1	10	7	257
INTDP3	4.153	2.011	-0.012	-1.086	1	60	7	87
INTDP4	3.838	2.024	0.157	-1.087	1	76	7	70
INTDP5	5.593	1.790	-0.993	-0.144	1	15	7	220
TRUST1	5.707	1.623	-0.987	0.054	1	11	7	218
TRUST2	5.685	1.623	-0.982	0.059	1	10	7	213
TRUST3	5.034	1.838	-0.517	-0.732	1	22	7	143
TRUST4	5.203	1.882	-0.663	-0.621	1	25	7	175
TRUST5	5.472	1.690	-0.687	-0.643	1	8	7	192
TRUST6	5.286	1.727	-0.595	-0.533	1	16	7	170
TRUST7	5.801	1.643	-1.155	0.323	1	10	7	236
TRUST8	4.666	1.912	-0.328	-0.850	1	38	7	114
COMIT1	5.833	1.620	-1.125	0.087	1	5	7	240
COMIT2	5.799	1.738	-1.342	0.774	1	17	7	241
COMIT3	5.421	1.627	-0.577	-0.710	1	6	7	176
COMIT4	5.441	1.795	-0.853	-0.332	1	18	7	192
COMIT5	4.804	1.995	-0.471	-0.858	1	44	7	136
COMIT6	5.782	1.588	-0.970	-0.222	1	4	7	231
COMIT7	5.562	1.859	-1.060	-0.002	1	24	7	219
SHAMG1	5.692	1.624	-0.917	-0.303	1	5	7	215
SHAMG2	5.535	1.709	-0.873	-0.284	1	11	7	195
SHAMG3	5.499	1.876	-1.004	-0.162	1	23	7	207
SHAMG4	5.588	1.634	-0.849	-0.340	1	6	7	194
SHAMG5	5.373	1.688	-0.596	-0.733	1	8	7	175
SHAMG6	5.402	1.808	-0.833	-0.375	1	18	7	187
ALTRN1	3.087	2.026	0.550	-0.860	1	149	7	45
ALTRN2	2.603	1.727	0.687	-0.586	1	181	7	12
ALTRN3	3.077	1.974	0.565	-0.782	1	139	7	41



ALTRN4	3.167	1.994	0.510	-0.825	1	134	7	46
ALTRN5	3.184	1.964	0.523	-0.764	1	125	7	45
ALTRN6	2.528	1.721	0.780	-0.399	1	192	7	14
RSTPW1	5.538	1.623	-0.737	-0.523	1	7	7	187
RSTPW2	5.552	1.616	-0.775	-0.419	1	7	7	188
RSTPW3	5.344	1.626	-0.529	-0.714	1	8	7	160
KNACQ1	4.969	1.869	-0.436	-0.889	1	23	7	143
KNACQ2	4.811	1.730	-0.280	-0.721	1	19	7	108
KNACQ3	4.731	1.861	-0.362	-0.825	1	32	7	108
KNACQ4	4.726	1.775	-0.290	-0.776	1	24	7	100
KNACQ5	4.433	1.952	-0.340	-0.901	1	56	7	81
KNDST1	4.671	1.974	-0.418	-0.847	1	49	7	115
KNDST2	4.659	2.026	-0.502	-0.888	1	58	7	105
KNDST3	5.136	1.728	-0.537	-0.576	1	18	7	140
KNDST4	5.145	1.992	-0.764	-0.595	1	39	7	167
INSTU1	4.896	1.976	-0.558	-0.747	1	44	7	139
INSTU2	4.642	1.873	-0.253	-0.910	1	31	7	108
INSTU3	5.189	1.632	-0.398	-0.794	1	8	7	141
INSTU4	5.145	1.757	-0.617	-0.441	1	22	7	143
INSTU5	5.271	1.596	-0.450	-0.731	1	7	7	146
INSTU6	5.150	1.865	-0.712	-0.493	1	29	7	151
CNCPU1	5.450	1.643	-0.788	-0.266	1	11	7	167
CNCPU2	5.685	1.571	-0.949	-0.039	1	6	7	201
CNCPU3	5.608	1.721	-1.023	0.021	1	14	7	204
CNCPU4	5.390	1.677	-0.686	-0.504	1	10	7	169
CNCPU5	5.266	1.741	-0.702	-0.387	1	18	7	155
SYMBU1	5.329	1.663	-0.644	-0.522	1	10	7	154
SYMBU2	5.501	1.545	-0.637	-0.698	1	2	7	165
SYMBU3	5.303	1.705	-0.695	-0.421	1	14	7	153
SYMBU4	5.419	1.683	-0.757	-0.381	1	11	7	170
SCPERFRM	60.123	10.038	0.296	1.358	28	1	98	1
MKTPERFM	32.646	9.400	-0.355	0.259	7	10	49	26

Note: Skewness with absolute value greater than 1 and Kurtosis with absolute value greater than 1.5 indicate presence of non-normality.

Table 9-4 Test of Univariate Normality for Continuous Variables

Items	Skewness		Kurtosis		Skewness and Kurtosis	
	Z-Score	P-Value	Z-Score	P-Value	Chi-Square	P-Value
INTDP1	-7.630	0.000	-0.164	0.870	58.244	0.000
INTDP2	-8.919	0.000	2.496	0.013	85.775	0.000
INTDP3	-0.102	0.918	-11.229	0.000	126.090	0.000
INTDP4	1.314	0.189	-11.252	0.000	128.335	0.000
INTDP5	-7.100	0.000	-0.546	0.585	50.701	0.000
TRUST1	-7.066	0.000	0.336	0.737	50.046	0.000
TRUST2	-7.039	0.000	0.357	0.721	49.669	0.000
TRUST3	-4.112	0.000	-4.849	0.000	40.427	0.000
TRUST4	-5.119	0.000	-3.727	0.000	40.098	0.000
TRUST5	-5.274	0.000	-3.933	0.000	43.291	0.000
TRUST6	-4.662	0.000	-2.973	0.003	30.575	0.000
TRUST7	-7.939	0.000	1.307	0.191	64.745	0.000
TRUST8	-2.697	0.007	-6.353	0.000	47.634	0.000
COMIT1	-7.789	0.000	0.465	0.642	60.886	0.000
COMIT2	-8.819	0.000	2.553	0.011	84.297	0.000
COMIT3	-4.538	0.000	-4.610	0.000	41.845	0.000
COMIT4	-6.304	0.000	-1.574	0.115	42.225	0.000
COMIT5	-3.777	0.000	-6.469	0.000	56.116	0.000
COMIT6	-6.972	0.000	-0.944	0.345	49.507	0.000
COMIT7	-7.459	0.000	0.105	0.917	55.642	0.000
SHAMG1	-6.678	0.000	-1.399	0.162	46.555	0.000
SHAMG2	-6.423	0.000	-1.290	0.197	42.918	0.000
SHAMG3	-7.160	0.000	-0.635	0.526	51.663	0.000
SHAMG4	-6.283	0.000	-1.621	0.105	42.104	0.000
SHAMG5	-4.664	0.000	-4.868	0.000	45.449	0.000
SHAMG6	-6.187	0.000	-1.842	0.065	41.669	0.000
ALTRN1	4.345	0.000	-6.502	0.000	61.152	0.000
ALTRN2	5.278	0.000	-3.414	0.001	39.514	0.000
ALTRN3	4.454	0.000	-5.442	0.000	49.450	0.000
ALTRN4	4.066	0.000	-6.009	0.000	52.645	0.000
ALTRN5	4.156	0.000	-5.224	0.000	44.561	0.000
ALTRN6	5.867	0.000	-1.996	0.046	38.403	0.000
RSTPW1	-5.599	0.000	-2.890	0.004	39.694	0.000
RSTPW2	-5.836	0.000	-2.131	0.033	38.599	0.000
RSTPW3	-4.198	0.000	-4.653	0.000	39.281	0.000
KNACQ1	-3.522	0.000	-6.952	0.000	60.739	0.000
KNACQ2	-2.313	0.021	-4.735	0.000	27.768	0.000
KNACQ3	-2.956	0.003	-6.007	0.000	44.819	0.000
KNACQ4	-2.393	0.017	-5.375	0.000	34.616	0.000
KNACQ5	-2.789	0.005	-7.144	0.000	58.812	0.000

KNDST1	-3.389	0.001	-6.314	0.000	51.349	0.000
KNDST2	-4.004	0.000	-6.936	0.000	64.137	0.000
KNDST3	-4.253	0.000	-3.326	0.001	29.147	0.000
KNDST4	-5.768	0.000	-3.491	0.000	45.461	0.000
INSTU1	-4.406	0.000	-5.024	0.000	44.653	0.000
INSTU2	-2.098	0.036	-7.295	0.000	57.616	0.000
INSTU3	-3.230	0.001	-5.601	0.000	41.806	0.000
INSTU4	-4.811	0.000	-2.280	0.023	28.341	0.000
INSTU5	-3.624	0.000	-4.848	0.000	36.635	0.000
INSTU6	-5.437	0.000	-2.661	0.008	36.639	0.000
CNCPU1	-5.913	0.000	-1.189	0.234	36.374	0.000
CNCPU2	-6.856	0.000	-0.057	0.955	47.004	0.000
CNCPU3	-7.263	0.000	0.201	0.840	52.787	0.000
CNCPU4	-5.270	0.000	-2.747	0.006	35.319	0.000
CNCPU5	-5.376	0.000	-1.919	0.055	32.582	0.000
SYMBU1	-4.993	0.000	-2.883	0.004	33.238	0.000
SYMBU2	-4.948	0.000	-4.484	0.000	44.582	0.000
SYMBU3	-5.328	0.000	-2.142	0.032	32.975	0.000
SYMBU4	-5.724	0.000	-1.879	0.060	36.300	0.000
SCPERFRM	2.440	0.015	3.736	0.000	19.910	0.000
MKTPERFM	-2.905	0.004	1.094	0.274	9.636	0.008

Note: significant z-score suggest skewness or kurtosis is present, assumption of normality is problematic.

The test results of raw data against normality assumptions suggested that commonly used Maximum Likelihood (ML), and Generalized Least Squares (GLS) methods were inappropriate. It is suggested that using ordinary sample covariance matrix, and analyzing with Weighted Least Squares (WLS), with correct weight matrix (i.e. asymptotic covariance matrix of sample covariance matrix) will give a more robust analysis (Joreskog and Sorbom, 1989). The WLS method is also referred to as Asymptotically Distribution Free (ADF) (Browne, 1984), which does not depend upon the normality assumption. However, it may require a large sample to ensure asymptotic covariance of the sample variances or that covariance could be estimated accurately. For example, Browne (1984) anticipated that models with greater than 20 variables could not feasibly be estimated with ADF. Boomsma and Hoogland (2001) argued that “With finite sample sizes the ADF estimator is not free from distributional effects”. It is suggested that a poorly estimated asymptotic covariance matrix, such as that estimated from a small sample, can do more harm than good, when used with WLS (Joreskog and Sorbom,

1989).

Since the current study involves a large number of observed variables, and has a sample size of only 413, using WLS may not generate accurate results. On the other hand, Browne (1987) formulated a Robust Maximum Likelihood (RML) method for factor analysis and related models. The RML method is suggested to generate more accurate test statistics under conditions of non-normality (Curran et al., 1996). It adjusts the normal theory of ML chi-square estimate for the presence of non-normality. Satorra & Bentler (1988) extended this method by providing a correct Chi-square test statistic S-B  $\chi^2$  (Curran et al., 1996; Mels, 2004). RML is attractive because it not only considers non-normality but also requires a smaller sample size. It is proved to be more robust than other estimation (Boomsma and Hoogland, 2001). Curran, et al. (1996) suggested that S-B  $\chi^2$  behaved extremely well in nearly every condition across sample size, distribution, and model specification. It is also argued that RML could work even with ordinal variables, treated as continuous despite their severe non-normality (Wallentin, 2004).

Under RML, ML method is used to fit the model but standard errors and chi-squares are corrected for non-normality using the asymptotic covariance matrix provided (Boomsma and Hoogland, 2001). RML has the advantage that the Asymptotic Covariance Matrix does not need to be inverted (as compared with WLS), so RML works better with sample sizes as small as 200 (Joreskog, 2005). Given the advantages of RML in giving more robust analysis, this research followed the RML estimation method with Satorra-Bentler scaled Chi-square (S-B  $\chi^2$ ) as an indication of goodness of fit. In the rest of the analysis, where no additional explanation is given, sample Covariance Matrix and the corresponding Asymptotic Covariance Matrix were used, and Robust Maximum Likelihood (RML) was employed as the main estimation method.

#### **9.4 Measurement Model Evaluation**

With the data preparation completed and model estimation method selected, the main

statistical analysis started with measurement model evaluation. As was mentioned in section 9.2.2, the evaluation of the measurement model allowed the author to refine and validate the original scale. Confirmatory Factor Analysis (CFA) was used to assess both measures of supply chain partnership characteristics, and measures of knowledge transfer activity. This section details the statistical method that was used to assess the measurement model.

#### **9.4.1 CFA and Validity Assessment**

Confirmatory Factor Analysis (CFA), which is different from Exploratory Factor Analysis (EFA), is a method of evaluating a pure measurement model, i.e., the structure of the observed indicators and corresponding underlying latent variables. CFA is called ‘confirmatory’ because it is used to confirm that indicators are consistently measuring the corresponding latent variables which are pre-specified based on existing theory or hypothesis. EFA, on the other hand, is concerned with exploring the patterns of relationships or underlying dimensionality among a number of variables, where no pre-specified structures were determined. Hence, the CFA model is based on a priori information about the data structure in the form of a specified theory or hypothesis (Joreskog and Sorbom, 1989). It is, therefore, a more theory-driven approach.

As Bryant et al. (1999) suggested, CFA has several advantages over EFA: (1) CFA enables investigators to systematically test specific prior hypotheses about the structure underlying survey results and to compare alternative measurement models with respect to explanatory power; (2) researchers can also use CFA to refine a suboptimal model into a simpler form that is both parsimonious and reliable, thus improving conceptual and statistical precision; (3) thus, researchers can use CFA to evaluate how well the survey results match the hypothesized measurement model, when they have a hypothesis beforehand about the factors that underlie survey responses (Bryant et al., 1999). Moreover, since CFA combines ex ante theoretical expectations with empirical data for factor validation, it is a stronger statistical method compared to EFA (Bhattacharjee, 2002).

In the current research, each underlying latent construct (including trust, commitment, interdependence, shared meaning, availability of alternatives, restraint use of power, knowledge acquisition, knowledge distribution, and three dimensions of knowledge utilization) was indicated by a number of observed variables. Since all the proposed relationships between latent variables and observed indicators were determined by existing theories or literature, it was more reasonable to follow a theory driven approach. Hence, Confirmatory Factor Analysis was appropriate for the purpose of evaluating the pre-specified measurement model.

One of the main advantages of CFA is that it provides the researcher with a way of assessing measurement properties, i.e., validities and reliabilities of the measurement instruments used. Noticeably, Fornell and Larcker (1981) proposed a series of criteria to evaluate the convergent and discriminant validity of the instrument. Here convergent validity is the degree to which multiple attempts to measure the same concept are in agreement, whilst discriminant validity measures the degree to which measures of different constructs are unique/distinct (Campbell and Fiske, 1959). To have convergent and discriminant validity, measures of the same concept should covary highly, and the measures of different concepts should not correlate too highly (Bagozzi et al., 1991).

Fornell and Larcker (1981) have introduced two statistics to serve the purpose of construct validation, which are also recommended by Medsker et al. (1994, p.457). Construct reliability (also called composite reliability), which is different from conventional Cronbach's alpha, is a measure of the reliability of a construct or the internal consistency of indicators for each construct. Average Variance Extracted (AVE) is a measure of the amount of variance that is captured by the construct in relation to the amount of variance due to measurement error.

According to Fornell and Larcker (1981), to establish convergent validity, the constructs have to show the following properties: (1) all factor loadings must be significant and

exceed 0.70; (2) construct reliabilities must exceed 0.80; (3) Average Variance Extracted (AVE) by each construct must exceed the variance due to measurement error for that construct (i.e. AVE must exceed 0.50). To demonstrate discriminant validity, AVE for each construct should exceed the squared factor correlations between that construct and other constructs. Due to the statistical power of these criteria, they have been used by increasingly more empirical researchers. Thus, this research also followed these criteria to validate the instrument and pave the way for later stage structural model evaluation.

#### **9.4.2 Measurement Model Improvement and Scale Refinement**

Since the supply chain relationship characteristics and the knowledge transfer process have a large number of items in the original scale, the measurement model evaluation could potentially be very complicated. To ensure that the measurement model evaluation and scale refinement could be carried out in a consistent manner, a step-by-step process of model improvement was developed based on the experiences of prior studies:

- (1) The original data set was split into two random halves: a calibration sample and a validation sample. The calibration sample was used to evaluate the measurement model and refine the instrument, while the validation sample was used to cross-validate the refined measurement model.
- (2) The original scale was examined with CFA for the calibration sample. Model fit indices (including S-B  $\chi^2$ ,  $\chi^2/df$ , GFI, CFI, RMSEA, and SRMR) were examined to see whether the pre-identified structure of indicators fit well with the data.
- (3) Factor loadings were examined to make sure that items are loaded highly on the corresponding construct. Indicators with low loadings are problematic and were considered as candidates for elimination based on the review of item contents. Benson and Bandalos (1992) followed a process of scale reduction, through which items were deleted one at a time in order to study changes in parameter estimates, modifications indices and standardized residuals. This research largely followed this approach, although in some cases where items were clearly irrelevant, more than one

item might be deleted at a time.

- (4) Modification Indices (MI) of constrained parameters were evaluated, to see whether there were significantly large values. Those constraints with large MI values were considered for freeing, or the redundant items would be considered for deletion. This step is subject to evaluation of item content and substantive theories.
- (5) After eliminating problematic indicators or freeing necessary constrained parameters, CFA was conducted again on the refined model with the calibration sample to assess the model fit and indicator structures.
- (6) The above process (from step 3 to step 5) continued until the model fit was satisfactory or could not be improved significantly by further modification, and the structure of the indicators made sense theoretically.
- (7) To cross-validate the refined model, the model was fitted again with the validation sample. Various tests of invariance were conducted to see whether the refined measurement model had similar satisfactory properties with the validation sample as well (Joreskog and Sorbom, 1989). If so, the measurement model would demonstrate stability across samples, so the quality of the measurement model was acceptable.
- (8) Lastly, convergent validity and discriminant validity of the improved scale were assessed with the entire sample through another CFA procedure to confirm the measurement properties of the scale. This scale was then used in the next round of Structural Equation Modeling.

During the above process the author paid particular attention to the following points:

- (1) As suggested by Anderson and Gerbing (1988, p. 143) there is not one best fit index and there may never be a single index that should always be used to the exclusion of others. To evaluate the measurement model fit, a combination of model fit indices has been used (S-B  $\chi^2$ ,  $\chi^2/df$ , GFI, CFI, RMSEA, and SRMR). As mentioned already, S-B  $\chi^2$ , which is adjusted for non-normality, was used to evaluate the model fit. The  $\chi^2/df$  ratio is used by increasingly more researchers as a measure of model fit. Compared to chi-square,  $\chi^2/df$  is less sensitive to the sample sizes and indicates a



better fit index (Bentler and Bonnett, 1980; Bhattacharjee, 2002). It is suggested that a ratio of less than 3 will indicate a good model fit (Kline, 1998). Nevertheless, a more liberal criterion of 5 was also commonly referred to by researchers (Marsh and Hoceuar, 1983; Bentler, 1989). GFI (Goodness of Fit Index) is a measure of the proportion of variance accounted for in the sample covariance matrix by the estimated population covariance matrix. Although no absolute threshold levels for acceptability have been established, the closer the value to 1, the better the model fit (Hair et al., 1998). CFI (Comparative Fit Index) indicates the proportion in the improvement of the overall fit of the existing model to the null model. CFI is robust to the sample sizes (Bhattacharjee, 2002). Normally, a value greater than 0.90 will indicate a good model fit (Bentler and Bonnett, 1980). RMSEA (Root Mean Square Error of Approximation) is a measure of the average difference per degree of freedom expected to occur in the population. A value ranging from 0.05 to 0.08 is deemed acceptable (Hair et al., 1998). SRMSR or SRMR (Standardized Root Mean Square Residual) indicates the average difference between the predicted and observed variances and covariances in the model, based on standardized residuals. A value of less than 0.1 will suggest a good fit (Hu and Bentler, 1998; Kline, 1998).

- (2) The interpretation of model fit indices needed to be careful, since the model fit is not the same as the strength of the parameter. Therefore, a better-fitted model may have lower value model parameters. This point is especially important at the stage of structural equation modeling.
- (3) According to Joreskog and Sorbom (1989, p.45), MI needs to be used with caution, it is used only when relaxing a parameter makes sense from a substantive point of view, and when the estimated value of this parameter can be clearly interpreted. Moreover, items with large modifications were also considered as candidates for deletion, especially when the item wording was redundant to other related items, which were found to fit the theorized structure better. The process ensured a more parsimonious scale was developed, which maintained the original factor structure and approximated a simple structure as closely as possible.
- (4) Finally, although the redundant items were considered for removal, at least three

items were retained for each construct to avoid convergence problems (Benson & Bandalos, 1992).

## **9.5 Indicators of Supply Chain Partnership Characteristics**

The scale of supply chain partnership characteristics contains 6 main constructs: trust, commitment, interdependence, shared meaning, availability of alternatives, and restraint in use of power. To cross validate the refined scale the original data set was randomly split into two halves. The first half with 206 cases was used as the calibration sample to refine the measurement model. As mentioned above, Robust Maximum Likelihood method was used as estimation method with sample Covariance Matrix and the Asymptotic Covariance Matrix entered. The second half sample with 207 cases was used as the validation sample, to cross-validate the refined model.

### **9.5.1 Confirmatory Factor Analysis**

As shown in table 9-5, the CFA analysis with the original full scale (Model R1) indicated only a moderate model fit ( $\chi^2/df=2.23$ , GFI=0.69, CFI=0.97, RMSEA=0.077, SRMR=0.074). When factor loadings were examined, INTDP 3, INTDP4, TRUST3, TRUST8, and COMIT5 were found to have small (lower than 0.6) factor loadings with the correspondent latent variables.

With INTDP3, INTDP4, TRUST3, TRUST8, and COMIT5 eliminated, another CFA analysis was conducted with the refined supply chain relationship scale (Model R2). The result showed a significant improvement in model fit ( $\chi^2/df=2.12$ , GFI=0.73, CFI=0.98, RMSEA= 0.074, SRMR=0.065). Nevertheless, the modification index of correlated error term between ALTRN3 and ALTRN5 showed a large value (MI-TD=41.11, Par change=0.19)<sup>2</sup>. This indicated potential correlated error terms between two indicators. If the error terms between two indicators were allowed to correlate the estimated decrease in chi-square fit index would be 41.11, and the estimated correlation would be 0.19. The

---

<sup>2</sup> Without further indication, only standardized Par change is provided throughout the report.

contents of both items were evaluated again. ALTRN3 was found to have overlap in meaning with ALTRN5. Therefore, to avoid redundant indicators, ALTRN3 was eliminated to construct the next CFA model (Model R3). Unfortunately, the result did not show much improvement in model fit ( $\chi^2/df=2.16$ , GFI=0.73, CFI=0.98, RMSEA=0.075, SRMR=0.063), which suggested that the modification may not be appropriate.

Alternatively, instead of eliminating ALTRN3, Model R4 was constructed which allowed error terms of ALTRN3 and ALTRN5 to correlate. This time model fit was improved to a certain degree ( $\chi^2/df=2.10$ , GFI=0.73, CFI=0.98, RMSEA=0.073, SRMR=0.063). This time the modification index for the correlated error term between COMIT2 and COMIT7 was the highest (MI-TD=33.09, Par change=0.18).

Model R5 was constructed with error term correlation between COMIT2 and COMIT7 freed. This model showed certain improvement over the previous models ( $\chi^2/df=2.04$ , GFI=0.74, CFI=0.98, RMSEA=0.071, SRMR=0.063), which suggested that modification was appropriate<sup>3</sup>. Nevertheless, a large modifications index for the correlated error term between ALTRN2 and ALTRN6 suggested possible improvement in model fit (MI-TD=30.02, Par change=0.15).

Table 9-5 CFA Analysis of Indicators of Partnership Characteristics from Calibration Sample

CFA Model	$\chi^2$	df	P-value	$\chi^2/df$	GFI	CFI	RMSEA	SRMR
Model R1	1213.20	545	0.00	2.23	0.69	0.97	0.077	0.074
Model R2	827.73	390	0.00	2.12	0.73	0.98	0.074	0.065
Model R3	781.31	362	0.00	2.16	0.73	0.98	0.075	0.063
Model R4	816.88	389	0.00	2.10	0.73	0.98	0.073	0.063
Model R5	790.70	388	0.00	2.04	0.74	0.98	0.071	0.063
Model R6	722.66	360	0.00	2.01	0.75	0.98	0.070	0.063
Model R7	674.66	333	0.00	2.03	0.75	0.98	0.071	0.060

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square; SRMR denotes standardized Root Mean Square Residual; N=206.

<sup>3</sup> Another modification was also tried with COMIT7 eliminated from Model R4. The result showed worse model fit.

Model R6 was constructed, with ALTRN6 deleted, which was found to be rather vague and redundant in meaning. The improvement in model fit ( $\chi^2/df=2.01$ , GFI=0.75, CFI=0.98, RMSEA= 0.070, SRMR=0.063), justified the latest model re-specification. However, the modification index for correlated error terms between ALTRN4 and ALTRN5 was quite significant (MI-TD=122.29, Par change=0.84), which suggested potential redundancy of indicators. Since ALTRN4 was found to be vague in meaning, it was deleted in the measurement model R7. The minor changes in model fit indices suggested that deleting ALTRN4 did not have much impact on the overall model data fit ( $\chi^2/df=2.03$ , GFI=0.75, CFI=0.98, RMSEA= 0.070, SRMR=0.060). However, the much more moderated size of modification indices suggested that Model R7 is more stable than Model R6. As shown in figure 9-5, all the factor loadings were above the acceptable level of 0.6 (Bagozzi and Yi, 1988) and significant (t-values ranged from 8.99 to 18.29). Therefore, Model R7 was considered the best fitted model.

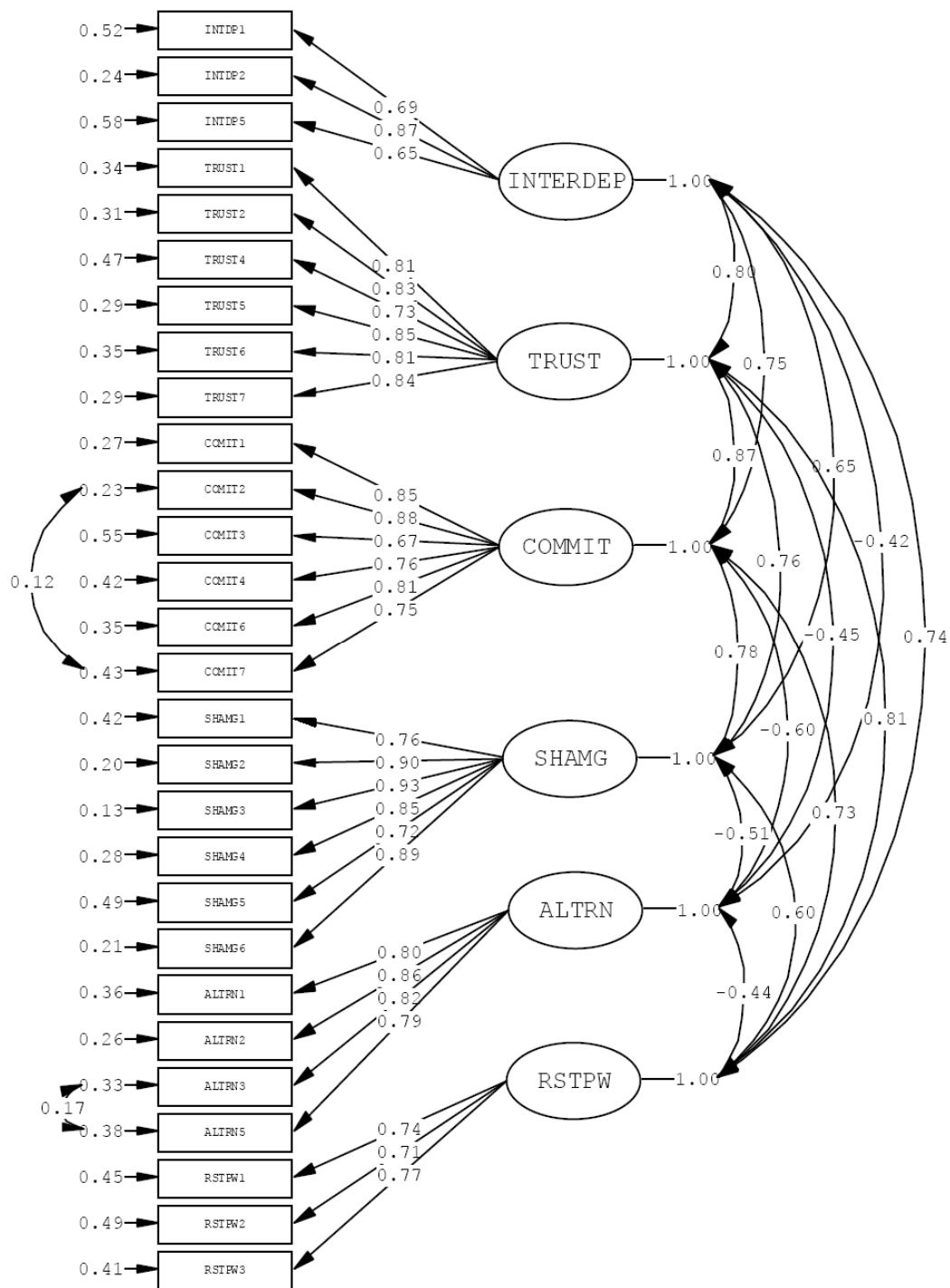


Figure 9-5 CFA of Refined Supply Chain Relationship Scale Based on Calibration Sample, Model R7

### 9.5.2 Cross-validation of Supply Chain Relationship Scale

To ensure that the refined scale of relationship characteristics was stable across different samples, a series of test of invariance were conducted with the calibration sample and the

validation sample (Benson and Bandalos, 1992). First of all, an identical CFA Model R7 was conducted with the validation sample again. The result suggested Model R7 fitted well with the validation sample ( $\chi^2/df=1.93$ , GFI=0.72, CFI=0.99, RMSEA= 0.067, SRMR=0.057). Factor loadings resulting from the validation sample remained significant and comparable with those resulting from the calibration sample (see table 9-6). This suggested that the refined scale of relationship characteristics applied to the validation sample equally well.

Table 9-6 Comparison of Parameters Estimates of Refined Relationship Scales

Items	Constructs					
	INTERDEP	TRUST	COMMIT	SHAMG	ALTRN	RSTPW
INTDP1	0.69(0.71)					
INTDP2	0.87(0.82)					
INTDP5	0.65(0.69)					
TRUST1		0.81(0.83)				
TRUST2		0.83(0.88)				
TRUST4		0.73(0.66)				
TRUST5		0.85(0.88)				
TRUST6		0.81(0.82)				
TRUST7		0.84(0.85)				
COMIT1			0.85(0.88)			
COMIT2			0.88(0.87)			
COMIT3			0.67(0.79)			
COMIT4			0.76(0.74)			
COMIT6			0.81(0.85)			
COMIT7			0.75(0.77)			
SHAMG1				0.76(0.88)		
SHAMG2				0.90(0.86)		
SHAMG3				0.93(0.86)		
SHAMG4				0.85(0.82)		
SHAMG5				0.72(0.86)		
SHAMG6				0.89(0.83)		
ALTRN1					0.80(0.80)	
ALTRN2					0.86(0.83)	
ALTRN3					0.82(0.87)	
ALTRN5					0.79(0.81)	
RSTPW1						0.74(0.88)
RSTPW2						0.71(0.76)
RSTPW3						0.77(0.75)

	Factor Correlations					
	INTERDEP	TRUST	COMMIT	SHAMG	ALTRN	RSTPW
INTERDEP	1.00					
TRUST	0.80(0.80)	1.00				
COMMIT	0.75(0.82)	0.87(0.92)	1.00			
SHAMG	0.65(0.75)	0.76(0.89)	0.78(0.88)	1.00		
ALTRN	-0.42(-0.49)	-0.45(-0.56)	-0.60(-0.57)	-0.51(-0.63)	1.00	
RSTPW	0.74(0.72)	0.81(0.81)	0.73(0.75)	0.6(0.73)	-0.44(-0.45)	1.00
Note: Loadings are completely standardized within each sample;						
First value is from the calibration sample; value in parentheses is from the validation sample.						

Secondly, a series of invariance test was conducted (see table 9-7). The first test assumed both samples had the same pattern of factor model and same pattern of error variance as defined in the refined scale of Model R7. The acceptable goodness of fit indices suggested that the assumption was reasonable and the two samples had the same pattern of factor and error terms. Holding the assumption of equal patterns, the second test assumed that calibration sample and validation sample had the same error variance. The goodness of fit indices remained acceptable. Since this test and the first test had no change in number of indicators and constructs, they are actually Nested Models (Deng et al., 2005). A chi-square change test could be used to indicate the validity of the assumption (Anderson and Gerbing, 1988). The non-significant Chi-square change in this case indicated that the assumption of invariant error variance was acceptable. The third test was carried out by holding the previous two assumptions, and in addition assumed that both samples had equal factor and equal error variances. Although the result showed a significant Chi-square change ( $P=0.03$ ), the improved model fit as indicated by  $\chi^2/df$ , suggested that the assumption was reasonable. Holding all the previous assumptions, the fourth test assumed equal factor covariance matrices. Again, the non-significant Chi-square change supported the assumption. Overall, the invariance tests suggested that the calibration sample and the validation sample shared the same measurement model, which indicated that the refined scale in Model R7 was stable across samples.

Table 9-7 Test of Invariance of Refined Relationship Scales

No.	Model	$\chi^2$	df	P-value	$\chi^2/\text{df}$	CFI	RMSEA	Nested Models	$\Delta \chi^2$	$\Delta \text{df}$
1	Equal pattern	1315.54	666	0.00	1.98	0.98	0.069		-	-
2	Error variance invariant	1325.40	696	0.00	1.90	0.98	0.066	2-1	9.86	30
3	Error and factor loading invariant	1370.60	724	0.00	1.89	0.98	0.066	3-2	45.2	28
4	Error variance, factor loading and factor covariance invariant	1374.46	739	0.00	1.86	0.98	0.065	4-3	3.86	15

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square.

### 9.5.3 Convergent Validity and Discriminant Validity of Refined Relationship Scale

To assess the convergent validity and discriminant validity of the refined scale, the CFA analysis of refined model R7 was again fitted to the entire sample. The result suggested that the refined model fitted the data quite well without excessive modification indices ( $\chi^2/\text{df}=2.70$ , GFI=0.80, CFI=0.99, RMSEA= 0.064, SRMR=0.049). All the factor loadings were significant and ranged from 0.68 to 0.89 (see figure 9-6).

Construct reliability and Average Variance Extracted (AVE) were computed with the refined scale, Model R7 (see table 9-8). Construct reliability of all the supply chain relationship constructs was greater than the suggested value of 0.7. AVEs for all constructs were greater than 0.5. In addition, given that all factor loadings for each indicator were greater than or very close to 0.7, the convergent validity of the relationship constructs was acceptable.

Discriminant validity of the constructs was examined by comparing the AVEs with the corresponding Squared Factor Correlations between constructs. It was found that some of the construct AVEs were smaller than the squared factor correlation (see table 9-8). For instance, AVE for trust was 0.688, which was smaller than its squared factor correlation with commitment, shared meaning and restrained use of power. Taking another example, AVE for commitment was 0.651, which was smaller than its squared factor correlation with trust, and shared meaning. Specifically, these were mainly due to the large



correlations between indicators. Interfirm trust tends to be interrelated with interdependence, shared meaning, and commitment. The discriminant validity seemed to be violated.

Nevertheless, given that the indicators for these constructs were developed based on the distinct theoretical underpinnings and different previous developed scales, it seemed arbitrary to converge these constructs. As noted by Moore and Benbasat (1991) conceptual dimensionality should be distinguished from empirical dimensionality, in that constructs can be conceptually different although they tend to be viewed identically by the respondents. For instance, a respondent, who perceives higher trust between partner firms, may also give positive responses to the level of commitment, and vice versa. Therefore it is not surprising to see high correlations between these constructs. Bollen and Hoyle (1990) suggested that high or perfect correlation is not a sufficient condition to claim that a concept is uni-dimensional rather than bi-dimensional. Therefore, in this research they are retained as separate constructs in the following analysis.

Table 9-8 CFA Analysis of Refined Supply Chain Relationship Scale (n=413)

Construct	Number of items	Cronbach's alpha	Construct reliability	AVE (Ave Var Ext)	Squared Factor Correlations					
					INTERDEP	TRUST	COMMIT	SHAMG	ALTRN	RSTPW
INTERDEP	3	0.788	0.789	0.557	1.000					
TRUST	6	0.921	0.923	0.668	0.640	1.000				
COMMIT	6	0.919	0.918	0.651	0.624	0.810	1.000			
SHAMG	6	0.937	0.938	0.718	0.504	0.706	0.706	1.000		
ALTRN	4	0.899	0.893	0.677	0.221	0.260	0.348	0.336	1.000	
RSTPW	3	0.816	0.817	0.599	0.533	0.672	0.548	0.462	0.194	1.000

Notes: INTERDEP=Interdependence, TRUST=Trust, COMMIT=Commitment, SHAMG=Shared Meaning, ALTRN=Availability of Alternatives, RSTPW=Restrained Power Use.

Construct reliability  $\rho_c = (\sum \lambda)^2 / [(\sum \lambda)^2 + \sum \text{var}(\delta)]$ , AVE =  $\sum \lambda^2 / [\sum \lambda^2 + \sum \text{var}(\delta)]$ .

On the contrary, inter-correlations between constructs actually confirmed the conceptualization of partnership strength presented in Chapter 5, in which trust, commitment, shared meaning and interdependence were proposed to contribute to the

strength of interfirm partnership. In the next section (section 9.5.4) a second-order CFA was conducted to confirm the common representation of these four factors on partnership strength.

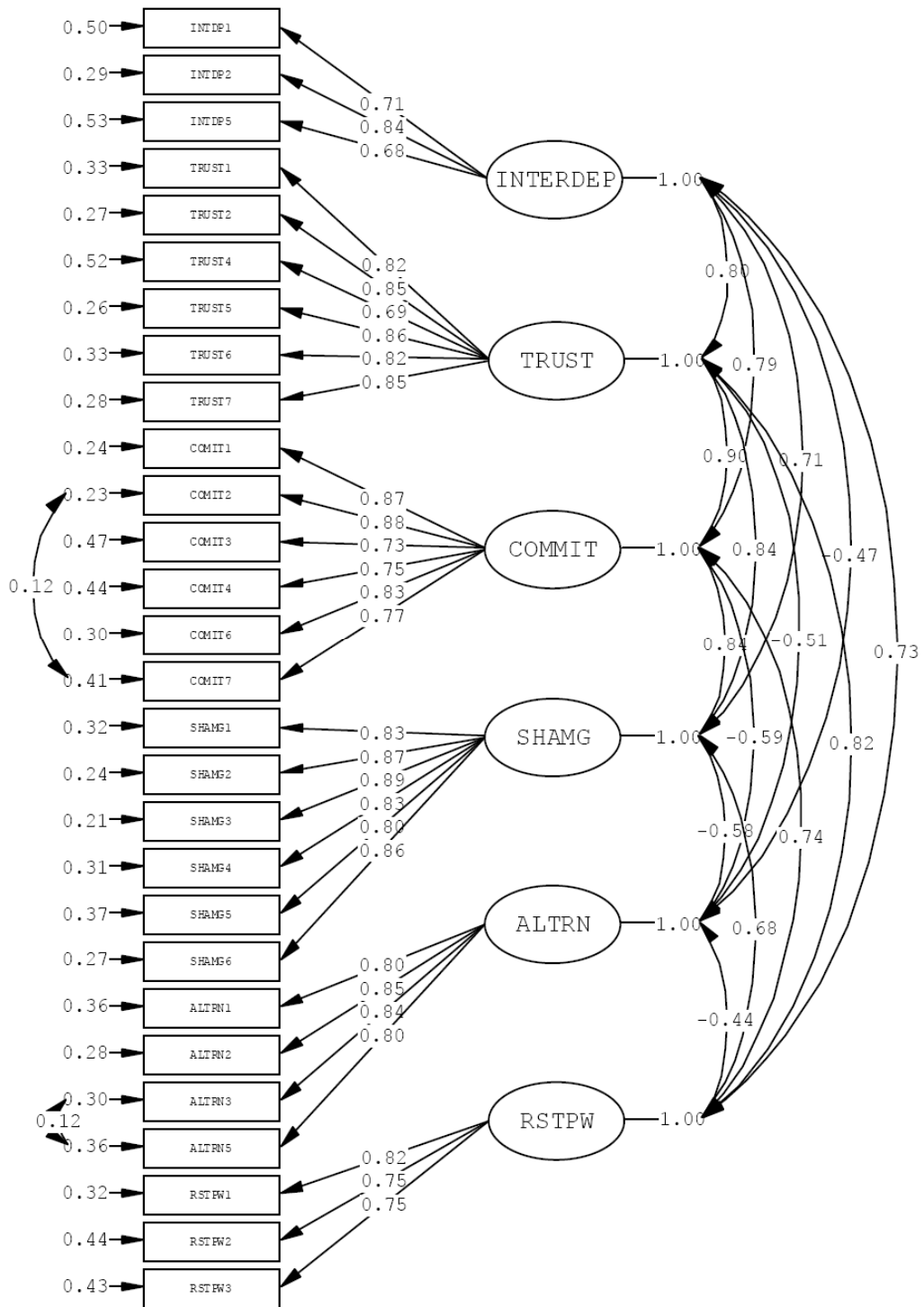


Figure 9-6 CFA of Supply Chain Relationship Scale Based on Entire Sample, Model R7

Moreover, it is interesting to see large correlations between restrained power use and

trust ( $r=0.82$ ). The positive relationship between the two constructs suggested that restrained power use may have contributed to higher levels of trust between firms, and that the higher levels of trust will encourage firms to use less power to leverage the cooperation with partner firms.

Surprisingly, there were negative correlations between restrained power use and availability of alternatives ( $r=-0.44$ ), as these two constructs were proposed to represent the common factor of balanced power. In the initial conceptual framework presented in Chapter 5, balanced power between supply chain partners was supposed to arise from both availability of alternative partners and restrained use of power by supply chain partners. The empirical evidence of negative correlation appears to contradict the initial theorization of balanced power. One possible explanation is that firms with more choice of available partners could be less reliant on the existing partner. Thus chances of playing opportunistically and leveraging its own power against the partner may rise. If this was the case, partnership with a higher level of interdependence should show higher levels of restrained power use. As shown in figure 9-6, the positive correlation between these two factors ( $r=0.73$ ) supported such an explanation. Therefore, in the later stages of analysis, availability of alternatives and restrained use of power were treated as two independent factors when examining the effects of partnership characteristics on interfirm knowledge transfer.

#### **9.5.4 Second-order CFA of Partnership Strength Indicators**

In order to confirm the common underlining factor indicated by trust, commitment, shared meaning, and interdependence, a second order factor analysis was conducted. In this model partnership strength (STREGTH) acts as the second order factor (i.e. a more abstract construct, which is not directly measured) comprised of four dimensions of first order factors (TRUST, INTERDEP, COMMIT, and SHAMG). The overall goodness of fit indices ( $\chi^2/df=2.74$ , GFI=0.83, CFI=0.99, RMSEA= 0.065, SRMR=0.042) suggested an acceptable model fit. The large second-order factor loadings (at least 0.83) suggested

that four dimensions of supply chain partnership characteristics shared similar weight in representing the strength of the partnership (see figure 9-7). It is worth pointing out that although four factors of partnership characteristics appear to represent the common factor of partnership strength, in the later stage of analysis these four factors were entered as independent factors. This allowed the author to examine more closely the individual effects of each dimension of partnership characteristics on knowledge transfer.

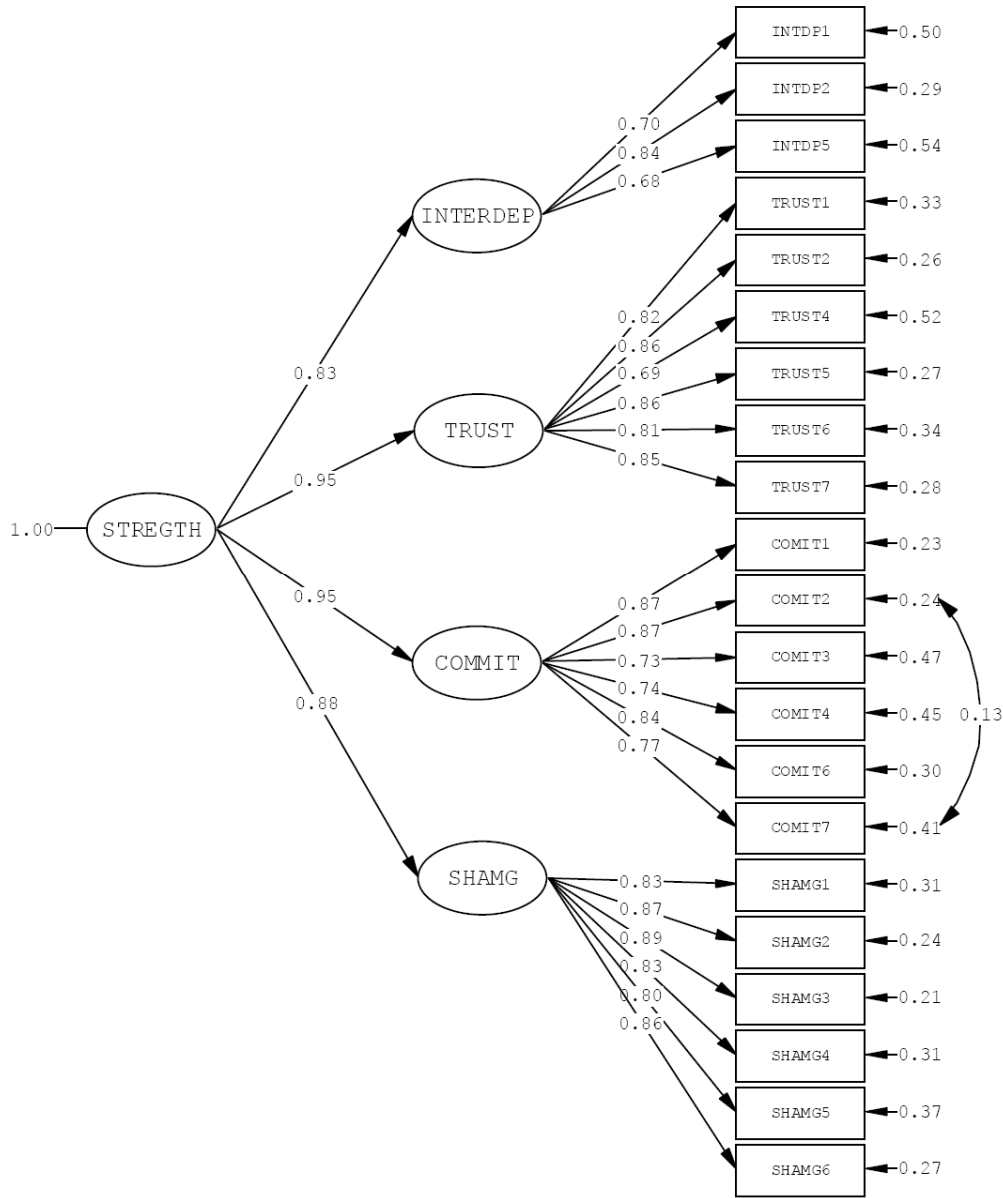


Figure 9-7 Second-order CFA of Partnership Strength

## 9.6 Indicators of Knowledge Transfer Activities

It has already been stated that knowledge transfer was conceptualized as three independent stages of activities (knowledge acquisition, knowledge internalization, knowledge utilization). Among these stages, knowledge utilization comprised of three dimensions (i.e. Instrumental Use, Conceptual Use, and Symbolic Use). Each dimension is supposed to represent one aspect of knowledge utilization. In order to examine validity and reliability of knowledge transfer constructs, a second-order CFA analysis was conducted with three dimensions of knowledge utilization first. The calibration sample (n=206) was used to refine the scale of knowledge utilization. The validation sample (n=207) was then used to cross-validate the scale. After certain improvements in the knowledge utilization constructs, the CFA analysis and cross-validation process was conducted again with the entire construct of knowledge transfer to ensure the quality of the construct, which was used in the later stage of model testing.

### 9.6.1 Second-order CFA of Knowledge Utilization Scale with Calibration Sample

To examine the global structure of knowledge utilization indicators, a second-order CFA model was conducted with the calibration sample (Model U1, see figure 9-8 for the path diagram). As shown in table 9-9, although model Chi-Square has a significant value ( $\chi^2=249.13$ ,  $df=87$ ),  $\chi^2/df=2.86$  indicates an acceptable level of model fit (Wheaton et al., 1977). Other fit indices, including GFI=0.74, CFI=0.97, RMSEA=0.095 and SRMR=0.067, also indicated reasonable level of model fit.

Table 9-9 Second-order CFA analysis of Knowledge Utilization Scales with Calibration Sample

CFA Model	$\chi^2$	df	P-value	$\chi^2/df$	GFI	CFI	RMSEA	SRMR
Model U1	249.19	87	0.00	2.86	0.74	0.97	0.095	0.067
Model U2 INSTU2 eliminated	210.01	74	0.00	2.84	0.75	0.98	0.095	0.065
Model U3 SYMBU2 eliminated	171.45	62	0.00	2.77	0.77	0.98	0.093	0.059
Model U4 INSTU5 eliminated	130.08	51	0.00	2.55	0.81	0.98	0.087	0.057
Model U5 INSTU4 eliminated	97.84	41	0.00	2.39	0.84	0.98	0.082	0.054

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square; SRMR denotes standardized Root Mean Square Residual; N=206

As shown in figure 9-8, three dimensions of knowledge utilization all loaded highly on the global second order factor. Most of the factor loadings except that of INSTU1 and INSTU2 are reasonably large ( $\lambda > 0.70$ ) (Fornell & Larcker, 1981). The small factor loading of INSTU2 on instrumental utilization ( $\lambda = 0.12$ ,  $t = 1.56$ ) suggests that INSTU2 is a poor indicator of instrumental utilization. INSTU2 is a reverse-coded item on the questionnaire asking whether the information from supply chain partner were ignored. The covariance matrix of all the knowledge utilization items was examined. It was found that INSTU2 had low covariance with other knowledge utilization items. This suggested that respondents tend to give inconsistent answers to INSTU2 compared with other knowledge utilization items. One likely explanation is that respondents became more conservative when answering reverse-coded questions. To avoid the analysis being biased by INSTU2, another second-order CFA model (Model U2) was conducted with INSTU2 eliminated.

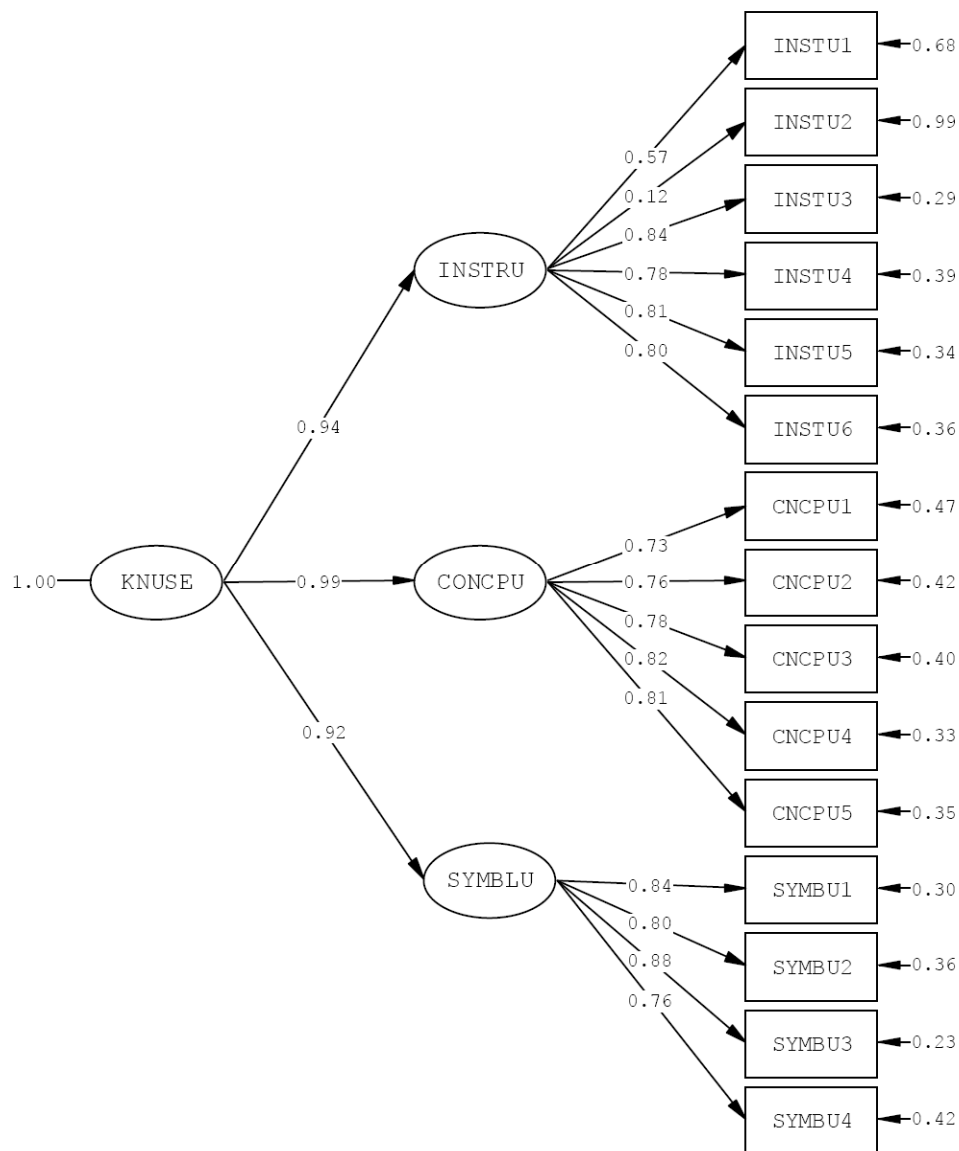


Figure 9-8 Second-order CFA of Knowledge Utilization Constructs, Model U1

As shown in table 9-9, the modified model did show a certain improvement in terms of model fit. However, factor loading for INSTU1 was still slightly lower than the preferred level ( $\lambda = 0.57$ ). In particular, the modification index for the loading of SYMBU2 on instrumental use showed a large value (MI=115.68, Par change=-3.11). SYMBU2 as a reverse coded item tends to be less indicative to the right construct. It was considered as a candidate for elimination. Therefore, Model U3 was composed with SYMBU2 deleted.

Again, the model fit showed certain improvement ( $\chi^2/df=2.77$ , GFI=0.77, CFI=0.98, RMSEA= 0.093, SRMR=0.059). Modification Indices were assessed. Two large



modification indices were found on the correlated error term between INSTU5 and INSTU3 (MI-TE=75.61, Par-change=0.35) and between INSTU5 and INSTU4 (MI-TE=26.46, Par-change=-0.19), suggesting INSTU5 a redundant indicator. INSTU5 asked the level of supply chain knowledge used in daily operations. Although the INSTU5 is slightly different from the other two items, INSTU5 tends to be more vague and includes a broader sense. INSTU3 tends to be a sufficient condition to INSTU5, in that people who suggested that knowledge use is high in solving key issues will almost certain give a positive answer to the level of knowledge use in daily operations. Instead of freeing the error term covariance (TE) for the two items, INSTU5 was deleted to avoid a redundant indicator and develop a more parsimonious scale of instrumental use (Benson and Bandalos, 1992).

The resultant Model U4 showed acceptable model fit ( $\chi^2/df=2.55$ , GFI=0.81, CFI=0.98, RMSEA= 0.087, SRMR=0.057). However, large Modification Indices were found for the correlated error term between INSTU4 and INSTU3 (MI-TE=44.67, Par-change=-0.40) and between INSTU4 and CNCPU5 (MI-TE=40.42, Par-change=0.18). Therefore, INSTU4 was considered a confusing item, and was eliminated in Model U5. The goodness of fit for Model U5 was acceptable ( $\chi^2/df=2.39$ , GFI=0.84, CFI=0.98, RMSEA=0.082, SRMR=0.054), with most of the factor loadings satisfactory (ranges from 0.73 to 0.88). Although factor loadings for INSTU1 was slightly lower ( $\lambda=0.56$ ) than the preferred level, it was retained to make sure that at least three indicators were included for Instrumental Use. In addition, no excessive modification indices were found in model U5. Therefore, the refined scale in Model U5 was found to be the best model so far.

### **9.6.2 Cross-validation of Knowledge Utilization Scale**

Model U5 was fitted again to the validation sample to make sure the refined scale of knowledge utilization was stable across samples. The model fitted the data quite well ( $\chi^2/df=1.62$ , GFI=0.88, CFI=0.99, RMSEA= 0.055, SRMR=0.047), with no problematic

modification indices. Three dimensions of knowledge utilization loaded highly on the global second-order factor. All the factor loadings were satisfactory (ranges from 0.64 to 0.88). Therefore, the stability of the refined scale of knowledge utilization was confirmed.

To assess the Invariance between the two samples, first order CFA analysis was conducted based on the refined scale of Model U5. The same pattern of factor loading was fitted again to the calibration sample and the validation sample. First of all, the parameter estimates were compared (see table 9-10). The factor loadings and factor correlations did not show much variation between the two samples.

Table 9-10 Comparison of Parameters Estimates of Refined Knowledge Utilization Scales

Items	Constructs		
	INSTRU	CONCPU	SYMBLU
INSTU1	0.56(0.64)		
INSTU3	0.82(0.83)		
INSTU6	0.84(0.75)		
CNCPU1		0.73(0.80)	
CNCPU2		0.77(0.77)	
CNCPU3		0.79(0.71)	
CNCPU4		0.80(0.84)	
CNCPU5		0.80(0.82)	
SYMBU1			0.80(0.88)
SYMBU3			0.88(0.87)
SYMBU4			0.77(0.76)
	Factor Correlations		
	INSTRU	CONCPU	SYMBLU
INSTRU	1.00		
CONCPU	0.87(0.94)	1.00	
SYMBLU	0.91(0.88)	0.93(0.93)	1.00
Note: Loadings are completely standardized within each sample;			
First value is from the calibration sample;			
Value in parentheses is from the validation sample.			

Secondly, a series of invariance tests were conducted with various invariance assumptions across two samples (see table 9-11). The assumption of equal factor pattern

was supported as the model fitted the data quite well. The model with factor loading invariance showed significant Chi-square change from the first model. However, since the model fit was still good, there wasn't enough evidence to reject the model, so the factor loading invariance assumption was also supported. The following two models tested additional assumptions of error variance invariance and factor covariance invariance, respectively. The acceptable model fit indices and non-significant Chi-square change supported the two assumptions. Therefore, the stability of the refined scale of knowledge utilization was confirmed.

Table 9-11 Test of Invariance of Refined Knowledge Utilization Scales

No.	Model	$\chi^2$	df	P-value	$\chi^2/df$	CFI	RMSEA	Nested Models	$\Delta \chi^2$	$\Delta df$
1	Equal pattern	94.91	76	0.070	1.25	1.00	0.035	-	-	-
2	Factor loading invariant	127.26	87	0.003	1.46	0.98	0.069	2-1	32.35	11
3	Error and factor loading invariant	140.31	98	0.003	1.43	0.99	0.046	3-2	13.05	11
4	Error variance, factor loading and factor covariance invariant	144.47	104	0.005	1.39	0.99	0.044	4-3	4.16	6

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square.

### 9.6.3 Validity and Reliability of Knowledge Utilization Scale

To examine the convergent validity and discriminant validity of these three dimensions of knowledge utilization, a first order CFA based on the refined scale (Model U5) was fitted to the entire sample. The CFA analysis showed a good model fit ( $\chi^2/df=3.19$ , GFI=0.88, CFI=0.99, RMSEA=0.073 SRMR=0.045). As shown in figure 9-9, most of the factor loadings were greater than 0.7, except for INSTU1 ( $\lambda=0.6$ ).

As shown in table 9-12, the construct reliability of all three constructs was higher than or very close to 0.8. Average Variance Extracted (AVE) by each construct all exceeded 0.5. Therefore, the convergent validity of the three knowledge utilization constructs was confirmed. However, since AVE for each construct was lower than the squared factor correlations between corresponding constructs, discriminant validity was not confirmed.

This indicates that there were no large variations between measures of Instrumental Use, Conceptual Use, and Symbolic Use. The three dimensions of knowledge utilization tended to be correlated highly with each other. It could be interpreted, therefore, that the three dimensions of knowledge utilization tended to measure the same underlying factor.

Table 9-12 CFA Analysis of Refined Knowledge Utilization Constructs with Entire Sample

Construct	Number of items	Cronbach's alpha	Construct reliability	AVE (Ave Var Ext)	Squared Factor Correlations		
					INSTRU	CONCPU	SYMBLU
INSTRU	3	0.778	0.790	0.561	1.000		
CONCPU	5	0.890	0.890	0.619	0.828	1.000	
SYMBLU	3	0.861	0.867	0.685	0.792	0.865	1.000

Notes: INSTRU=Instrumental Use, CONCPU=Conceptual Use, SYMBLU=Symbolic Use.  
Construct reliability  $\rho_c = (\sum \lambda)^2 / [(\sum \lambda)^2 + \sum \text{var}(\delta)]$ , AVE =  $\sum \lambda^2 / [\sum \lambda^2 + \sum \text{var}(\delta)]$ . N=413

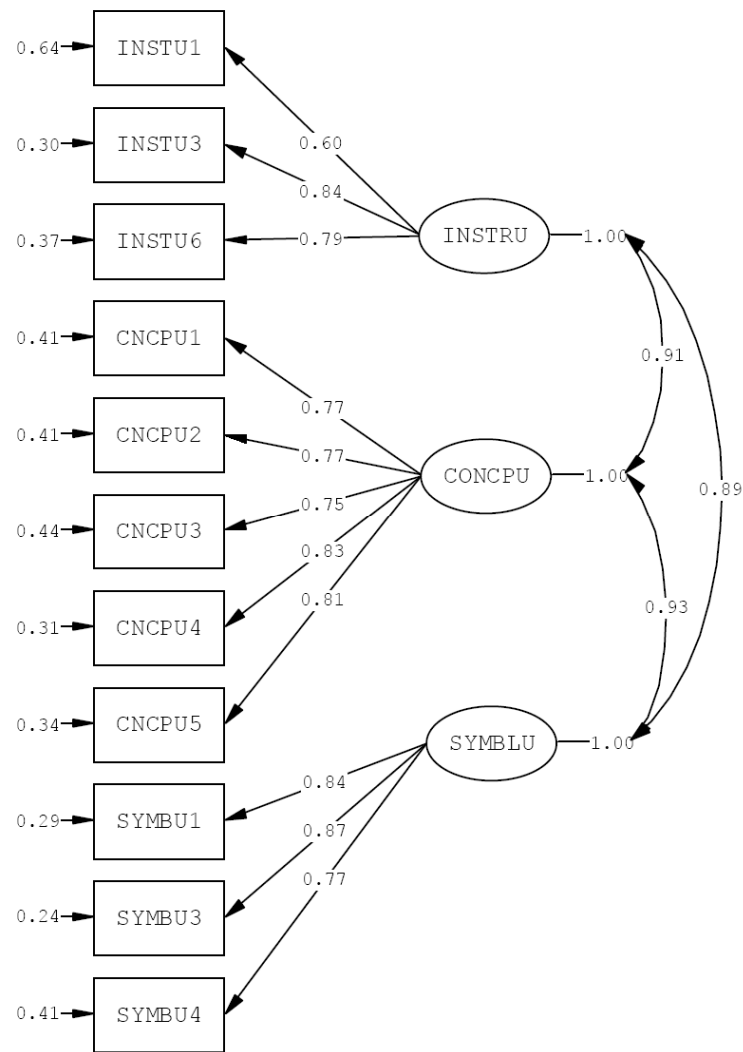


Figure 9-9 First-order CFA of Knowledge Utilization Constructs with Entire Sample, Model U5

Moreover, given that the internal consistency was high within each dimension of knowledge utilization, the scores of the remaining items in each dimension were averaged to generate three new variables, Instrumental Use (INSTRU), Conceptual Use (CONCPU) and Symbolic Use (SYMBLU). These newly generated variables were used in the rest of the analysis. The main reason for doing this was to reduce the measurement structure of knowledge utilization into a lower-ordered measurement structure, which was fitted into the measurement model of the whole knowledge transfer process.

Before each dimension of knowledge utilization was averaged, a Principal Component

Analysis (PC) was conducted with each dimension of the utilization scale, to confirm that the underlying dimensionality of each knowledge utilization construct was indeed one. As shown in table 9-13, for each knowledge utilization construct, only one component had an eigenvalue over 1. The first principal component accounted for large proportions of variances in each dimension, and all the items had large positive correlations with the corresponding first principal component. Therefore, items in each corresponding knowledge utilization dimension can be reduced to a single variable.

Table 9-13 Principal Component Analysis of Knowledge Utilization Dimensions

Constructs	Number of Items	Number of Eigenvalues>1	Value of Eigenvalues <sup>a</sup>	% of Variance	Smallest loading
Instrumental Use	3	1	2.100	70.006	0.777
Conceptual Use	5	1	3.476	69.516	0.812
Symbolic Use	3	1	2.351	78.367	0.846

Note: a. Only those eigenvalues over 1 are provided. N=413.

#### 9.6.4 CFA Analysis of Knowledge Transfer Scale with Calibration Sample

To assess and refine the measurement model of the entire knowledge transfer process, first order CFA analysis was fitted to the calibration sample with the three constructs of knowledge transfer (i.e., knowledge acquisition, knowledge distribution<sup>4</sup>, and knowledge utilization). Here, the averaged constructs of knowledge utilization were incorporated into the CFA model together with rest of the knowledge transfer constructs (i.e., knowledge acquisition and knowledge distribution).

Model KT1 (see table 9-14) showed a moderate model fit ( $\chi^2/df=3.08$ , GFI=0.81, CFI=0.97, RMSEA=0.100, SRMR=0.068). When Modification Indices were examined, it was found that MI for factor loading of KNACQ5 on knowledge distribution had a significant value of 30.11 (Par change=0.58). This implied a potential decrease in Chi-Square if the parameter was freed. However, given that KNACQ5 also loaded highly on knowledge acquisition ( $\lambda=0.83$ ), it seemed that indicator KNACQ5 tended to be

<sup>4</sup> As was discussed in section 7.6.2, construct knowledge distribution was adopted to represent the original concept of knowledge internalization.

explained by both latent variables (i.e. knowledge acquisition and knowledge distribution). Since in this research, knowledge acquisition and knowledge distribution were defined as two distinct constructs, in order to avoid the overlapped indication to both constructs, it was better to eliminate the problematic indicators.

**Table 9-14 CFA Analysis of Knowledge Transfer Constructs with Calibration Sample**

CFA Model	$\chi^2$	df	P-value	$\chi^2/df$	GFI	CFI	RMSEA	SRMR
Model KT1	157.01	51	0.00	3.08	0.81	0.97	0.100	0.068
Model KT2	95.06	41	0.00	2.32	0.87	0.98	0.080	0.061

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square; SRMR denotes standardized Root Mean Square Residual. N=206.

Consequently, KNACQ5 was eliminated in the next CFA analysis (Model KT2). All the factor loadings still remained high and significant (Ranged from 0.71 to 0.89). The model fit was acceptable ( $\chi^2/df=2.32$ , GFI=0.87, CFI=0.98, RMSEA=0.080, SRMR=0.061), with no excessive MI found in the result.

#### **9.6.5 Cross-validation of Knowledge Transfer Scales**

Model KT2 was fitted to the validation sample to ensure the stability of the refined scale of knowledge transfer. The result showed a good model fit ( $\chi^2/df=2.04$ , GFI=0.89, CFI=0.98, RMSEA=0.071, SRMR=0.056), with significant factor loadings.

A comparison of parameter estimates is shown in table 9-15. There was not much variation between the two samples. Therefore, a series of Invariance Tests were again conducted with the calibration sample and the validation sample (see table 9-16). The equal factor pattern assumption was supported by the good model fit indices. The non-significant changes in Chi-square in Nested Models supported the incremental assumptions of factor loading invariance, and error variance invariance, and factor covariance invariance. Therefore, the stability of the refined scale of knowledge transfer was confirmed.

Table 9-15 Comparison of Parameters Estimates of Refined Knowledge Transfer Scales

Items	Constructs		
	KNACQ	KNDIST	KNUSE
KNACQ1	0.75(0.71)		
KNACQ2	0.82(0.83)		
KNACQ3	0.81(0.77)		
KNACQ4	0.82(0.86)		
KNDST1		0.83(0.76)	
KNDST2		0.87(0.75)	
KNDST3		0.71(0.80)	
KNDST4		0.75(0.74)	
INSTRU			0.82(0.84)
CONCPU			0.89(0.92)
SYMBLU			0.89(0.89)
	Factor Correlations		
	KNACQ	KNDIST	KNUSE
KNACQ	1.00		
KNDIST	0.79(0.77)	1.00	
KNUSE	0.70(0.62)	0.59(0.55)	1.00

Note: Loadings are completely standardized within each sample;  
First value is from the calibration sample;  
Value in parentheses is from the validation sample.

Table 9-16 Test of Invariance of Refined Knowledge Transfer Scales

No.	Model	$\chi^2$	df	P-value	$\chi^2/df$	CFI	RMSEA	Nested Models	$\Delta \chi^2$	$\Delta df$
1	Equal pattern	178.51	82	0.000	2.18	0.98	0.076	-	-	-
2	Factor loading invariant	194.28	93	0.000	2.09	0.98	0.073	2-1	15.77	11
3	Error and factor loading invariant	203.05	104	0.000	1.95	0.98	0.068	3-2	8.77	11
4	Error variance, factor loading and factor covariance invariant	204.41	107	0.000	1.91	0.98	0.067	4-3	1.36	3

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square.

### 9.6.6 Reliability and Validity of Knowledge Transfer Scales

To assess the convergent validity and discriminant validity of the knowledge transfer construct, Model KT2 was fitted again to the entire sample. The result exhibited an acceptable model fit ( $\chi^2/df=3.48$ , GFI=0.90, CFI=0.98, RMSEA=0.078, SRMR=0.053).

Interestingly, the error term correlation between Instrumental Use and Conceptual Use



showed a large modification index (MI-TD=135.26, Par change=-6.59). This suggested a potential negative prediction between the two constructs. Hence, another CFA model was fitted to the whole sample with error term correlation between INSTRU and CONCPU freed. Nevertheless, the result did not show much improvement in the model fit ( $\chi^2/df=3.55$ , GFI=0.90, CFI=0.98, RMSEA=0.079, SRMR=0.052,  $\Delta \chi^2=-0.63$ ,  $\Delta df=-1$ ), which suggested that the error term correlation might not be consistent across samples. Therefore, instead of freeing the parameter, it was fixed in the refined measurement model.

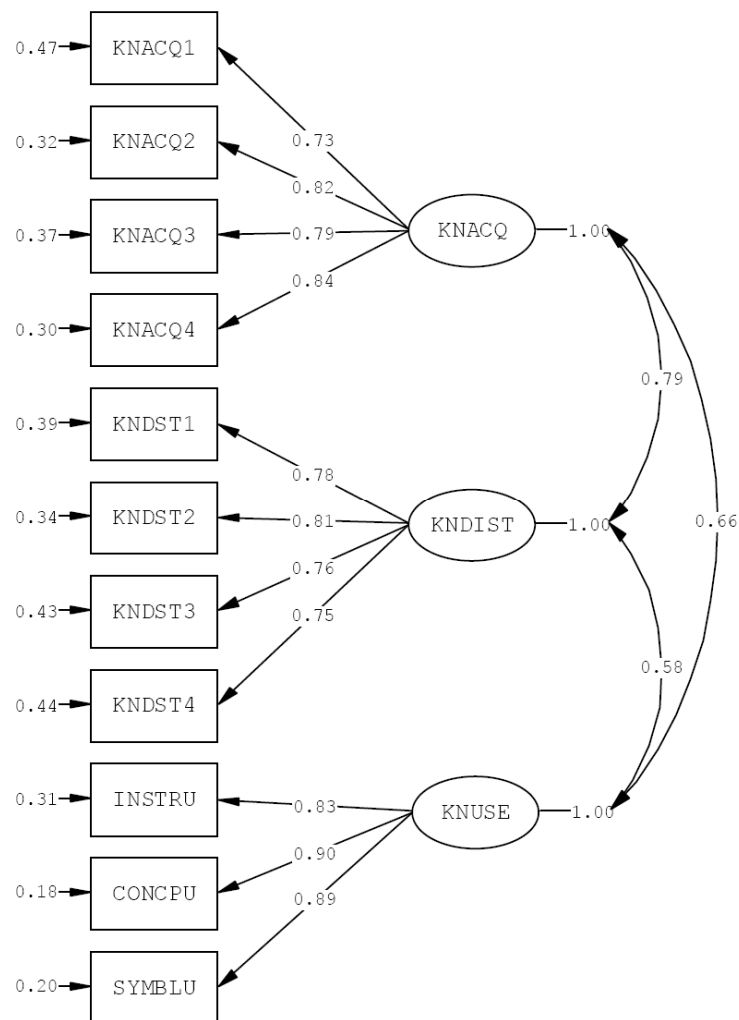


Figure 9-10 CFA of Refined Scale of Knowledge Transfer based on Entire Sample, Model KT2

As shown in figure 9-10, all the factor loadings were greater than 0.7. The construct

reliability of the three knowledge transfer constructs was greater than 0.8. AVEs all exceeded 0.50 (see table 9-17). Therefore, the convergent validity of the three dimensions of knowledge transfer was confirmed. However, when discriminant validity was examined, it was indicated that AVE of knowledge distribution (KNDIST) was lower than the Squared Factor Correlations between constructs KNDIST and KNACQ. The discriminant validity of the two constructs seemed to be violated. Nevertheless, for the same reason mentioned in section 9.5.3, it seemed arbitrary to accept unidimensionality and converge these constructs. For instance, a respondent who perceives knowledge acquisition activities to be high in the organization, may also give positive responses to knowledge distribution items, and vice versa. Therefore, in this research they were retained as separate constructs in the further analysis.

Table 9-17 Confirmatory Factor Analysis of Refined Knowledge Transfer Constructs (n=413)

Construct	Number of items	Cronbach's alpha	Construct reliability	AVE (Ave Var Ext)	Squared Factor Correlations		
					KNACQ	KNDIST	KNUSE
KNACQ	4	0.873	0.874	0.634	1.000		
KNDIST	4	0.855	0.858	0.601	0.624	1.000	
KNUSE	3	0.906	0.906	0.764	0.436	0.336	1.000

Notes: KNACQ=Knowledge Acquisition, KNDIST=Knowledge Distribution, KNUSE=Knowledge Utilization;  
Construct reliability  $\rho_c = (\sum \lambda)^2 / [(\sum \lambda)^2 + \sum \text{var}(\varepsilon)]$ , AVE =  $\sum \lambda^2 / [\sum \lambda^2 + \sum \text{var}(\varepsilon)]$ .

## 9.7 Summary

After a comprehensive process of measurement model evaluation and refinement, the measurement model of supply chain partnership characteristics and knowledge transfer was fixed. The cross-validation process ensured that the measurement model was stable across samples. This process ensured that the measurement model was of acceptable quality, which paved the way for a more accurate estimation of the later stage structural equation modeling. Moreover, the process of measurement model assessment ensured the author estimated and improved the model in a consistent manner throughout the analysis.

This is especially important when the model involves a large number of latent constructs and observed indicators. The next chapter continues the analysis, moving on to the stage of structural equation modeling.

# **CHAPTER 10 STRUCTURAL EQUATION MODELING**

## **10.1 Preamble**

In the last chapter, scales of supply chain partnership characteristics and knowledge transfer activities were refined and cross-validated, so that the measurement models were confirmed. Such procedures ensured the stability of measurement model, and paved the way for the structural equation models in this chapter. As introduced in the last chapter, the whole conceptual model was divided into two parts. Part one examined the relationship between supply chain partnership characteristics and knowledge transfer activities. Part two examined the relationship between knowledge transfer activities and a firm's performance. Before Structural Equation Models are fitted to the data, the strategy of SEM will be discussed. This served as a consistent guideline to the model specification process. The author intended to examine the moderating effect of partnership duration. However, the non-identical measurement models between the short duration and long duration samples restricted the testing of the moderating effect (see more in section 10.3.2.3). Moreover, different relationships across sub-samples in terms of contract status and location in the supply chain were also examined on each part of the model. By splitting the entire sample according to these criteria and fitting SEM models on subsets of the sample, the author was able to determine the differences in path estimates due to different characteristics of the sub-samples.

## **10.2 Strategy of Structural Equation Modeling**

### **10.2.1 Competing Model Strategy**

Hair et al. (1998) highlighted the importance of defining an appropriate strategy in structural equation modeling. In the authors' opinion, the choice of modeling strategy should be consistent with the objectives of the research. Among the three most often used

modeling strategies<sup>5</sup> (i.e., Confirmatory Modeling Strategy, Competing Models Strategy, and Model Development Strategy), Competing Models Strategy was considered as the most appropriate one for the current study. Competing Models Strategy advocates that obtaining an acceptable level of fit for both the overall model and the measurement and structural models does not assure the “best model” has been found. Numerous alternative models may provide equal or even better fits (Hair et al., 1998). By identifying and testing competing models that represent different hypothetical structural relationships, researchers are actually testing competing theories. Such a procedure is considered to be much stronger than just a slight modification of a single “theory”.

In this research, although the conceptual model developed in Chapter 5 served as the guideline for model building and hypotheses testing, given that this research was also exploratory in nature, it was also interesting to indicate alternative findings from the empirical data. In this sense, the method of Structural Equation Modeling should not be limited to only confirming the hypotheses previously developed. Therefore, competing models strategy gave the author more chance to find out alternative explanations from the empirical data.

### **10.2.2 Model Trimming Approach**

Within various applications of Competing Models Strategy, Model Trimming is a commonly used approach. Specifically, an initial model that is most loosely constrained is constructed and tested, until the most restrictive model is tested (Marsh and Hoceuar, 1994). Model trimming is normally done by deleting one path at a time from the initial model until a significant chi-square difference appears, which indicates that model trimming is going too far. The purpose of model trimming is to compare a number of Nested Models, while maintaining accordance with the underlying theory, until the most parsimonious model is reached (the one that specifies fewest parameters, not significantly different from the saturated model, and fully but trivially explains the data).

---

<sup>5</sup> For more explanations of different modeling strategy, please see (Hair et al., 1998).

During the model trimming process, normally paths that are not significant are considered as candidates for deletion. However, any model re-specification, such as adding or dropping paths, should be in accordance with the theory and face validity (Hair et al., 1998). One of the main advantages of the model trimming approach to the current study is that the author has an initial model to start with rather than starting from nowhere.

The models are “Nested” when the indicators and constructs remain constant, and only the number of the estimated relationships changes. Thus, parameters estimated in a more restrictive model are a subset of the parameters estimated in the less restrictive model (Deng et al., 2005). According to Lee and Hershberger (1990), the most restrictive or parsimonious model is preferable since it is subject to the most stringent test. This is because nested models share the same null model, so that the feasibility of model re-specification can be tested by the difference in Chi-square values and degrees of freedom between nested models (Anderson and Gerbing, 1988). It is expected that a more restrictive model will have a higher Chi-square value and degree of freedom. Thus an insignificant increase in Chi-square with respect to the change in degrees of freedom will indicate that the more restrictive/parsimonious model should be chosen.

To ensure that model re-specification was consistent throughout the analysis, the following rules were used as the guideline for model trimming:

- (1) Path coefficient with t-values greater than 2 suggested a significant relationship (Joreskog and Sorbom, 1989, p.89);
- (2) Path parameters were fixed one at a time;
- (3) Those path parameters with smallest t-value were considered as candidate for fixing.
- (4) Underlying theory was also considered, so that a path parameter which did not have substantive meaning was considered for fixing (Joreskog and Sorbom, 1989; Hair et al., 1998);
- (5) When two parameters had same t-value, the path parameter which clearly contradicted existing theory was considered for fixing;

- (6) If fixing a path parameter resulted in a worse model fit, an alternative path parameter was considered to be a candidate for fixing according to rule (1) to rule (5);
- (7) The process continued until an additional constraint resulted in a significant increase in Chi-square statistics.
- (8) Moreover, when a model had the same goodness of fit indices, it suggested that the additional constraint didn't have an impact on overall model data fit (Deng et al., 2005). In this case, whether or not the additional constraint would be imposed should be justified by substantive meanings.

### **10.2.3 Issues of Cross-validation**

Ideally, the final model should be cross-validated on a different data set to ensure the predictive validity of the model (Joreskog and Sorbom, 1989). Normally the sample needs to be split into two random halves as was done in Chapter 9. The calibration sample is used for estimating the regression weights/Path coefficient. The validation sample is used for calculating the cross-validation coefficient. However, the main weakness of this cross-validation method is that the sample size is sacrificed. When the sample size is small, the calibration sample may be too small to provide stable estimates of parameters in complex models (Cudeck and Browne, 1983). As in the case of the current research the entire sample is 413, the calibration sample would be less than 207 cases. For the proposed model, which involved a large number of variables and parameters, the calibration sample might become too small to provide stable estimates. Therefore, cross-validation of the Structural Equation Model was restricted due to the relatively small sample size in this study.

Browne and Cudeck (1989) introduced the Expected Cross-validation Index (ECVI), as an approximation of cross-validation coefficient. Instead of using a cross-validation index produced by splitting two samples, ECVI is an index produced by one sample only, but with approximately the same expected value. The index measures the likelihood that the model cross-validates across similar sample sizes. The smaller the index the more

stable the model will be across different samples. Without a specified range of acceptable values, the ECVI is usually used for comparing alternative models (Hair et al., 1998). In the current study, ECVI is reported together with other model fit indices, to indicate the stability of the parameter estimates and the appropriateness of the model re-specification.

### **10.3 SEM Part One: Partnership Characteristics and Knowledge**

#### **Transfer Activities**

The first part of the structural equation model of this study is constructed to examine the relationship between supply chain partnership characteristics and knowledge transfer activities. In this part of the model, interdependence, trust, commitment, shared meaning, availability of alternatives, and restrained power use as latent explanatory variables are expected to have effects on the latent response variables of knowledge transfer activities. Refined scales of partnership characteristics and knowledge transfer indicators were entered into the model (see section 9.5 and 9.6). The process of Model Trimming was followed, in which paths between partnership characteristics and knowledge transfer activities were examined and specified. The relationships between latent response variables (i.e., knowledge acquisition, knowledge distribution, and knowledge utilization) were predetermined according to initial conceptualization. Parameter estimates and modification index gave support on whether the hypothesized relationship between latent response variables was appropriate. Hence, the main focus of model specification was to identify the relationship between relationship characteristics and knowledge transfer activities.

#### **10.3.1 Submodel 1: Entire Sample**

##### ***10.3.1.1 The Model Trimming Process***

The model trimming process started from the entire sample, which contained 413 cases of responding supply chain partnerships. The following discussions give an illustration of



model trimming process based on the entire sample<sup>6</sup>.

- (1) Model P1M1 was the least restricted model with all the paths leading to partnership characteristics and knowledge activities freed. The model had an acceptable model fit ( $\chi^2/df=2.85$ , GFI=0.74, CFI=0.98, RMSEA=0.067, SRMR=0.053). The model estimation gave the smallest path coefficient between commitment and knowledge acquisition (i.e. GA(1 3)=0.03,  $t=0.15$ ), so it was fixed in the next nested model.
- (2) Model P1M2 was estimated with GA(1 3) fixed. The Chi-square actually decreased somewhat ( $\Delta \chi^2=-0.03$ ,  $\Delta df=1$ ), which suggested that the path coefficient between commitment and knowledge acquisition (i.e. GA(1 3)) was redundant. Model P1M2 was more parsimonious than P1M1. The estimation showed the smallest path coefficient between commitment and knowledge utilization (GA(3 3)=0.02,  $t=0.15$ ). It was therefore fixed in the next model.
- (3) Model P1M3 had an insignificant Chi-square increase ( $\Delta \chi^2=0.59$ ,  $\Delta df=1$ ). Thus P1M3 was more parsimonious than P1M2. The smallest path coefficient between shared meaning and knowledge acquisition (GA(1 4)=0.04,  $t=0.33$ ) was considered to be fixed in the next model.
- (4) The above process continued until Model P1M11 was reached, in which paths from trust, commitment, shared meaning to knowledge acquisition; paths from trust, shared meaning, availability of alternatives, and restrained power use to knowledge distribution; and paths from commitment, shared meaning and restrained power use to knowledge utilization were fixed (see figure 10-1 for the path diagram). The model showed an acceptable model fit ( $\chi^2/df=2.81$ , GFI=0.74, CFI=0.98, RMSEA=0.066, SRMR=0.053). The ECVI index had the lowest value (ECVI=5.12) compared to all previous models, suggesting model P1M11 was the most stable one. Furthermore, the paths from knowledge acquisition to knowledge distribution and from knowledge distribution to knowledge utilization were all significant ( $t=8.55$  and  $t=3.44$ , respectively), and there were no significant modification index for other paths between knowledge transfer stages (MI ranges from 0.38 to 2.51, Par change ranges

---

<sup>6</sup> Subsequent sections will follow similar model trimming process, so details will not be given due to space limits.

from -1.16 to 0.08). This suggested that the initial specification of path between knowledge transfer stages was appropriate.

- (5) To find out whether a more parsimonious model existed, the path coefficient between trust and knowledge utilization ( $\beta = -0.15$ ,  $t = -1.57$ ) was fixed from P1M11. The resulting model P1M12 showed a significant increase in model fit ( $\Delta \chi^2 = 5.75$ ,  $\Delta df = 1$ ). Moreover, it was less stable than model P1M11 (ECVI=5.13). Therefore, model P1M11 was the best-fitted and most parsimonious model based on the entire sample.
- (6) The author also tried to free the path between knowledge acquisition and knowledge utilization from model P1M11 to see whether there are direct effects between the two knowledge transfer stages. The resulting model estimation (known as P1M13) showed worse fit than model P1M11 ( $\chi^2/df = 2.82$ , GFI=0.74, CFI=0.98, RMSEA=0.066, SRMR=0.053). The decrease in Chi-square is non-significant ( $\Delta \chi^2 = -1.79$ ,  $\Delta df = -1$ ), suggesting that P1M11 was more parsimonious and more preferred. Moreover, path estimates from knowledge acquisition to knowledge distribution, and from knowledge distribution to knowledge utilization became insignificant, suggesting freeing the path was not appropriate.

Table 10-1 Structural Equation Model Comparing Nested Models

CFA Model	$\chi^2$	df	P-value	$\chi^2/\text{df}$	GFI	CFI	RMSEA	SRMR	ECVI	Nested models	$\Delta \chi^2$	$\Delta \text{df}$
Model P1M1	1894.59	665	0.00	2.85	0.74	0.98	0.067	0.053	5.16		-	-
Model P1M2	1894.56	666	0.00	2.85	0.74	0.98	0.067	0.053	5.15	2-1	-0.03	1
Model P1M3	1895.15	667	0.00	2.84	0.74	0.98	0.067	0.053	5.15	3-2	0.59	1
Model P1M4	1894.91	668	0.00	2.84	0.74	0.98	0.067	0.053	5.14	4-3	-0.24	1
Model P1M5	1894.95	669	0.00	2.83	0.74	0.98	0.067	0.053	5.14	5-4	0.04	1
Model P1M6	1895.62	670	0.00	2.83	0.74	0.98	0.067	0.053	5.14	6-5	0.67	1
Model P1M7	1898.08	671	0.00	2.83	0.74	0.98	0.067	0.053	5.14	7-6	2.46	1
Model P1M8	1897.16	672	0.00	2.82	0.74	0.98	0.067	0.053	5.13	8-7	-0.92	1
Model P1M9	1896.62	673	0.00	2.82	0.74	0.98	0.066	0.053	5.12	9-8	-0.54	1
Model P1M10	1898.31	674	0.00	2.82	0.74	0.98	0.066	0.053	5.12	10-9	1.69	1
<b>Model P1M11</b>	1899.44	675	0.00	2.81	0.74	0.98	0.066	0.053	5.12	11-10	1.13	1
Model P1M12	1905.19	676	0.00	2.82	0.74	0.98	0.066	0.053	5.13	12-11	5.75	1
Model P1M13	1897.65	674	0.00	2.82	0.74	0.98	0.066	0.053	5.12	13-11	-1.79	-1

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square; SRMR denotes standardized Root Mean Square Residual.  $\Delta \chi^2$  is the change in Chi-square statistic. N=413.

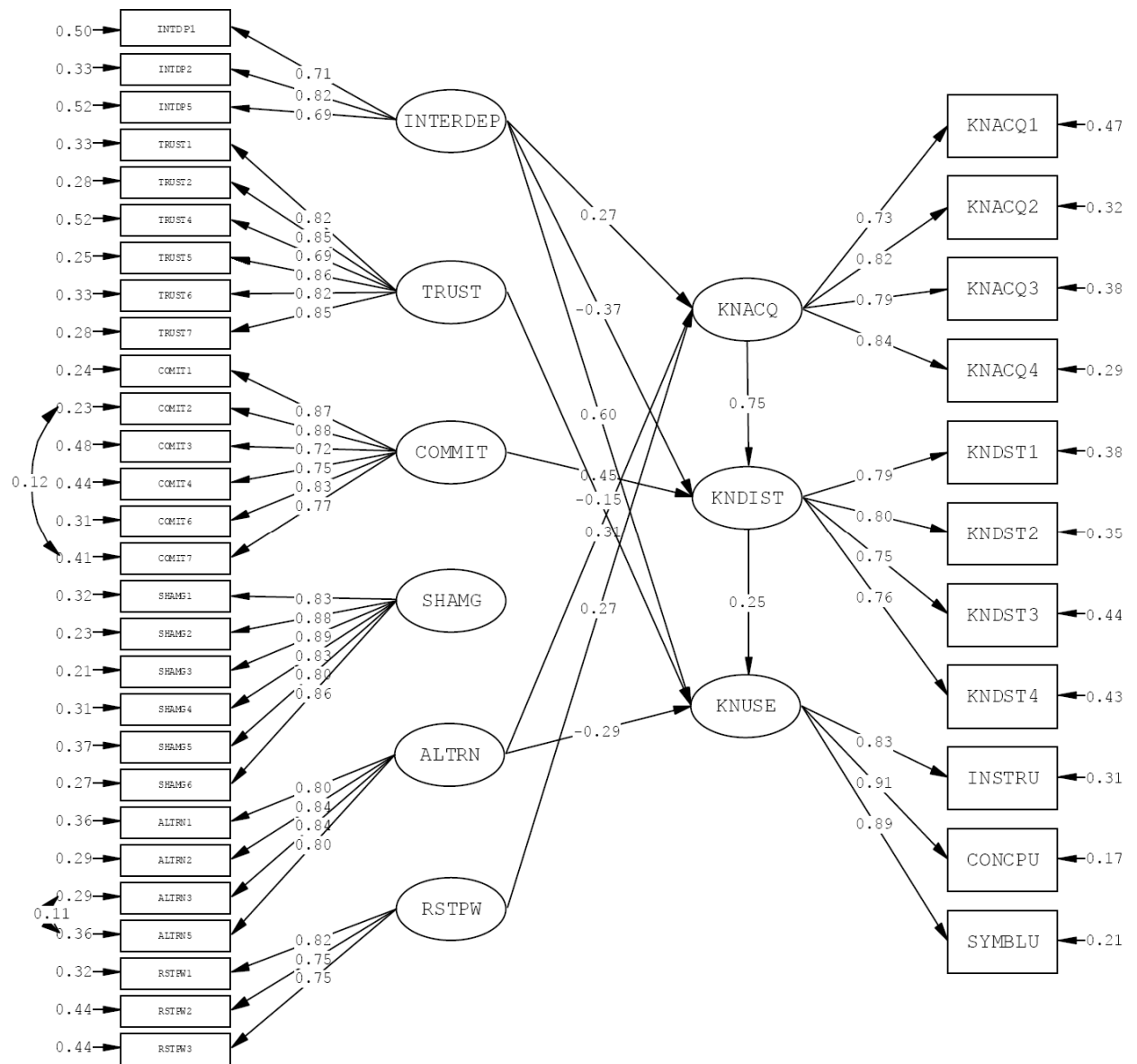


Figure 10-1 Path Diagram of SEM Model Part 1, Model P1M11, Entire Sample

### 10.3.1.2 Path Parameter Estimates

The above model trimming process suggested that P1M11 was the most parsimonious model and best fitted model so far. To test the hypotheses developed in Chapter 5, path coefficient estimates from the model were examined (see table 10-2). As expected, knowledge acquisition had significant effect on knowledge distribution, which in turn facilitates knowledge utilization. Therefore, Hypotheses 5 and 6 were supported. Moreover, the positive and significant path coefficient suggested that interdependence between supply chain partners facilitates the knowledge acquisition activities of the

responding firm. Therefore, Hypothesis 1c was supported. Since the model did not show a significant relationship between trust, commitment, and shared meaning, and knowledge acquisition, there was not enough evidence to support Hypotheses 1a, 1b, and 1d.

Table 10-2 Path Coefficient Estimates based on the Entire Sample

Knowledge Transfer Activities	Partnership Characteristics					
	INTERDEP	TRUST	COMMIT	SHAMG	ALTRN	RSTPW
Knowledge Acquisition	0.27* (2.81)	--	--	--	-0.31* (-4.37)	0.27* (2.82)
Knowledge Distribution	-0.37* (-5.01)	--	0.45* (6.08)	--	--	--
Knowledge Utilization	0.60* (6.90)	-0.15 (-1.57)	--	--	-0.29* (-4.66)	--
	Indirect Effects					
	KNACQ	KNDIST	KNUSE			
Knowledge Acquisition	--	--	--	--	--	--
Knowledge Distribution	0.20* (2.62)	--	--	--	-0.23* (-4.53)	0.20* (2.76)
Knowledge Utilization	-0.04 (-1.37)	--	0.11* (2.68)	--	-0.06* (-2.90)	0.05* (2.02)
	Knowledge Transfer Activities					
	KNACQ	KNDIST	KNUSE			
Knowledge Acquisition	--	--	--			
Knowledge Distribution	0.75* (8.55)	--	--			
Knowledge Utilization	--	0.25* (3.44)	--			

\* Significant Path Estimates; N=413. First value is the standardized parameter estimate; value in parenthesis is the t-value.

As was shown in the last chapter (see section 9.5), availability of alternatives and restraint in use of power appeared to be two independent indicators rather than jointly determining the level of balanced power. Accordingly, their effects on knowledge acquisition were also diversified. Availability of alternatives showed significant negative effects on knowledge acquisition, whilst restraint in use of power showed significant

positive effects on knowledge acquisition. Therefore, only Hypothesis 3b was supported. The opposite direction of the effect of availability of alternatives on knowledge acquisition suggested alternative explanations to the initial theorization of the relationship. Possible explanations for this observation are provided in Chapter 11.

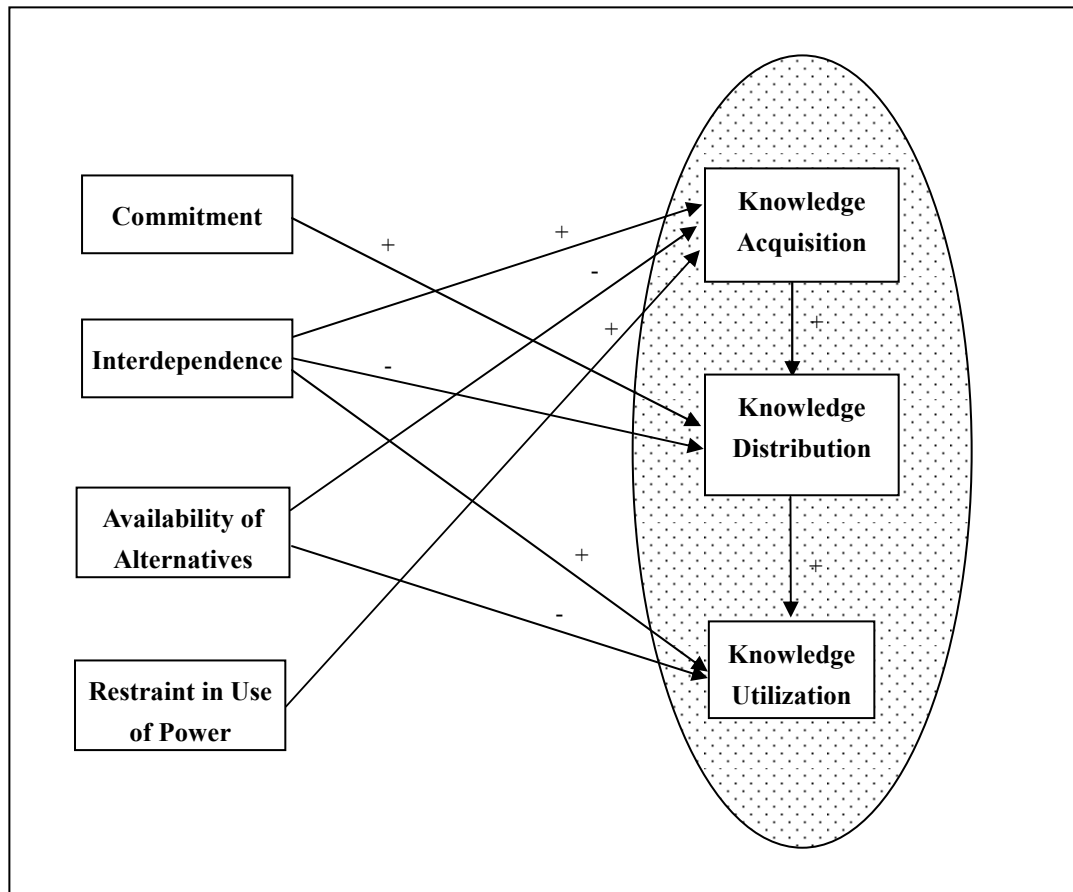


Figure 10-2 Significant Relationships in Model Part One, Entire Sample

Within indicators of supply chain partnership strength, only interdependence and commitment had significant effects on knowledge distribution, although with opposite direction of impact. As expected, commitment had positive effects on knowledge distribution. Thus, only Hypothesis 2b was supported by the empirical data, whilst Hypotheses 2a and 2d were rejected. Surprisingly, interdependence showed negative effects on knowledge distribution, which suggested that interdependence doesn't necessarily facilitate the knowledge distribution activities of the firm. Interestingly, when the indirect effects were examined, interdependence had a positive indirect effect on knowledge distribution. This is mainly because interdependence between partners

facilitates knowledge acquisition, which in turn positively influences knowledge distribution.

The path estimation did not show significant effects of restraint in use of power on supply chain knowledge utilization. Thus there was not sufficient evidence to support Hypothesis 4b. Similarly to the effect on knowledge acquisition, availability of alternatives showed a negative relationship with knowledge utilization. In addition to that, interdependence had significant positive effects on knowledge utilization. Both these findings need alternative explanations to the initial theorization (see Chapter 11). The relationships supported by the structural equation model are shown in figure 10-2.

### **10.3.2 Submodel 1a: Controlling Duration**

To examine the moderating effects of partnership duration on the relationship between supply chain partnership characteristics and knowledge transfer activities, the whole sample was divided into two samples according to the reported length of partnership duration. The intention was to find out whether long partnerships and short partnerships have different path estimates. As was discussed in table 8-12 in Chapter 8, 51.6% of responding partnerships were less than 7 years of age, which is about half of the whole sample. To ensure that the long sample and short sample had a similar number of cases, partnerships of less than 7 years ( $n=213$ ) were separated from partnerships of 7 years or more ( $n=200$ ).

Model trimming procedures were followed in fitting structural equation models on the short duration sample and long duration sample, respectively. By generating new structural equation models, rather than directly fitting the comprehensive model (as described in section 10.2.1) on the two samples, the author was able to examine not only the different levels of significance of the path estimates, but also different paths in the two samples. Again the model trimming started from the least restrictive model and imposed more constraints by fixing insignificant paths one at a time. Nested models were

compared by evaluating Chi-square changes and also ECVI indices.

#### ***10.3.2.1 Sample of Short Duration Partnerships***

As shown in table 10-3, fourteen nested models were derived and compared for the short duration partnership sample. Path coefficients were constrained one at a time. Model P1M13 fitted the data best, and was found to be the most parsimonious model.

Coefficient Estimates are shown in table 10-4. For short duration partnerships, interdependence was found to have significant positive effects on knowledge acquisition and knowledge utilization, but a negative effect on knowledge distribution. Trust and shared meaning did not have significant effects on any of the three stages of knowledge transfer. Moreover, commitment was found to be a significant positive predictor of knowledge distribution. Consistent with the entire sample, availability of alternatives had a significant negative effect on knowledge acquisition and knowledge distribution in the short duration sample. Restraint in use of power had only a moderate effect on the stage of knowledge acquisition. As expected, knowledge acquisition had a positive significant effect on knowledge distribution, which in turn had a positive significant effect on knowledge utilization. The significant relationships in the short duration sample are demonstrated in figure 10-3.



Table 10-3 Comparing Nested Models for Short Duration Sample

CFA Model	$\chi^2$	df	P-value	$\chi^2/df$	GFI	CFI	RMSEA	SRMR	ECVI	Nested models	$\Delta \chi^2$	$\Delta df$
Model P1M1	1311.11	665	0.00	1.97	0.69	0.98	0.068	0.068	7.27	-	-	-
Model P1M2	1311.21	666	0.00	1.97	0.69	0.98	0.068	0.068	7.26	2-1	0.10	1
Model P1M3	1312.44	667	0.00	1.97	0.69	0.98	0.068	0.068	7.26	3-2	1.23	1
Model P1M4	1312.15	668	0.00	1.96	0.69	0.98	0.067	0.068	7.25	4-3	-0.29	1
Model P1M5	1312.48	669	0.00	1.96	0.69	0.98	0.067	0.068	7.24	5-4	0.33	1
Model P1M6	1312.79	670	0.00	1.96	0.69	0.98	0.067	0.068	7.23	6-5	0.31	1
Model P1M7	1312.22	671	0.00	1.96	0.69	0.98	0.067	0.068	7.22	7-6	-0.57	1
Model P1M8	1312.89	672	0.00	1.95	0.69	0.98	0.067	0.068	7.21	8-7	0.67	1
Model P1M9	1312.99	673	0.00	1.95	0.69	0.98	0.067	0.068	7.20	9-8	0.10	1
<b>Model P1M10</b>	1310.95	674	0.00	1.95	0.69	0.98	0.067	0.069	7.18	10-9	-2.04	1
Model P1M11	1314.21	675	0.00	1.95	0.69	0.98	0.067	0.069	7.20	11-10	3.26	1
Model P1M12	1319.42	676	0.00	1.95	0.68	0.98	0.067	0.069	7.21	12-11	5.21	1
Model P1M13	1317.55	676	0.00	1.95	0.69	0.98	0.067	0.069	7.20	13-11	3.34	1
Model P1M14	1322.90	677	0.00	1.95	0.68	0.98	0.067	0.070	7.21	14-13	5.35	1

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square; SRMR denotes standardized Root Mean Square Residual.  $\Delta \chi^2$  is the change in Chi-square statistic. N=213.

Table 10-4 Path Coefficient Estimates based on Short Duration Sample

Knowledge Transfer Activities	Partnership Characteristics					
	INTERDEP	TRUST	COMMIT	SHAMG	ALTRN	RSTPW
Knowledge Acquisition	0.28*	--	--	--	-0.35*	0.25
	(2.31)				(-4.14)	(1.94)
Knowledge Distribution	-0.21*	-0.35*	0.72*	--	--	--
	(-2.02)	(-1.63)	(3.94)			
Knowledge Utilization	0.56*	--	-0.14	--	-0.32*	--
	(7.00)		(-1.17)		(-3.32)	
Knowledge Transfer Activities	Knowledge Transfer Activities					
	KNACQ	KNDIST	KNUSE			
Knowledge Acquisition	--	--	--			
Knowledge Distribution	0.69*	--	--			
	(6.30)					
Knowledge Utilization	--	0.31*	--			
		(2.59)				

\* Significant Path Estimates; N=213. First value is the standardized parameter estimate; value in parenthesis is the t-value.

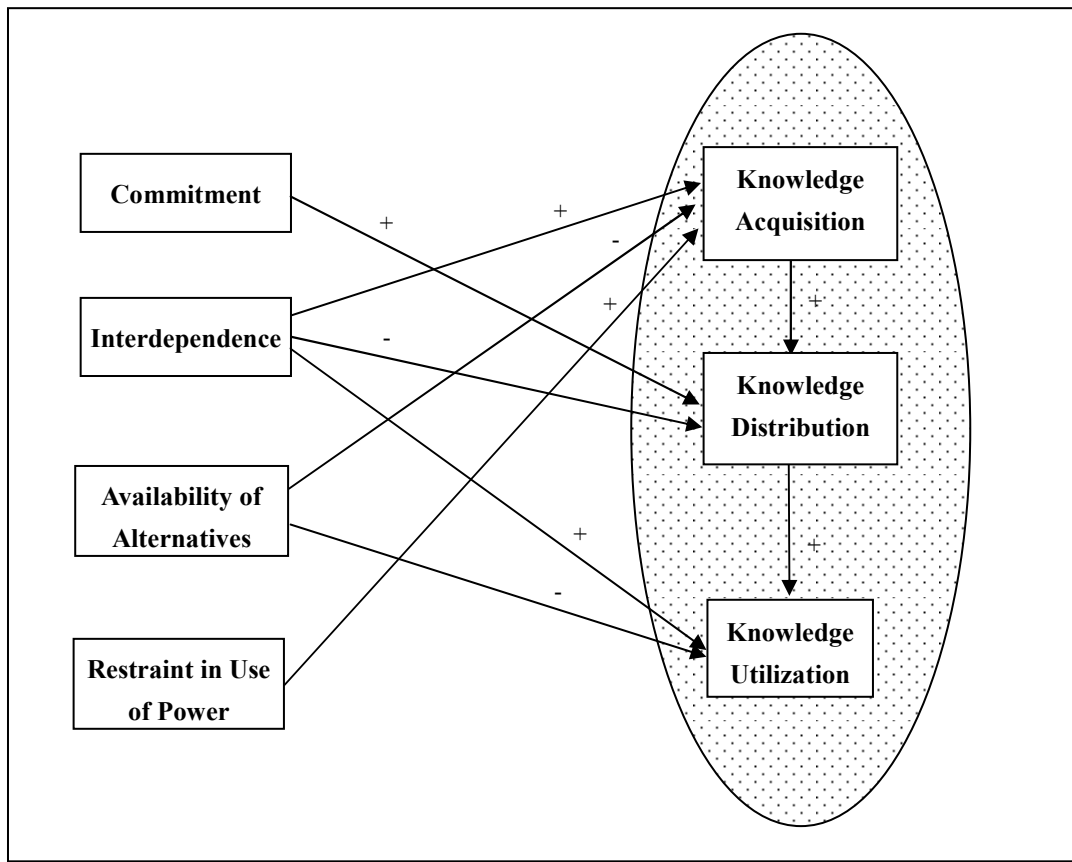


Figure 10-3 Significant Relationships in Model Part One, Short Duration Sample

#### 10.3.2.2 Sample of Long Duration Partnerships

For the sample of long duration partnerships, nine nested models were compared (see table 10-5). Model P1M8 was found to be the most parsimonious model, which fitted the data best. As shown in table 10-6, interdependence had a significant positive effect only on knowledge acquisition. Surprisingly, trust had a significant negative effect on knowledge acquisition and knowledge utilization. Trust had a significant positive effect only on knowledge distribution. Commitment had a significant positive effect on knowledge utilization, so did shared meaning. Nevertheless, shared meaning had a significant negative effect on knowledge distribution. Availability of alternatives again had a significant negative effect on knowledge utilization. Moreover, restraint in use of power had a positive effect on knowledge acquisition. Again, knowledge acquisition was found to have a positive effect on knowledge distribution, which in turn facilitated knowledge utilization. Figure 10-4 shows the significant relationships for the long

duration sample.

Table 10-5 Comparing Nested Models for Long Duration Sample

CFA Model	$\chi^2$	df	P-value	$\chi^2/df$	GFI	CFI	RMSEA	SRMR	ECVI	Nested models	$\Delta \chi^2$	$\Delta df$
Model P1M1	1482.60	665	0.00	2.23	0.63	0.98	0.079	0.068	8.61		-	-
Model P1M2	1482.17	666	0.00	2.23	0.63	0.98	0.078	0.068	8.59	2-1	-0.43	1
Model P1M3	1483.17	667	0.00	2.22	0.63	0.98	0.078	0.068	8.59	3-2	1.00	1
Model P1M4	1484.50	668	0.00	2.22	0.63	0.98	0.078	0.068	8.59	4-3	1.33	1
Model P1M5	1484.51	669	0.00	2.22	0.63	0.98	0.078	0.068	8.58	5-4	0.01	1
Model P1M6	1483.59	670	0.00	2.21	0.63	0.98	0.078	0.068	8.56	6-5	-0.92	1
Model P1M7	1485.98	671	0.00	2.21	0.63	0.98	0.078	0.068	8.56	7-6	2.39	1
<b>Model P1M8</b>	1486.44	672	0.00	2.21	0.63	0.98	0.078	0.068	8.55	8-7	0.46	1
Model P1M9	1490.82	673	0.00	2.22	0.63	0.98	0.078	0.068	8.57	9-8	4.38	1

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square; SRMR denotes standardized Root Mean Square Residual.  $\Delta \chi^2$  is the change in Chi-square statistic. N=200.

Table 10-6 Path Coefficient Estimates based on Long Duration Sample

Knowledge Transfer Activities	Partnership Characteristics					
	INTERDEP	TRUST	COMMIT	SHAMG	ALTRN	RSTPW
Knowledge Acquisition	0.87* (3.82)	-0.73* (-2.81)	--	--	--	0.66* (4.88)
Knowledge Distribution	-0.26 (-1.05)	1.00* (3.13)	--	-0.58* (-3.20)	--	-0.29 (-1.39)
Knowledge Utilization	--	-0.57* (-2.68)	0.36* (2.24)	0.58* (2.95)	-0.32* (-3.81)	--
Knowledge Transfer Activities	Knowledge Transfer Activities					
	KNACQ	KNDIST	KNUSE			
Knowledge Acquisition	--	--	--			
Knowledge Distribution	0.93* (5.15)	--	--			
Knowledge Utilization	--	0.27* (3.01)	--			

\* Significant Path Estimates; N=200. First value is the standardized parameter estimate; value in parenthesis is the t-value.

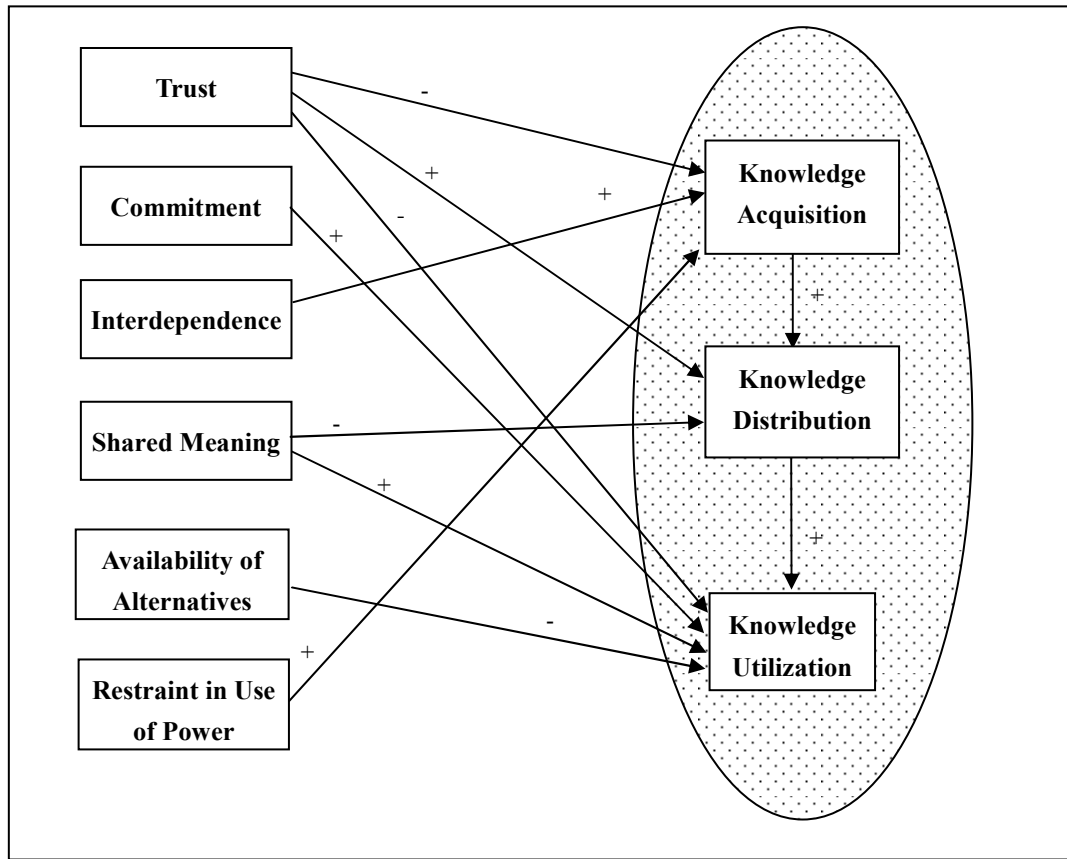


Figure 10-4 Significant Relationships in Model Part One, Long Duration Sample

### 10.3.2.3 Comparing Short and Long Duration Samples

To indicate the moderating effect of partnership duration, the author intended to compare the parameter estimates between short duration and long duration samples. It is suggested that only if the same measurement model is applicable to both groups, could one compare unstandardized path coefficients of two subgroups of the sample directly (Joreskog and Sorbom, 1989). Therefore, a series of tests of invariance in the measurement model were carried out. The first set of invariance tests examined the partnership characteristics scale of the short duration and long duration samples (see table 10-7). Although both samples showed equal patterns of factor model and error variance (as indicated by acceptable model fit), assumptions of equal factor loading or equal error terms were not supported (as indicated by significant Chi-square changes, and the worse model fit).

Table 10-7 Test of Invariance of Relationship Scales on Short and Long Duration Samples

No.	Model	$\chi^2$	df	P-value	$\chi^2/\text{df}$	CFI	RMSEA	Nested Models	$\Delta \chi^2$	$\Delta \text{df}$
1	Equal pattern	1388.49	666	0.00	2.09	0.98	0.073	-	-	-
2	Factor loading invariant	1513.35	694	0.00	2.18	0.98	0.076	2-1	124.86	28
3	Error and factor loading invariant	1610.87	724	0.00	2.23	0.98	0.077	3-2	97.52	30
4	Error variance, factor loading and factor covariance invariant	1713.23	739	0.00	2.32	0.98	0.080	4-3	102.36	15

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square.  $\Delta \chi^2$  is the change in Chi-square statistic.

The second set of invariance tests examined the knowledge transfer scales of the short duration and long duration samples (see table 10-8). Again, the two samples showed equal factor and error term patterns, but the assumption of equal factor loadings and error terms were violated (as indicated by worse model fit and significant Chi-square changes). Therefore, the measurement models of the two samples were not the same, and the level of path estimates from the long duration and short duration samples could not be compared directly. For this reason, the current research was unable to test the moderating effects of the partnership duration based on the chosen analytical method, i.e. Structural Equation Modeling. Nevertheless, the varied significant path estimates between the two samples still demonstrated some interesting findings, which are discussed in more detail in the next chapter.

Table 10-8 Test of Invariance of Knowledge Transfer Scales on Short and Long Duration Samples

No.	Model	$\chi^2$	df	P-value	$\chi^2/\text{df}$	CFI	RMSEA	Nested Models	$\Delta \chi^2$	$\Delta \text{df}$
1	Equal pattern	216.37	82	0.000	2.64	0.98	0.089	-	-	-
2	Factor loading invariant	268.26	93	0.000	2.88	0.98	0.073	2-1	51.89	11
3	Error and factor loading invariant	324.03	104	0.000	3.12	0.96	0.100	3-2	55.77	11
4	Error variance, factor loading and factor covariance invariant	323.64	107	0.000	3.02	0.96	0.099	4-3	-0.39	3

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square.  $\Delta \chi^2$  is the change in Chi-square statistic.

### 10.3.3 Submodel 1b: Controlling Contract Status

The author was also interested in finding out whether supply chain partnership with or without written agreement will show different effects of partnership characteristics on interfirm knowledge transfer. Among the 413 responding partnerships, 285 of them were reported to have an explicit written contract or cooperative agreement, whilst the remaining 128 partnerships were reported to have no cooperative agreement signed (see table 10-9). Thus, structural equation modeling with the model trimming process was followed with the contracted partnership sample and non-contracted partnership sample. Detailed comparisons of the two samples are presented in Chapter 11.

Table 10-9 Supply Chain Partnership Contract Status

Contract Status	Frequency	Percent	Cumulative Percent
With Contract	285	69.0	69.0
Without Contract	128	31.0	100.0
Total	413	100.0	

#### 10.3.3.1 Sample with Explicit Contract

For the sample of partnerships with an explicit contract, eleven nested models were compared (see table 10-10). Model P1M11 was found to be the best fitted model and the most parsimonious one. As shown in table 10-11, for supply chain partnerships with a written agreement, knowledge acquisition was more likely to be facilitated by shared meaning and restrained power use. Availability of alternatives did not foster but constrained the knowledge acquisition activities. Interfirm interdependence was negatively related with knowledge distribution activities, whilst commitment was positively related with knowledge distribution. Knowledge utilization appeared to be affected by interdependence, commitment, and availability of alternatives, although the directions of those effects were quite different. Commitment and availability of alternative were negatively related with the knowledge utilization activities of partnerships with contract. Interdependence, on the other hand, showed a significant positive relationship with knowledge utilization. Interrelationship between different stages of the knowledge transfer was examined. The hypothesized relationships between knowledge acquisition, knowledge distribution, and knowledge utilization were

supported. Figure 10-5 illustrates the significant relationships in the sample of partnerships with contract.

Table 10-10 Comparing Nested Models for Contracted Sample

CFA Model	$\chi^2$	df	P-value	$\chi^2/\text{df}$	GFI	CFI	RMSEA	SRMR	ECVI	Nested models	$\Delta \chi^2$	$\Delta \text{df}$
Model P1M1	1555.68	665	0.00	2.34	0.70	0.98	0.069	0.056	6.29	-	-	-
Model P1M2	1556.15	666	0.00	2.34	0.70	0.98	0.069	0.056	6.28	2-1	0.47	1
Model P1M3	1556.53	667	0.00	2.33	0.70	0.98	0.069	0.056	6.28	3-2	0.38	1
Model P1M4	1556.77	668	0.00	2.33	0.70	0.98	0.068	0.056	6.27	4-3	0.24	1
Model P1M5	1556.78	669	0.00	2.33	0.70	0.98	0.068	0.056	6.26	5-4	0.01	1
Model P1M6	1557.79	670	0.00	2.33	0.70	0.98	0.068	0.056	6.26	6-5	1.01	1
Model P1M7	1559.00	671	0.00	2.32	0.70	0.98	0.068	0.056	6.26	7-6	1.21	1
Model P1M8	1557.86	672	0.00	2.32	0.70	0.98	0.068	0.056	6.25	8-7	-1.14	1
Model P1M9	1560.76	673	0.00	2.32	0.70	0.98	0.068	0.056	6.25	9-8	2.90	1
Model P1M10	1562.87	674	0.00	2.32	0.70	0.98	0.068	0.056	6.25	10-9	2.11	1
<b>Model P1M11</b>	1562.59	675	0.00	2.31	0.70	0.98	0.068	0.056	6.24	11-10	-0.28	1

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square; SRMR denotes standardized Root Mean Square Residual.  $\Delta \chi^2$  is the change in Chi-square statistic. N=285.

Table 10-11 Path Coefficient Estimates based on Contracted Sample

Knowledge Transfer Activities	Partnership Characteristics					
	INTERDEP	TRUST	COMMIT	SHAMG	ALTRN	RSTPW
Knowledge Acquisition	--	--	--	0.30*	-0.27*	0.29*
				(2.72)	(-3.01)	(3.57)
Knowledge Distribution	-0.31*	--	0.50*	--	--	--
	(-5.79)		(6.70)			
Knowledge Utilization	0.61*	--	-0.38*	--	-0.26*	--
	(7.41)		(-2.76)		(-2.90)	
Knowledge Transfer Activities	Knowledge Transfer Activities					
	KNACQ	KNDIST	KNUSE			
Knowledge Acquisition	--	--	--			
Knowledge Distribution	0.73*	--	--			
	(8.59)					
Knowledge Utilization	--	0.49	--			
		(3.85)				

\* Significant Path Estimates; N=285. First value is the standardized parameter estimate; value in parenthesis is the t-value.

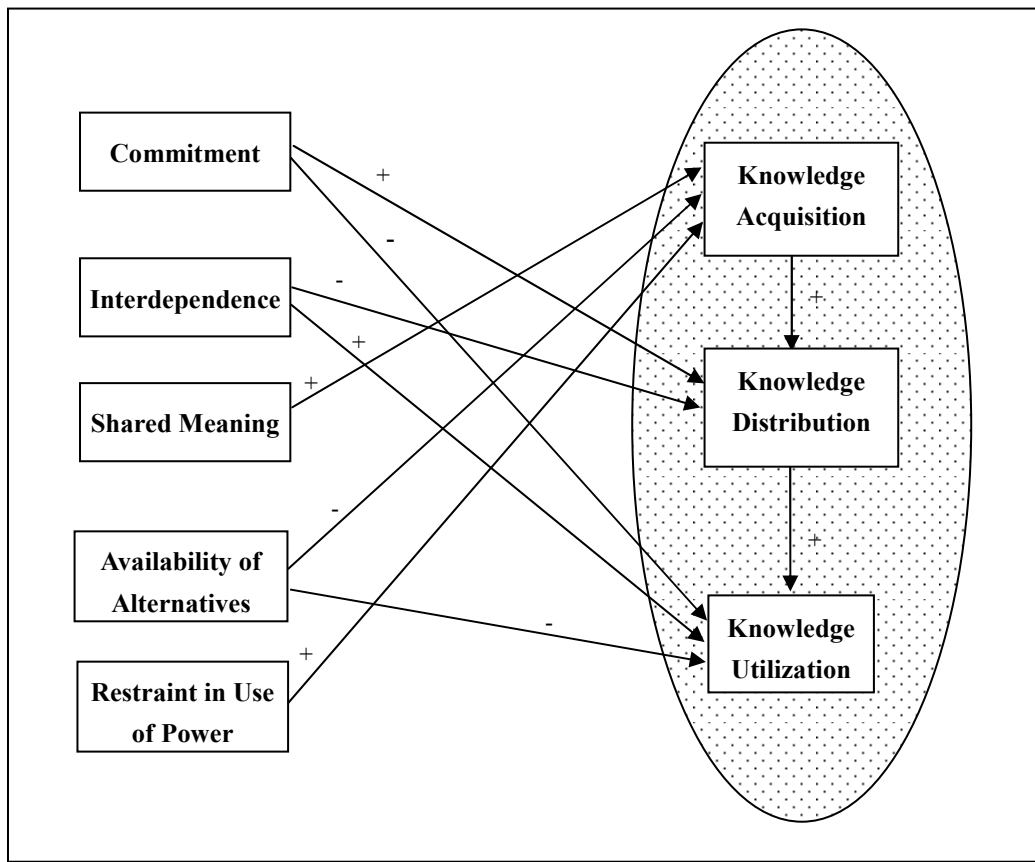


Figure 10-5 Significant Relationships in Model Part One, Contracted Sample

#### 10.3.3.2 Sample without Explicit Contract

Ten nested models based on the partnership sample without explicit contract agreement were compared (see table 10-12). Model P1M9 was found to be most parsimonious and fitted the data best. Path coefficient estimates are given in table 10-13.



Table 10-12 Comparing Nested Models for Non-contracted Sample

CFA Model	$\chi^2$	df	P-value	$\chi^2/\text{df}$	GFI	CFI	RMSEA	SRMR	ECVI	Nested models	$\Delta \chi^2$	$\Delta \text{df}$
Model P1M1	1322.81	665	0.00	1.99	0.58	0.95	0.088	0.091	12.23		-	-
Model P1M2	1322.95	666	0.00	1.99	0.58	0.95	0.088	0.091	12.20	2-1	0.14	1
Model P1M3	1323.82	667	0.00	1.98	0.58	0.95	0.088	0.091	12.19	3-2	0.87	1
Model P1M4	1324.49	668	0.00	1.98	0.58	0.95	0.088	0.091	12.19	4-3	0.67	1
Model P1M5	1325.72	669	0.00	1.98	0.58	0.95	0.088	0.091	12.19	5-4	1.23	1
Model P1M6	1324.92	670	0.00	1.98	0.58	0.95	0.088	0.091	12.16	6-5	-0.80	1
Model P1M7	1326.05	671	0.00	1.98	0.58	0.95	0.088	0.091	12.16	7-6	1.13	1
Model P1M8	1325.77	672	0.00	1.97	0.58	0.95	0.088	0.092	12.16	8-7	-0.28	1
<b>Model P1M9</b>	1328.67	673	0.00	1.97	0.58	0.95	0.088	0.092	12.15	9-8	2.90	1
Model P1M10	1336.07	674	0.00	1.98	0.58	0.95	0.088	0.092	12.19	10-9	7.40	1

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square; SRMR denotes standardized Root Mean Square Residual.  $\Delta \chi^2$  is the change in Chi-square statistic. N=128.

Knowledge acquisition activities between partners were affected by interdependence, shared meaning, availability of alternatives and restraint in use of power. It is worth noting, shared meaning had a significant negative relationship with knowledge acquisition, which contradicted the initial hypothesis. For non-contracted partnerships, none of the factors of partnership characteristics had significant effects on knowledge distribution. Moreover, knowledge utilization was found to be positively influenced by commitment and negatively by availability of alternatives. For supply chain partnerships without an explicit contract, knowledge distribution was facilitated by knowledge acquisition activities. However, knowledge distribution did not show a significant effect on the utilization of knowledge.

Table 10-13 Path Coefficient Estimates Based on Non-contracted Sample

Knowledge Transfer Activities	Partnership Characteristics					
	INTERDEP	TRUST	COMMIT	SHAMG	ALTRN	RSTPW
Knowledge Acquisition	0.35* (3.08)	--	--	-0.31* (-2.45)	-0.38* (-2.67)	0.48* (5.00)
Knowledge Distribution	--	0.21 (1.61)	--	-0.24 (-1.78)	--	--
Knowledge Utilization	--	-0.37 (-1.84)	0.72* (4.12)	--	-0.41* (-4.92)	0.27 (1.70)
	Knowledge Transfer Activities					
	KNACQ	KNDIST	KNUSE			
Knowledge Acquisition	--	--	--			
Knowledge Distribution	0.54* (4.10)	--	--			
Knowledge Utilization	--	0.02 (0.40)	--			

\* Significant Path Estimates; N=128. First value is the standardized parameter estimate; value in parenthesis is the t-value.

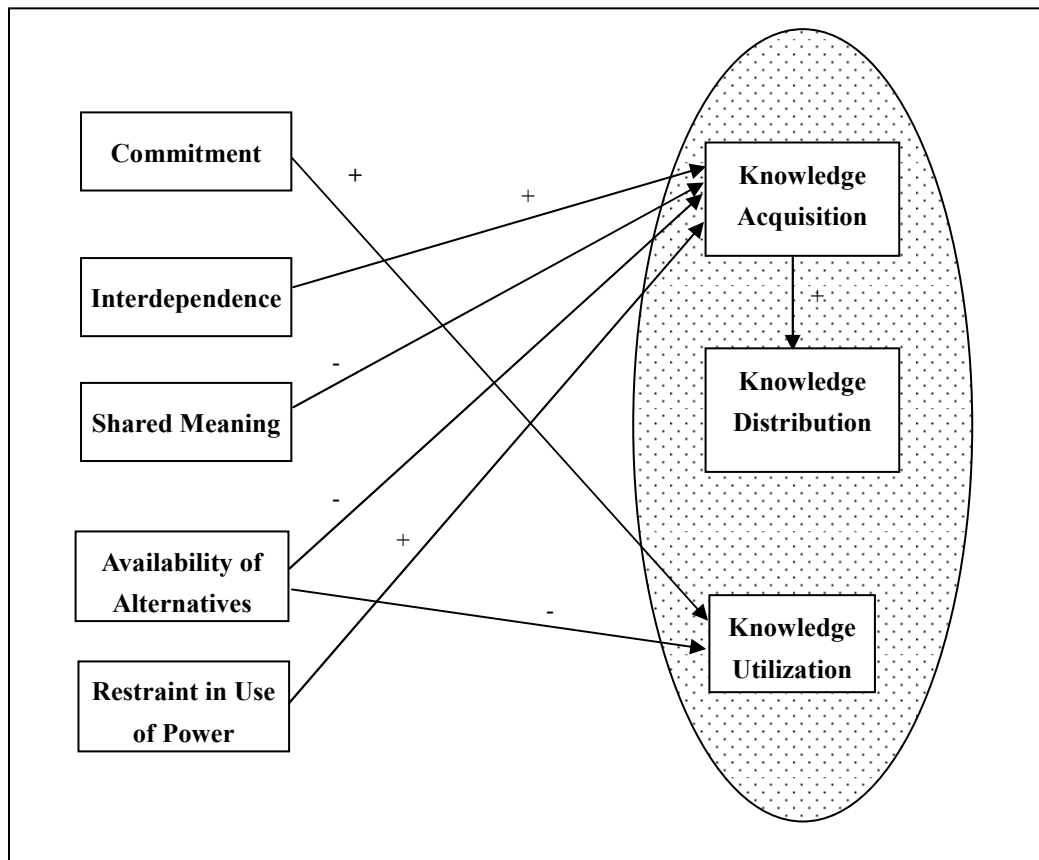


Figure 10-6 Significant Relationships in Model Part One, Non-contracted Sample

### 10.3.4 Submodel 1c: Controlling Upstream and Downstream in the Supply Chain

To examine differences of interfirm knowledge transfer activities of supply chain partnerships at different locations in the focal firm's supply chain, the entire sample was divided into two sub-samples, upstream or downstream (see table 10-14). The upstream sample (N=201) included the partnerships which are either direct or indirect partnerships upstream in Baogang's supply chain. The downstream sample (N=212) included the partnerships which are either direct or indirect partnerships downstream in Baogang's supply chain. Model trimming again was followed on the upstream and downstream samples, respectively. Comparisons could then be made between the path estimates of the two samples, details of which are presented in Chapter 11.

Table 10-14 Upstream or Downstream in the Supply Chain

Location in the Supply Chain	Frequency	Percent	Cumulative Percent
Upstream	201	48.7	48.7
Downstream	212	51.3	100.0
Total	413	100.0	

#### 10.3.4.1 Sample Upstream in the Supply Chain

Nine nested models were generated and compared for the upstream sample (see table 10-15). Model P1M8 was found to be the most parsimonious model. As shown in table 10-16, knowledge acquisition of upstream firms was positively affected by interdependence and trust between partners, whilst it was negatively affected by commitment and shared meaning. Interdependence also had significant positive effects on knowledge utilization of firms upstream in the supply chain. Characteristics of supply chain partnership did not have a significant effect on knowledge distribution of firms upstream in Baogang's supply chain. None of the indicators of balanced power showed significant effects on the knowledge transfer processes. Moreover, consistent with the entire sample, knowledge acquisition appeared to have significant positive effect on knowledge distribution of firms upstream in the supply chain. However, knowledge distribution did not show a significant effect on the knowledge utilization of firms. Figure 10-7 illustrates the significant relationships based on the upstream partnership

sample.

Table 10-15 Comparing Nested Models for Upstream Sample

CFA Model	$\chi^2$	df	P-value	$\chi^2/df$	GFI	CFI	RMSEA	SRMR	ECVI	Nested models	$\Delta \chi^2$	$\Delta df$
Model P1M1	1346.41	665	0.00	2.03	0.67	0.97	0.072	0.078	7.88		-	-
Model P1M2	1347.06	666	0.00	2.02	0.67	0.97	0.072	0.078	7.88	2-1	0.65	1
Model P1M3	1347.93	667	0.00	2.02	0.67	0.97	0.071	0.078	7.87	3-2	0.87	1
Model P1M4	1348.01	668	0.00	2.02	0.67	0.97	0.071	0.078	7.86	4-3	0.08	1
Model P1M5	1348.15	669	0.00	2.02	0.67	0.97	0.071	0.078	7.85	5-4	0.14	1
Model P1M6	1348.88	670	0.00	2.01	0.67	0.97	0.071	0.078	7.84	6-5	0.73	1
Model P1M7	1349.35	671	0.00	2.01	0.67	0.97	0.071	0.078	7.84	7-6	0.47	1
<b>Model P1M8</b>	1348.82	672	0.00	2.01	0.67	0.97	0.071	0.078	7.82	8-7	-0.53	1
Model P1M9	1354.03	673	0.00	2.01	0.67	0.97	0.071	0.078	7.84	9-8	5.21	1

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square; SRMR denotes standardized Root Mean Square Residual.  $\Delta \chi^2$  is the change in Chi-square statistic. N=128.

Table 10-16 Path Coefficient Estimates based on Upstream Sample

Knowledge Transfer Activities	Partnership Characteristics					
	INTERDEP	TRUST	COMMIT	SHAMG	ALTRN	RSTPW
Knowledge Acquisition	1.73* (3.86)	0.56* (2.11)	-1.21* (-3.11)	-0.64* (-2.79)	-0.32 (-1.74)	--
Knowledge Distribution	-0.41 (-1.14)	--	0.40 (1.44)	--	0.10 (1.09)	--
Knowledge Utilization	0.90* (5.03)	-0.23 (-1.49)	--	--	-0.18 (-1.40)	--
	Knowledge Transfer Activities					
	KNACQ	KNDIST	KNUSE			
Knowledge Acquisition	--	--	--			
Knowledge Distribution	1.02* (4.78)	--	--			
Knowledge Utilization	--	-0.03 (-0.32)	--			

\* Significant Path Estimates; N=201. First value is the standardized parameter estimate; value in parenthesis is the t-value.

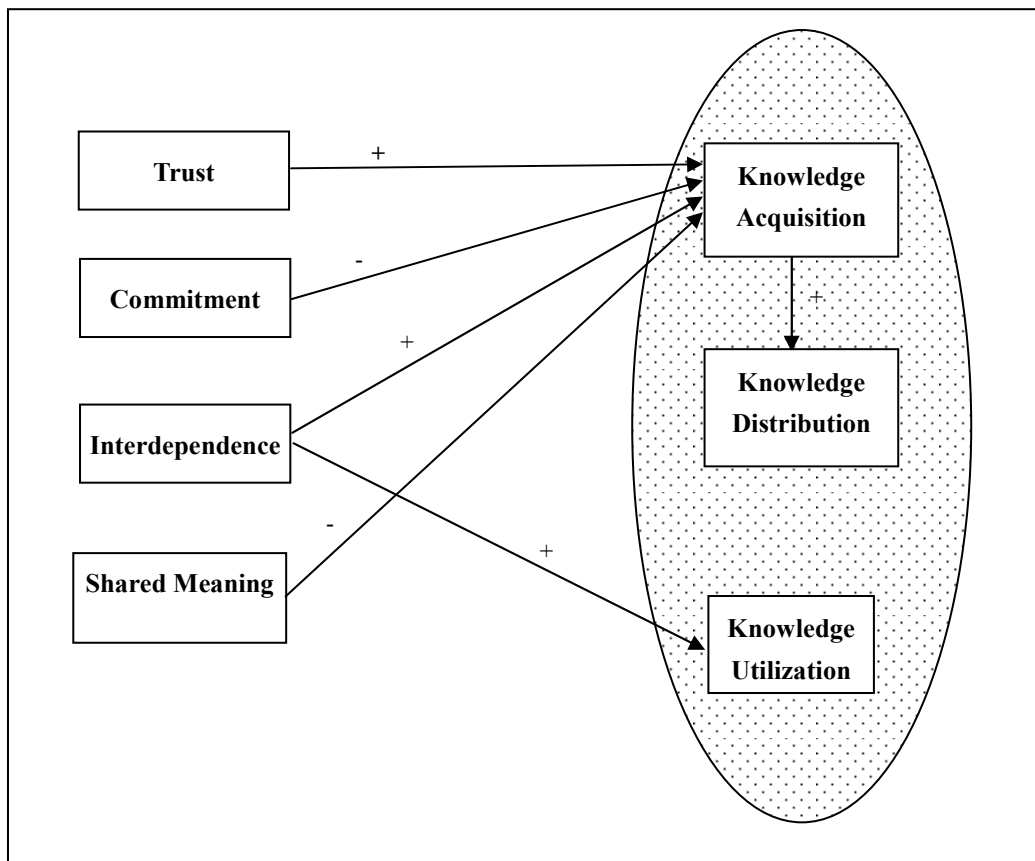


Figure 10-7 Significant Relationships in Model Part One, Upstream Sample

#### ***10.3.4.2 Sample Downstream in the Supply Chain***

Thirteen nested models were derived from the downstream partnership sample (see table 10-17). Model P1M13 was found to be the most parsimonious model. As shown in table 10-18, knowledge acquisition between partners downstream in the supply chain tended to be positively affected by shared meaning and partners' restrained power use, whilst it was negatively influenced by the availability of alternatives. Interdependence between partners negatively affected knowledge distribution of firms downstream in the supply chain. On the other hand, commitment between partners tended to facilitate the level of knowledge distribution for downstream firms. Moreover, knowledge utilization of downstream firms was negatively influenced by the level of commitment and availability of alternatives, but was positively influenced by the level of interdependence between partners. Consistent with the results based on the overall sample, knowledge acquisition positively influenced knowledge distribution, which in turn facilitated knowledge

utilization of firms downstream in Baogang's supply chain. Figure 10-8 shows the significant relationships demonstrated from the downstream sample.

Table 10-17 Comparing Nested Models for Downstream Sample

CFA Model	$\chi^2$	df	P-value	$\chi^2/\text{df}$	GFI	CFI	RMSEA	SRMR	ECVI	Nested models	$\Delta \chi^2$	$\Delta \text{df}$
Model P1M1	1525.37	665	0.00	2.29	0.64	0.98	0.078	0.064	8.32		-	-
Model P1M2	1525.26	666	0.00	2.29	0.64	0.98	0.078	0.065	8.31	2-1	-0.11	1
Model P1M3	1525.52	667	0.00	2.29	0.64	0.98	0.078	0.065	8.30	3-2	0.26	1
Model P1M4	1524.97	668	0.00	2.28	0.64	0.98	0.078	0.065	8.29	4-3	-0.55	1
Model P1M5	1525.29	669	0.00	2.28	0.64	0.98	0.078	0.065	8.28	5-4	0.32	1
Model P1M6	1526.62	670	0.00	2.28	0.64	0.98	0.078	0.065	8.28	6-5	1.33	1
Model P1M7	1526.85	671	0.00	2.28	0.64	0.98	0.078	0.065	8.27	7-6	0.23	1
Model P1M8	1526.87	672	0.00	2.27	0.64	0.98	0.078	0.065	8.26	8-7	0.02	1
Model P1M9	1530.86	673	0.00	2.27	0.64	0.98	0.078	0.065	8.27	9-8	3.99	1
Model P1M10	1526.94	673	0.00	2.27	0.64	0.98	0.078	0.065	8.25	10-8	0.07	1
Model P1M11	1531.10	674	0.00	2.28	0.64	0.98	0.078	0.065	8.26	11-10	4.16	1
Model P1M12	1526.82	674	0.00	2.27	0.64	0.98	0.077	0.065	8.24	12-10	-0.12	1
<b>Model P1M13</b>	1530.61	675	0.00	2.27	0.64	0.98	0.078	0.065	8.25	13-12	3.79	1

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square; SRMR denotes standardized Root Mean Square Residual.  $\Delta \chi^2$  is the change in Chi-square statistic. N=212.

Table 10-18 Path Coefficient Estimates based on Downstream Sample

Knowledge Transfer Activities	Partnership Characteristics					
	INTERDEP	TRUST	COMMIT	SHAMG	ALTRN	RSTPW
Knowledge Acquisition	--	--	--	0.26*	-0.19*	0.35*
				(2.05)	(-2.07)	(3.32)
Knowledge Distribution	-0.39*	--	0.47*	--	-0.10	--
	(-4.55)		(4.21)		(-1.35)	
Knowledge Utilization	0.73*	--	-0.38*	--	-0.34*	--
	(6.58)		(-2.32)		(-3.84)	
Knowledge Transfer Activities	Knowledge Transfer Activities					
	KNACQ	KNDIST	KNUSE			
Knowledge Acquisition	--	--	--			
Knowledge Distribution	0.58*	--	--			
	(5.78)					
Knowledge Utilization	--	0.41*	--			
		(3.27)				

\* Significant Path Estimates; N=212. First value is the standardized parameter estimate; value in parenthesis is the t-value.

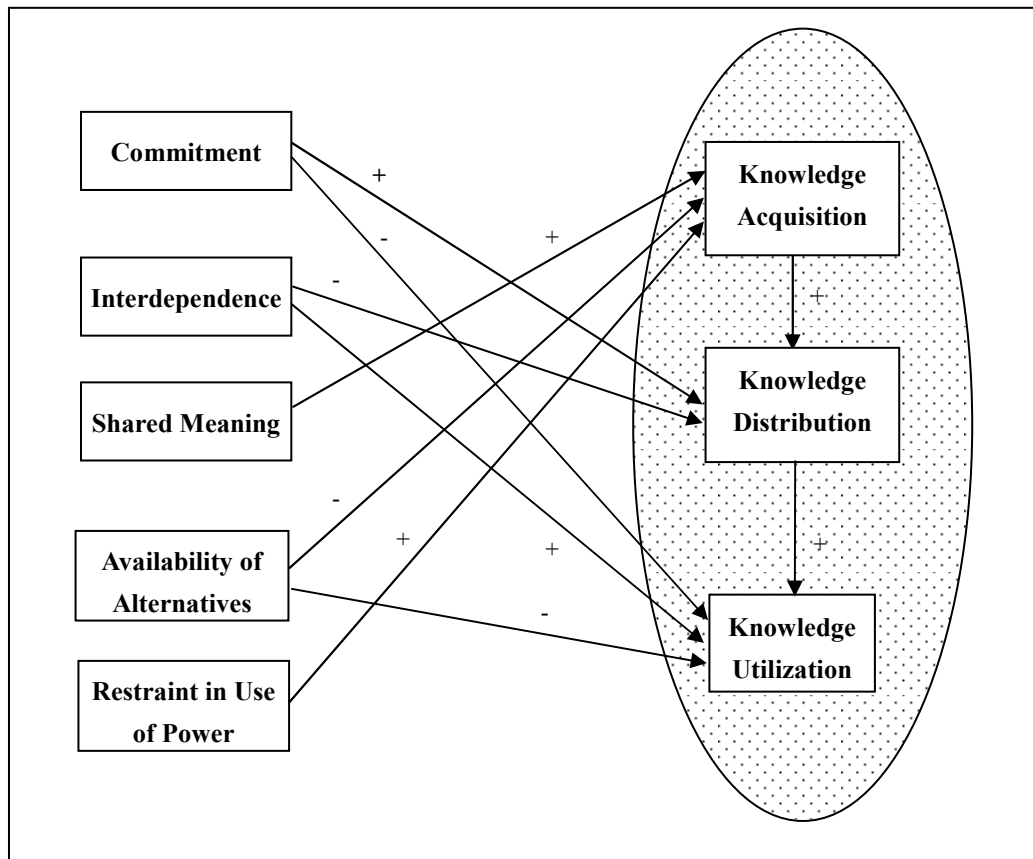


Figure 10-8 Significant Relationships in Model Part One, Downstream Sample

## 10.4 SEM Part Two: Knowledge Transfer Activities and Supply Chain Performance

The second part of the structural equation model was constructed to examine the relationship between knowledge transfer activities and a firm's performance. In this part of the model, knowledge acquisition, knowledge distribution, and knowledge utilization as latent explanatory variables were expected to influence supply chain performance and market performance as the latent response variables.

As was discussed in section 9.3.1, supply chain performance as well as market performance were indicated by the sum of various performance measurements. Therefore, the supply chain and market performance variables were entered into the model as single

indicator latent variables. Accordingly, the measurement unit of both latent performance variables was set to be identical to the two corresponding performance indicators, and the error terms of both indicators were specified to be zero. Moreover, since supply chain performance was expected to have positive effects on the market performance of the firm, the path of direct effect of supply chain performance on market performance was set to be free. For explanatory variables of the model, the refined scales of the knowledge transfer process were entered into the model (also refers to section 9.6). Again the Model Trimming process was followed to generate the most parsimonious model.

#### **10.4.1 Submodel 2: Entire Sample**

Four nested models were compared (see table 10-19), Model P2M4 was the most parsimonious model and fitted the data best. Evaluation of structural coefficients suggested that knowledge acquisition had no significant impact on either supply chain performance or market performance of responding firms (see table 10-20), thus Hypothesis 7 was not supported. However, knowledge distribution showed positive effects on both the supply chain and market performance of responding firms. Moreover, knowledge utilization had a positive impact on the supply chain performance of the firm but not on the market performance of firms. Therefore, Hypotheses 8a, 8b and 9a were supported. Interestingly, when indirect effects of knowledge utilization were examined, it was found that knowledge use had an indirect positive effect on the market performance through supply chain performance. However, this was mainly due to the significant positive effect of supply chain performance on market performance, where Hypothesis 10 was supported. Figure 10-9 gives the path diagram generated from the LISREL analysis. Figure 10-10 shows the significant relationships in model part two based on the entire sample.



Table 10-19 Comparing Nested Models Entire Sample for Model Part 2

CFA Model	$X^2$	df	P-value	$\frac{X^2}{df}$	GFI	CFI	RMSEA	SRMR	ECVI	Nested models	$\Delta X^2$	$\Delta df$
Model P2M1	191.25	57	0.00	3.36	0.89	0.98	0.076	0.051	0.63	-	-	-
Model P2M2	191.33	58	0.00	3.30	0.89	0.98	0.075	0.051	0.62	2-1	-0.08	1
Model P2M3	193.42	59	0.00	3.28	0.89	0.98	0.074	0.051	0.62	3-2	2.09	1
<b>Model P2M4</b>	<b>195.02</b>	<b>60</b>	<b>0.00</b>	<b>3.25</b>	<b>0.89</b>	<b>0.98</b>	<b>0.074</b>	<b>0.052</b>	<b>0.62</b>	<b>4-3</b>	<b>1.60</b>	<b>1</b>

Note:  $X^2$  is the Satorra-Bentler Scaled Chi-Square; SRMR denotes standardized Root Mean Square Residual.  $\Delta X^2$  is the change in Chi-square statistic. N=413.

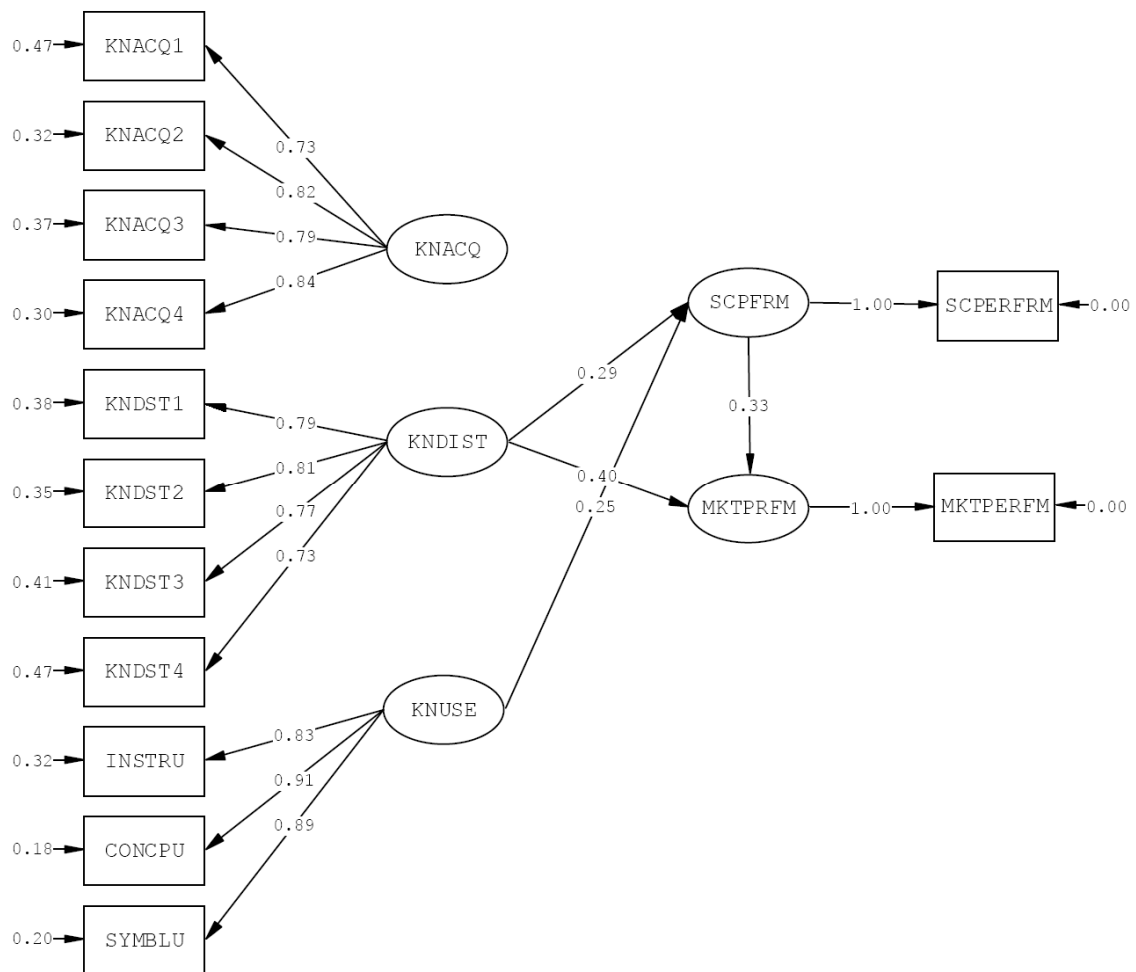


Figure 10-9 Path Diagram of SEM Model Part 2, Entire Sample

Table 10-20 Path Coefficient Estimates of Model Part Two based on Entire Sample

Performance	Knowledge Transfer Activities		
	KNACQ	KNDIST	KNUSE
Supply Chain Performance	--	0.29* (5.22)	0.25* (3.86)
Market Performance	--	0.40* (6.95)	--
<b>Indirect Effects</b>			
Supply Chain Performance	--	--	--
Market Performance	--	0.10* (4.11)	0.08* (3.33)
<b>Performance</b>			
	SCPERFM	MKPERFM	
Supply Chain Performance	--	--	
Market Performance	0.33* (7.48)	--	

\* Significant Path Estimates; N=413. First value is the standardized parameter estimate; value in parenthesis is the t-value.

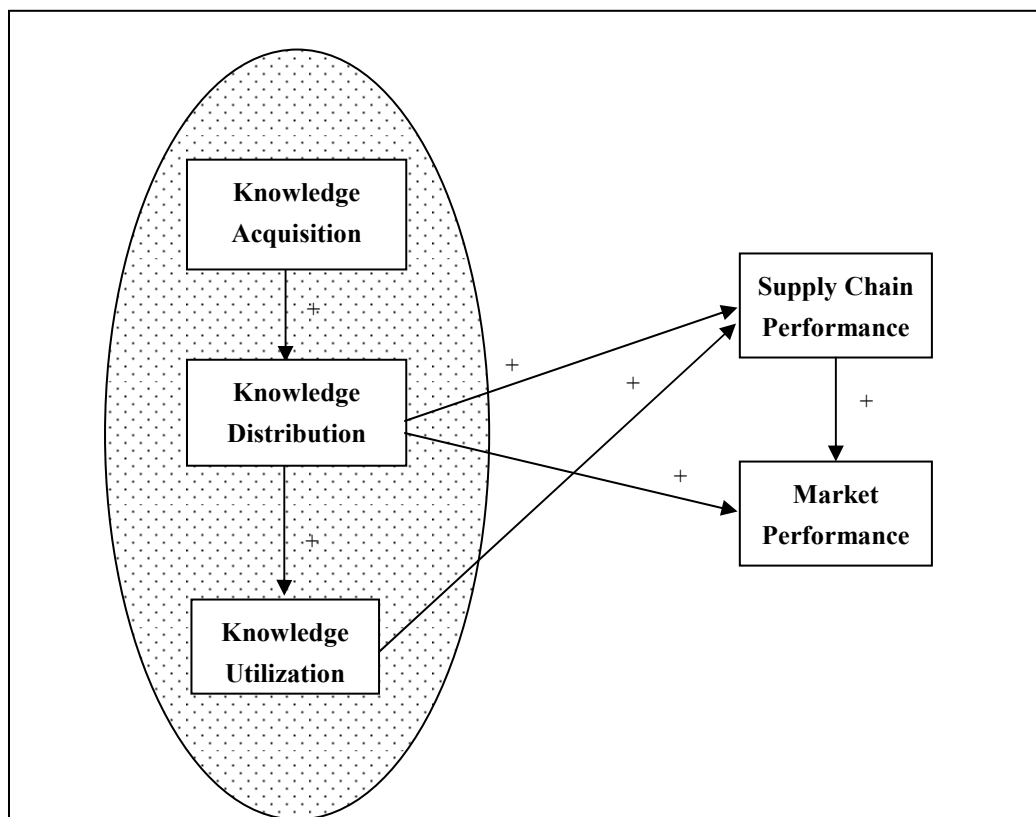


Figure 10-10 Significant Relationships in Model Part Two, Entire Sample

### 10.4.2 Submodel 2a: Controlling Duration

To find out whether partnership duration had a moderating effect on the relationship between knowledge transfer activities and a firm's performance, the entire sample was again divided into short duration sample and long duration sample (See also in section 10.3.2). Model trimming was again conducted with the two samples, respectively.

#### 10.4.2.1 Submodel 2a: Short Duration Sample

Three nested models were compared for the short duration sample. Model P2M3 was the most parsimonious one (see table 10-21). As shown in table 10-22 as well as in figure 10-11, knowledge acquisition appeared to have no significant effect on the two dimensions of a firm's performance. On the other hand, knowledge distribution and knowledge utilization tended to facilitate both supply chain and market performance of the responding firms. Consistent with the entire sample, supply chain performance positively predicted market performance of firms in the short duration sample.

Table 10-21 Comparing Nested Models of Short Duration Sample for Model Part 2

CFA Model	$\chi^2$	df	P-value	$\chi^2/df$	GFI	CFI	RMSEA	SRMR	ECVI	Nested models	$\Delta \chi^2$	$\Delta df$
Model P2M1	118.94	57	0.00	2.09	0.88	0.98	0.072	0.051	0.88		-	-
Model P2M2	121.06	58	0.00	2.09	0.88	0.98	0.072	0.051	0.88	2-1	2.12	1
<b>Model P2M3</b>	122.18	59	0.00	2.07	0.88	0.98	0.071	0.051	0.88	3-2	1.12	1

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square; SRMR denotes standardized Root Mean Square Residual.  $\Delta \chi^2$  is the change in Chi-square statistic. N=213.

Table 10-22 Path Coefficient Estimates of Model Part Two based on Short Duration Sample

Performance	Knowledge Transfer Activities		
	KNACQ	KNDIST	KNUSE
Supply Chain Performance	--	0.26* (3.58)	0.21* (2.53)
Market Performance	--	0.18* (2.20)	0.21* (2.08)
Performance			
	SCPERFM	MKPERFM	
Supply Chain Performance	--	--	
Market Performance	0.33* (5.21)	--	

\* Significant Path Estimates; N=213. First value is the standardized parameter estimate; value in parenthesis is the t-value.

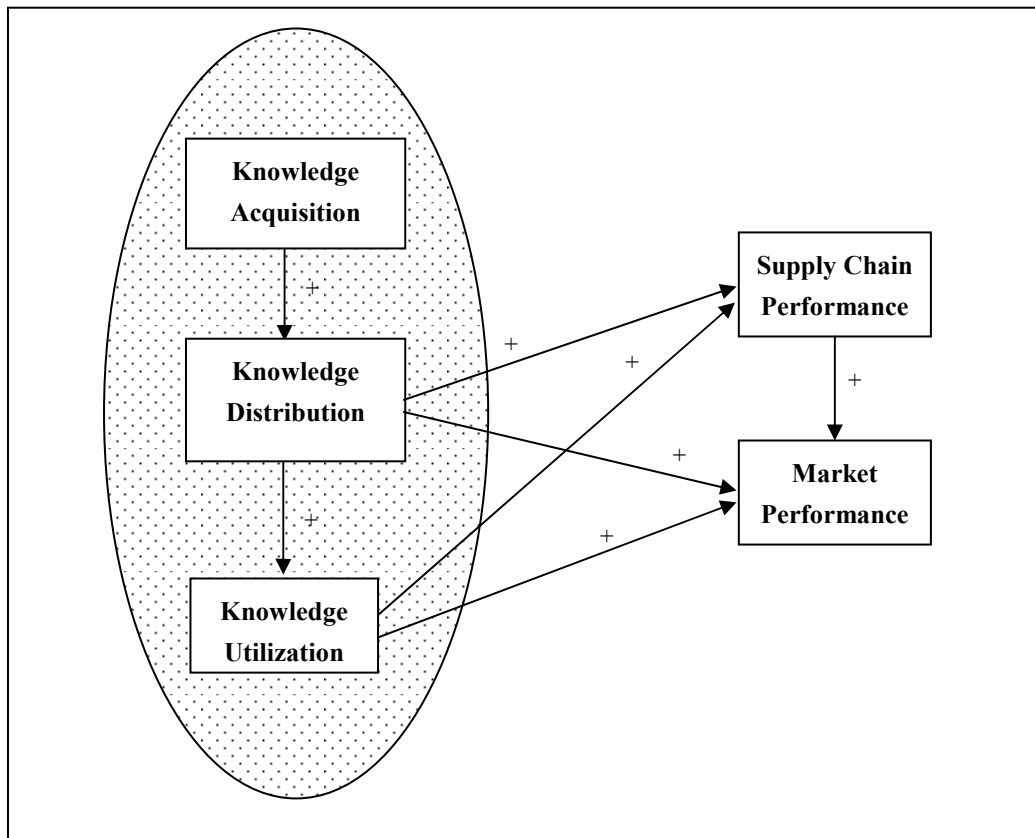


Figure 10-11 Significant Relationships in Model Part Two, Short Duration Sample

#### ***10.4.2.2 Submodel 2a: Long Duration Sample***

Two nested models were compared. Model P2M2 was the most parsimonious one (See table 10-23). For responding firms in the long duration sample, knowledge acquisition did show significant impact on market performance, although not on the supply chain performance. Knowledge distribution had a significant positive effect on supply chain and market performance. Surprisingly, knowledge utilization had a positive effect on supply chain performance, but had a negative impact on market performance.

Nevertheless, when indirect effect was examined, it was found that knowledge utilization did have a positive impact on market performance through its positive effects on supply chain performance (see table 10-24). Figure 10-12 shows the significant relationships in the model part two demonstrated from the long duration sample.

Table 10-23 Comparing Nested Models of Long Duration Sample for Model Part 2

CFA Model	$\chi^2$	df	P-value	$\chi^2/df$	GFI	CFI	RMSEA	SRMR	ECVI	Nested models	$\Delta \chi^2$	$\Delta df$
Model P2M1	164.12	57	0.00	2.88	0.82	0.97	0.097	0.075	1.17	-	-	-
<b>Model P2M2</b>	167.82	58	0.00	2.89	0.82	0.97	0.098	0.076	1.17	2-1	3.70	1

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square; SRMR denotes standardized Root Mean Square Residual.  $\Delta \chi^2$  is the change in Chi-square statistic. N=200.

Table 10-24 Path Coefficient Estimates of Model Part Two based on Long Duration Sample

Performance	Knowledge Transfer Activities		
	KNACQ	KNDIST	KNUSE
Supply Chain Performance	--	0.34* (4.03)	0.25* (2.94)
Market Performance	0.36* (2.70)	0.35* (2.95)	-0.24* (-2.31)
Indirect Effects			
Supply Chain Performance	--	--	--
Market Performance	--	0.11* (3.07)	0.08* (2.27)
Performance			
	SCPERFM	MKPERFM	
Supply Chain Performance	--	--	
Market Performance	0.31* (4.52)	--	

\* Significant Path Estimates; N=200. First value is the standardized parameter estimate; value in parenthesis is the t-value.

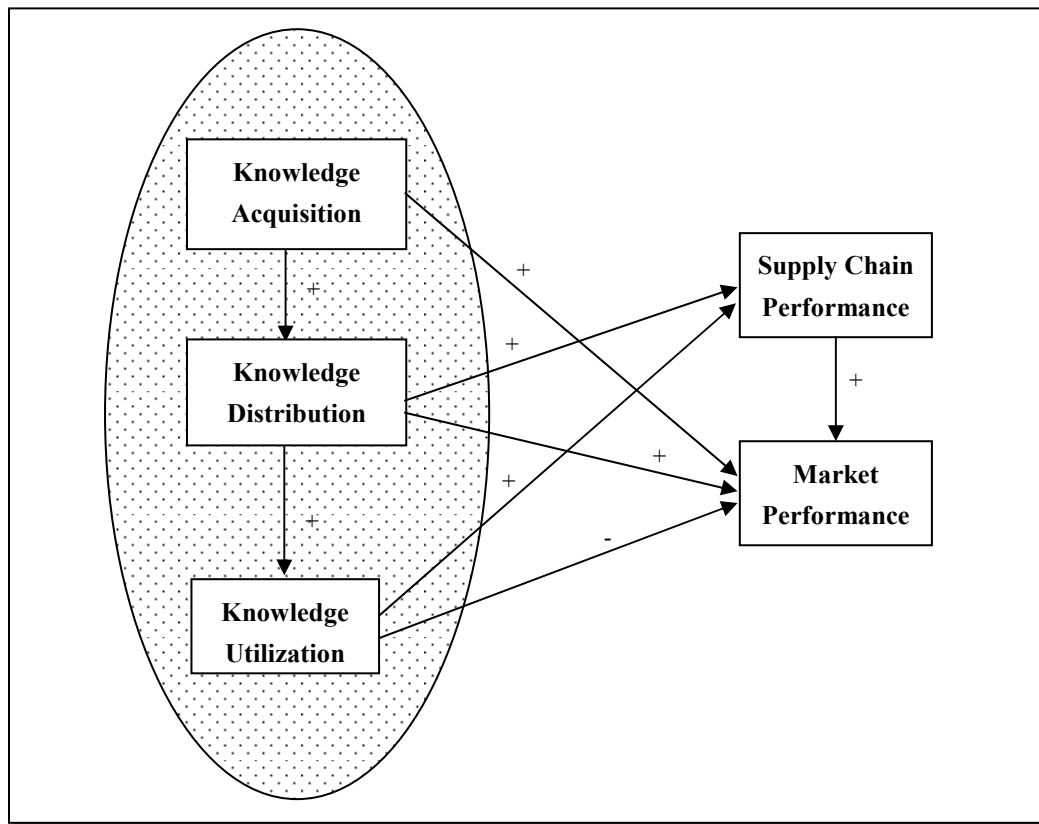


Figure 10-12 Significant Relationships in Model Part Two, Long Duration Sample

#### ***10.4.2.3 Comparing Long Duration Sample and Short Duration Sample***

The author had intended to examine the moderating effect of partnership duration on the relationship between supply chain knowledge transfer and a firm's performance.

However, the comparison of path parameter estimate for the short and long duration samples was restricted by the non-identical measurement models between the two samples (see also in section 10.3.2.3). For this reason, the relative strength of effect of knowledge transfer on a firm's performance could not be examined directly. More comparisons between the two samples are discussed in the next chapter.

#### **10.4.3 Submodel 2b: Controlling Contract Status**

To examine the differences in relationship between knowledge transfer activities and a firm's performance for the different contract status of supply chain partnerships,

structural equation models were established with the contracted sample and non-contracted sample (see also in section 10.3.3). Model trimming strategy was again followed to reach the most parsimonious model. Detailed comparisons of the two samples are presented in Chapter 11.

#### **10.4.3.1 Submodel 2b: Contracted Partnership Sample**

Among the four nested models for the sample with contract, model P2M3 was the most parsimonious (see table 10-25). As shown in table 10-26, supply chain performance appeared to have positive effects on market performance for the contracted sample. Knowledge acquisition had no effects on either dimension of a firm's performance. Knowledge distribution had positive effects on supply chain performance and market performance. Knowledge utilization had a positive effect only on the supply chain performance of the responding contracted partner firm. It also had a positive but non-significant impact on the market performance of the firm. Figure 10-13 illustrates the significant relationships between the knowledge transfer process and a firm's performance for the contracted partnership sample.

Table 10-25 Comparing Nested Models of Contracted Sample for Model Part 2

CFA Model	$\chi^2$	df	P-value	$\chi^2/df$	GFI	CFI	RMSEA	SRMR	ECVI	Nested models	$\Delta \chi^2$	$\Delta df$
Model P2M1	123.13	57	0.00	2.16	0.89	0.99	0.064	0.050	0.67	-	-	-
Model P2M2	124.06	58	0.00	2.14	0.89	0.99	0.063	0.050	0.67	2-1	0.93	1
<b>Model P2M3</b>	126.22	59	0.00	2.16	0.89	0.99	0.063	0.050	0.67	3-2	2.16	1
Model P2M4	132.81	60	0.00	2.21	0.88	0.99	0.065	0.051	0.69	4-3	6.59	1

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square; SRMR denotes standardized Root Mean Square Residual.  $\Delta \chi^2$  is the change in Chi-square statistic. N=285.



Table 10-26 Path Coefficient Estimates of Model Part Two based on Contracted Sample

Performance	Knowledge Transfer Activities		
	KNACQ	KNDIST	KNUSE
Supply Chain Performance	--	0.26* (4.13)	0.32* (4.10)
Market Performance	--	0.40* (5.06)	0.15 (1.87)
Performance			
	SCPERFM	MKPERFM	
Supply Chain Performance	--	--	
Market Performance	0.23* (4.18)	--	

\* Significant Path Estimates; N=285. First value is the standardized parameter estimate; value in parenthesis is the t-value.

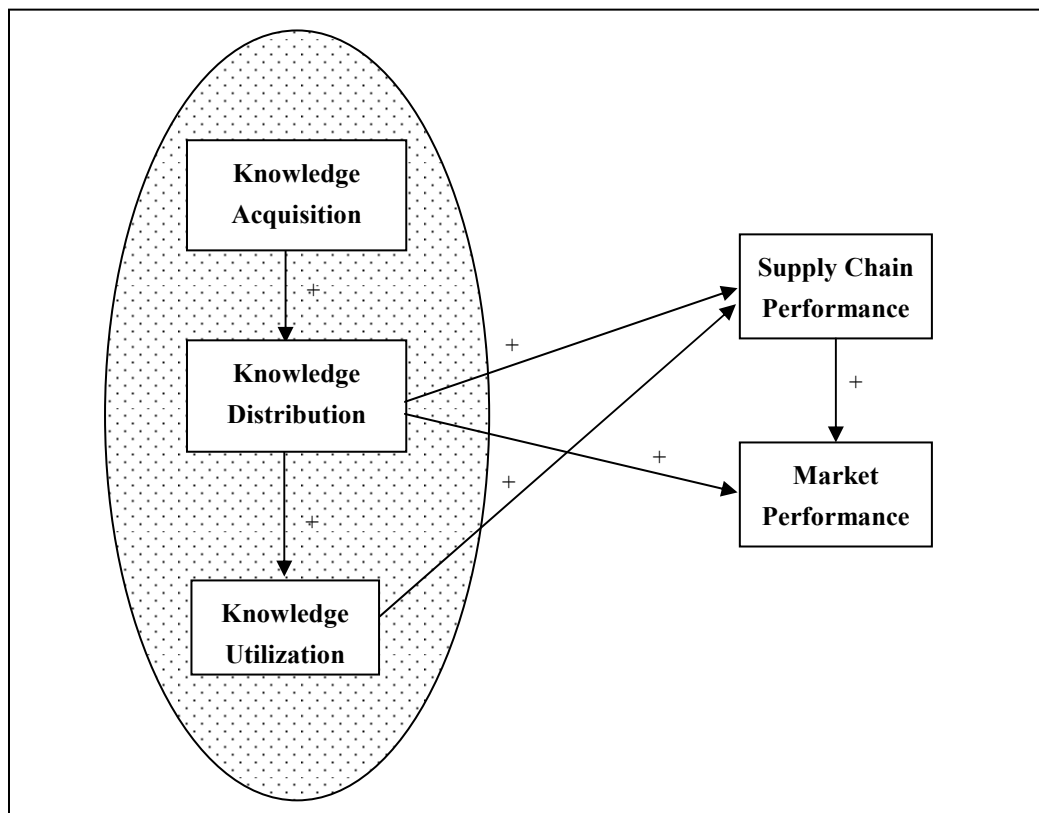


Figure 10-13 Significant Relationships in Model Part Two, Contracted Sample

#### 10.4.3.2 Submodel 2b: Non-contracted Partnership Sample

Five nested models were compared for the sample with no explicit contract. It was found that Model P2M3 was the most parsimonious model (see table 10-27). The path coefficient estimates suggested that only Knowledge distribution had a positive effect on supply chain performance of the responding firms. Supply chain performance as expected had significant positive effects on the market performance of the firm (see table 10-28). Figure 10-14 depicts the significant relationships demonstrated from the non-contracted sample.

Table 10-27 Comparing Nested Models of Non-contracted Sample for Model Part 2

CFA Model	$\chi^2$	df	P-value	$\chi^2/df$	GFI	CFI	RMSEA	SRMR	ECVI	Nested models	$\Delta \chi^2$	$\Delta df$
Model P2M1	185.30	57	0.00	3.25	0.78	0.91	0.130	0.100	1.99	-	-	-
Model P2M2	185.23	58	0.00	3.19	0.78	0.91	0.130	0.100	1.98	2-1	-0.07	1
<b>Model P2M3</b>	186.87	59	0.00	3.17	0.77	0.91	0.130	0.100	1.98	3-2	1.64	1
Model P2M4	190.65	60	0.00	3.18	0.77	0.91	0.130	0.100	1.99	4-3	3.78	1
Model P2M5	200.04	61	0.00	3.28	0.76	0.91	0.130	0.100	2.05	5-4	9.39	1

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square; SRMR denotes standardized Root Mean Square Residual.  $\Delta \chi^2$  is the change in Chi-square statistic. N=128.

Table 10-28 Path Coefficient Estimates of Model Part Two based on Non-contracted Sample

Performance	Knowledge Transfer Activities		
	KNACQ	KNDIST	KNUSE
Supply Chain Performance	--	0.40*	--
		(4.41)	
Market Performance	0.21	0.12	-0.16
	(1.51)	(1.25)	(-1.35)
Performance	Performance		
	SCPERFM	MKPERFM	
Supply Chain Performance	--	--	
Market Performance	0.46*	--	
	(5.62)		

\* Significant Path Estimates; N=128. First value is the standardized parameter estimate; value in parenthesis is the t-value.

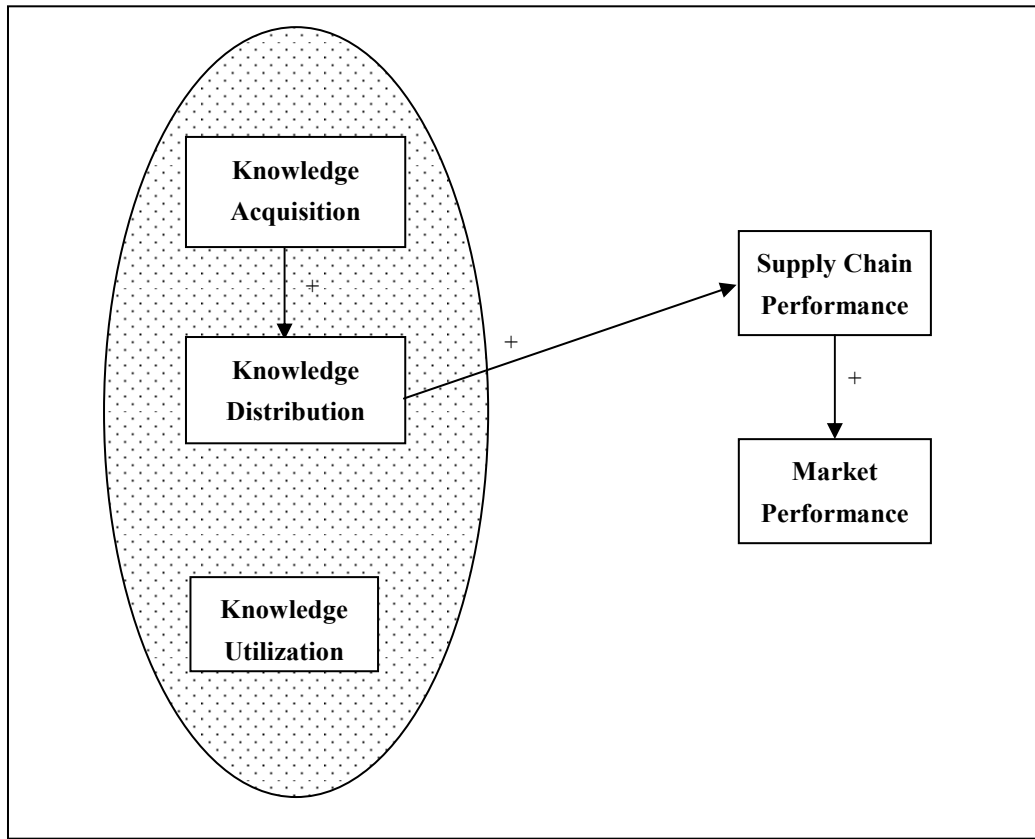


Figure 10-14 Significant Relationships in Model Part Two, Non-contracted Sample

#### 10.4.4 Submodel 2c: Controlling Upstream and Downstream in the Supply Chain

Consistent with section 10.3.4, the entire sample was divided into two samples according to the location of the responding partnerships in Baogang's supply chain. Structural Equation Models were fitted to samples of upstream and downstream partnerships in Baogang's supply chain, to examine the differences in structural weights between supply chain knowledge transfer and a firm's performance. The model trimming process was applied to both samples. The comparison of the two samples is presented in Chapter 11.

##### 10.4.4.1 Submodel 2c: Upstream Partnership Sample

Six nested models were derived from the upstream sample, and model P2M3 was found to be the most parsimonious model, with an appropriate level of goodness of fit (see table

10-29). Among three stages of knowledge transfer activities, only knowledge distribution was found to have a significant effect on supply chain performance and market performance of the upstream firms. Consistently, supply chain performance still positively predicted market performance (see table 10-30). Figure 10-15 shows the significant relationships demonstrated from the upstream sample.

Table 10-29 Comparing Nested Models of Upstream Sample for Model Part 2

CFA Model	$\chi^2$	df	P-value	$\chi^2/df$	GFI	CFI	RMSEA	SRMR	ECVI	Nested models	$\Delta \chi^2$	$\Delta df$
Model P2M1	144.36	57	0.00	2.53	0.85	0.97	0.088	0.074	1.06	-	-	-
Model P2M2	145.13	58	0.00	2.50	0.85	0.97	0.087	0.074	1.06	2-1	0.77	1
<b>Model P2M3</b>	147.40	59	0.00	2.50	0.85	0.97	0.087	0.075	1.06	3-2	2.27	1
Model P2M4	153.04	60	0.00	2.55	0.85	0.97	0.088	0.075	1.08	4-3	5.64	1
Model P2M5	151.17	60	0.00	2.53	0.85	0.97	0.087	0.076	1.07	5-3	3.77	1
Model P2M6	157.00	61	0.00	2.57	0.84	0.97	0.089	0.076	1.08	6-5	5.83	1

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square; SRMR denotes standardized Root Mean Square Residual.  $\Delta \chi^2$  is the change in Chi-square statistic. N=201.

Table 10-30 Path Coefficient Estimates of Model Part Two based on Upstream Sample

Performance	Knowledge Transfer Activities		
	KNACQ	KNDIST	KNUSE
Supply Chain Performance	--	0.31*	0.17
		(3.93)	(1.90)
Market Performance	-0.31	0.63*	--
	(-1.18)	(2.41)	
Performance	Performance		
	SCPERFM	MKPERFM	
Supply Chain Performance	--	--	
Market Performance	0.38*	--	
	(6.49)		

\* Significant Path Estimates; N=201. First value is the standardized parameter estimate; value in parenthesis is the t-value.

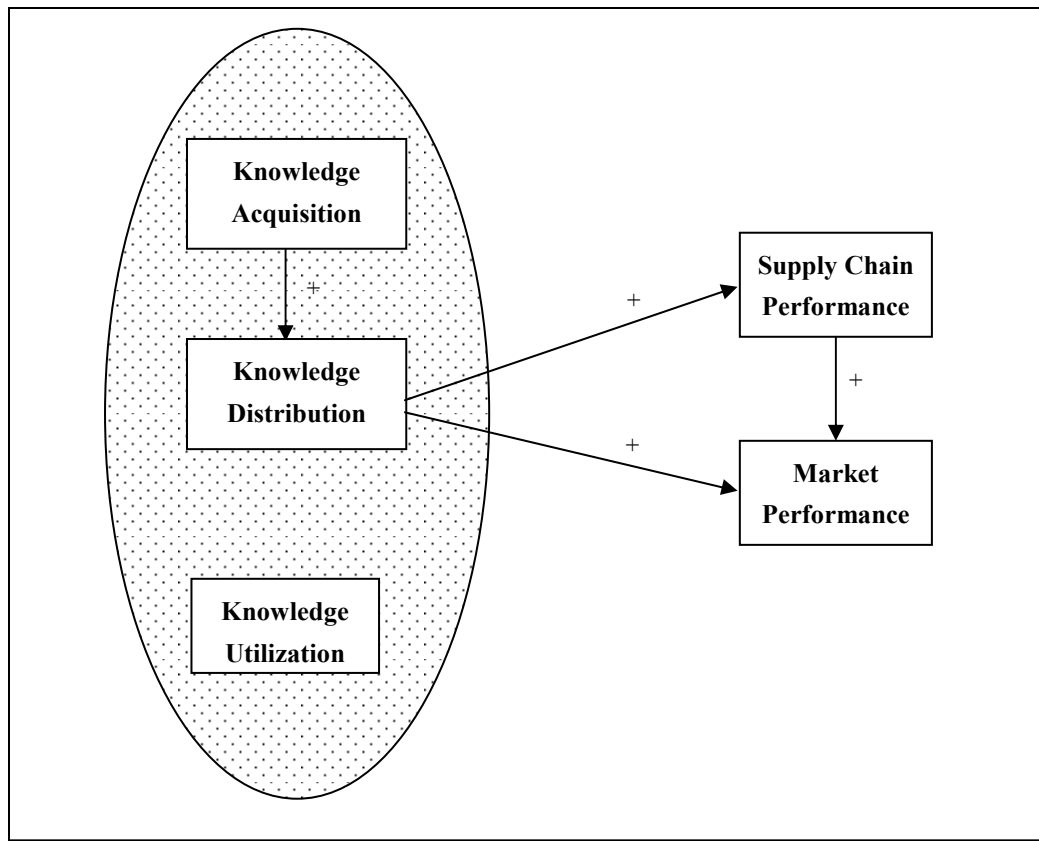


Figure 10-15 Significant Relationships in Model Part Two, Upstream Sample

#### ***10.4.4.2 Submodel 2c: Downstream Partnership Sample***

For the sample of downstream partner firms, five nested models were compared. Model P2M4 was the most parsimonious model (see table 10-31). As shown in table 10-32, knowledge acquisition exhibited significant positive effects on market performance, whilst knowledge distribution and knowledge utilization showed significant positive impact on supply chain performance. Again, supply chain performance showed significant positive effect on market performance of the downstream partner firms. The significant relationship demonstrated from the downstream sample for model part two was also shown in figure 10-16.

Table 10-31 Comparing Nested Models of Downstream Sample for Model Part 2

CFA Model	$\chi^2$	df	P-value	$\chi^2/\text{df}$	GFI	CFI	RMSEA	SRMR	ECVI	Nested models	$\Delta \chi^2$	$\Delta \text{df}$
Model P2M1	138.86	57	0.00	2.44	0.86	0.98	0.083	0.060	0.98	-	-	-
Model P2M2	139.92	58	0.00	2.41	0.86	0.98	0.082	0.060	0.98	2-1	1.06	1
Model P2M3	143.87	59	0.00	2.44	0.86	0.98	0.083	0.060	0.99	3-2	3.95	1
<b>Model P2M4</b>	140.93	59	0.00	2.39	0.86	0.98	0.081	0.061	0.97	4-2	1.01	1
Model P2M5	144.54	60	0.00	2.41	0.86	0.98	0.082	0.062	0.98	5-4	3.61	1

Note:  $\chi^2$  is the Satorra-Bentler Scaled Chi-Square; SRMR denotes standardized Root Mean Square Residual.  $\Delta \chi^2$  is the change in Chi-square statistic. N=212.

Table 10-32 Path Coefficient Estimates of Model Part Two based on Downstream Sample

Performance	Knowledge Transfer Activities		
	KNACQ	KNDIST	KNUSE
Supply Chain Performance	--	0.24* (3.48)	0.33* (3.77)
Market Performance	0.42* (4.18)	--	0.14 (1.34)
Performance	Performance		
	SCPERFM	MKPERFM	
Supply Chain Performance	--	--	
Market Performance	0.25* (3.60)	--	

\* Significant Path Estimates; N=212. First value is the standardized parameter estimate; value in parenthesis is the t-value.

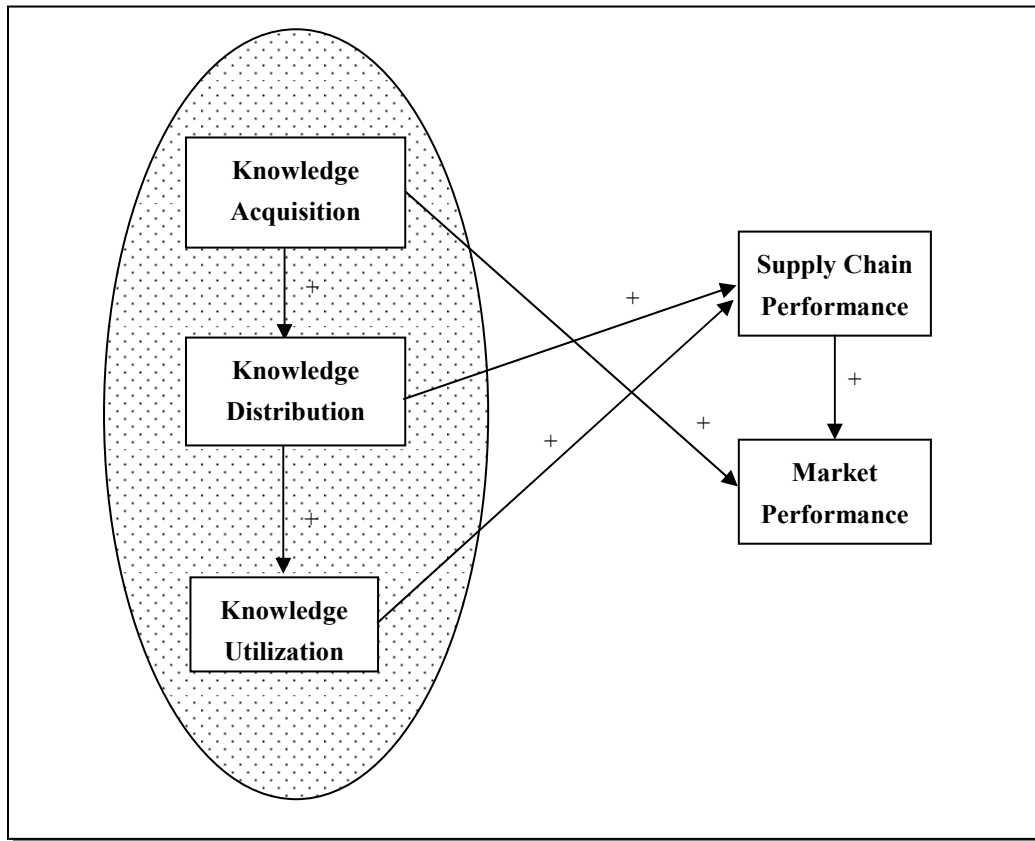


Figure 10-16 Significant Relationships in Model Part Two, Downstream Sample

## 10.5 Summary

In this chapter, the two parts of the conceptual model of knowledge transfer in supply chain partnerships were tested using Structural Equation Modeling. Structural models were fitted to the entire sample to examine the overall hypotheses. Only a small number of hypotheses were supported by the empirical data. However, since this research is also exploratory in nature and the competing model strategy (as opposed to the confirmatory model strategy) was followed, there were some significant relationships demonstrated by the data that were not proposed initially. Moreover, when the whole data set was divided according to partnership duration, contract status, and location in the supply chain, different sub-samples demonstrated different relationships among the latent variables. Alternative interpretations were therefore needed. The next chapter takes a closer look at

the empirical results with the support of literature such that some substantive explanations could be reached.



## **CHAPTER 11 DISCUSSION**

### **11.1 Preamble**

In the previous three chapters empirical data gained from a survey of Baogang's supply chain was examined in a systematic manner. The scales were validated through measurement model evaluation; the hypotheses were tested using structural equation models. However, only limited empirical support was gained for the initial hypotheses developed based on the theoretical model (see figure 11-1 and table 11-1 for a summary of tested hypotheses). Influences of partnership characteristics on supply chain knowledge transfer appeared to be varied, as well as the effects of knowledge transfer activities on supply chain firm performance. Moreover, firms with different partnership characteristics, such as partnership duration, contract status, and the location in the supply chain, also demonstrated varied relationships between different variables. However, examining findings that deviated from the original hypotheses is important and is considered to be both interesting and productive (Bryman and Bell, 2003). Because the findings could be largely contextual in relation to factors such as industry nature, time, location, and business environment, careful interpretation of the varied findings could potentially shed light on the complicated issue of knowledge transfer and stimulate further interpretation. Therefore, this chapter provides a more detailed explanation of the various empirical findings based on the extended literature review and an understanding of the nature of Baogang's supply chain.

The main discussion of the research findings is presented in the following seven sections. This chapter first examines the influence of the characteristics of supply chain partnership on knowledge transfer (section 11.2 and 11.3). It then examines the influence of knowledge transfer on firm performance (section 11.4). It is important to note that these three sections were based on a holistic view of the sample, by discussing the results from the entire sample rather than distinguishing samples with various

characteristics. This is followed by the comparison of different sub-samples in terms of partnership duration, contract status, and location in the supply chain (section 11.5 to 11.7). Section 11.8 compares findings of previous literature and the research findings from the current study on the main dimensions of the theoretical model.

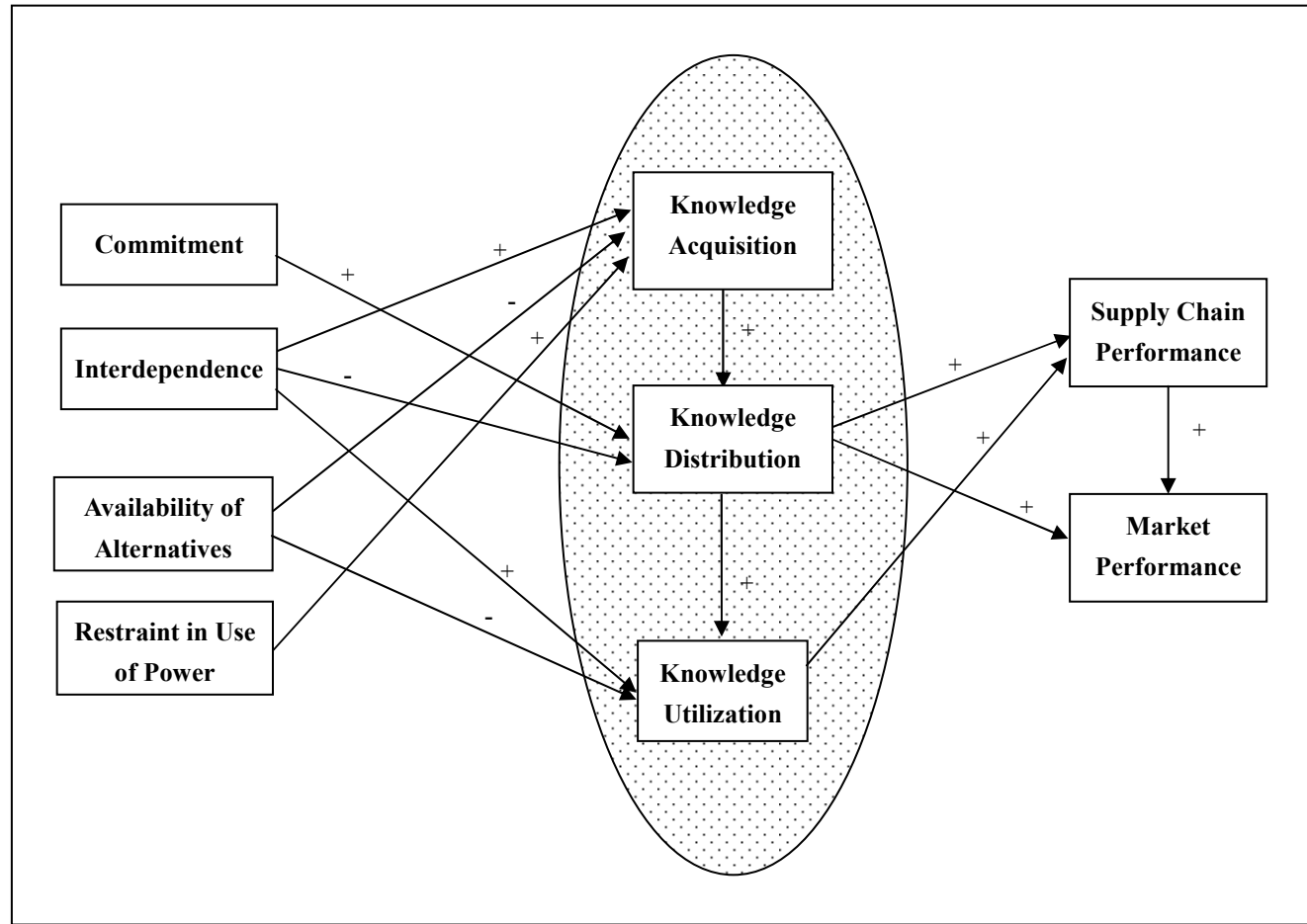


Figure 11-1 Significant Relationships in the Whole Model, Entire Sample

Table 11-1 Summary of Tested Hypothesis

<b>Hypotheses</b>	<b>Supported or Not</b>	<b>Refer to Section</b>	<b>Comments</b>
H1a Trust and knowledge acquisition	Partially	10.3.4.1	Supported in upstream sample
H1b Commitment and knowledge acquisition	No	10.3	-
H1c Interdependence and knowledge acquisition	Yes	10.3, 10.3.3.1 and 10.3.4.2	Not supported in contracted and downstream sample
H1d Shared meaning and knowledge acquisition	Partially	10.3.3.1 and 10.3.4.2	Supported in contracted sample and downstream sample
H2a Trust and knowledge internalization	Partially	10.3.2.2	Supported in long duration sample
H2b Commitment and knowledge internalization	Yes	10.3, 10.3.2.2, 10.3.3.2 and 10.3.4.1	Not supported in long duration sample, non-contracted sample, and upstream sample
H2c Interdependence and knowledge internalization	No	10.3	-
H2d Shared meaning and knowledge internalization	No	10.3	-
H3a Availability of alternatives and knowledge acquisition	No	10.3	Negative relationships have been found in all samples except in long duration sample and upstream sample
H3b Restraint in use of power and knowledge acquisition	Yes	10.3 and 10.3.4.1	Not supported in upstream sample
H4a Availability of alternatives and knowledge utilization	No	10.3 and 10.3.4.1	Negative relationships have been found in all samples except in upstream sample
H4b Restraint in use of power and knowledge utilization	No	10.3	-
H5 Knowledge acquisition and knowledge internalization	Yes	10.4	-
H6 Knowledge internalization and knowledge utilization	Yes	10.4, 10.4.3.2 and 10.4.4.1	Not supported in non-contracted sample and upstream sample
H7a Knowledge acquisition and supply chain performance	No	10.4	-
H7b Knowledge acquisition and market performance	Partially	10.4.2.2 and 10.4.4.2	Supported in long duration sample and downstream sample
H8a Knowledge internalization and supply chain performance	Yes	10.4	-
H8b Knowledge internalization and market performance	Yes	10.4, 10.4.3.2 and 10.4.4.2	Not supported in non-contracted sample and downstream sample

H9a Knowledge utilization and supply chain performance	Yes	10.4, 10.4.3.2 and 10.4.4.1	Not supported in non-contracted sample and upstream sample
H9b Knowledge utilization and market performance	Partially	10.4.2.1	Supported in short duration sample
H10 Supply chain performance and market performance	Yes	10.4	-
H11 Moderating effect of partnership duration on the relationship between partnership strength and knowledge transfer	Test restricted*	10.3.2	Relationship varied between long duration and short duration samples
H12 Moderating effect of duration on relationship between balanced power and knowledge transfer	Test restricted*	10.3.2	Relationship varied between long duration and short duration samples
H13 Moderating effect of duration on relationship between knowledge transfer and firm performance	Test restricted*	10.4.2	Relationship varied between long duration and short duration samples
* Test restricted due to non-identical measurement models between samples; see also in section 10.3.2.3 and 10.4.2.3.			

## **11.2 Influences of Partnership Magnitude on Supply Chain**

### **Knowledge Transfer**

As discussed in Chapter 5, various indicators of partnership magnitude/strength are hypothesized to have positive effect on knowledge acquisition and knowledge internalization. However, the empirical findings from Baogang's supply chain suggested that indicators of partnership magnitude have inconsistent impacts on stages of knowledge transfer. The following discussions take a closer look at each of these indicators and seek possible explanations for the findings.

#### **11.2.1 Trust and Commitment**

From the sample of Baogang's supply chain network, responding firms showed reasonable levels of trust and commitment (see section 9.3). This could be traced back to the procedure through which the sample was drawn. Since snowball sampling was used to indicate supply chain partners of Baogang, it was more likely to receive responses from those partnerships with established relationships. Therefore, it was not surprising to see generally higher levels of trust and commitment among the responding firms. Nevertheless, within the sample neither trust nor commitment had significant effects on knowledge acquisition. Only commitment showed some significant positive effect on the knowledge internalization of supply chain firms. As discussed in section 5.4, neither trust nor commitment was hypothesized to affect knowledge utilization. It is interesting to see these two often-related constructs in previous research demonstrating varied effects on the interfirm knowledge transfer.

The empirical findings did not give support to the positive influence trust could have on supply chain knowledge transfer, which is opposed to some prior research findings (e.g. Cummings and Teng, 2003; Dyer and Chu, 2003; McEvily et al., 2003; Soekijad and Andriessen, 2003; Chen, 2004; Squire et al., 2008). Surprisingly, trust, as the classical indicator of supply chain partnerships and which is frequently referred to by

previous researchers (Cummings and Teng, 2003; McEvily et al., 2003; Soekijad and Andriessen, 2003; Chen, 2004), demonstrated non-significant effects on the process of knowledge transfer. As proposed by many prior researchers, interfirm trust is the necessary condition for the establishment of supply chain partnership (Frankel et al., 1996; Monczka et al., 1998). Without a certain level of trust, no matter if it is competence based, goodwill based or contractual (Sako, 1992; Miyamoto and Rexha, 2004), a relationship is not really a partnership (see section 3.6.2). Nevertheless, trust is not taken for granted. Interfirm trust develops from successful transactions or contacts (Parkhe, 1993). It could be argued that building up of trust from previous good experiences (from direct transactions, or from indirect social networks) is never a guarantee that the relationship will continue.

The research findings have implied that trust might not matter so much to the knowledge sharing activities of established relationships. This may be difficult to understand but it is really in terms of the relative importance or diminishing effects of trust. As Becerra et al. (2008) pointed out, the need for trust only arises in a risky situation, in which perceived risk is compared to the level of trust. Within the supply network of Baogang, where supply chain partnerships are more stable, the need for trust as an ingredient of effective knowledge transfer is also reduced. According to Cousins et al. (2006):

“Key customer relationships may suffer from ‘overembeddedness’. That is, very close relationships may possibly insulate small firms from other external sources of information... as relationship quality (or trust) reaches a very high level, the perceived need to monitor diminishes, decreasing the level of conflict and of intense processing or information. If trust reaches a very high level, the expectation may exist that information will be provided when needed, so that the incentive to acquire external knowledge is reduced. In short, a high level of trust may allow a relationship to run smoothly and may reduce some of the transaction costs associated with managing the customer relationship but may not actually increase knowledge acquisition.”

As highlighted by Cousins (2002), to long-term inter-organizational relationship

management, the issue is not just about trust, but rather how to optimally manage the situation. The level of trust will matter more to an immature partnership than a more established partnership in facilitating knowledge sharing. Evidence has been gained by Ramasamy et al. (2006) in their study of Chinese enterprises. The results suggested that good communication and interaction between firms could be interpreted as a good relationship, which may lead to a lack of self-initiative to transfer knowledge. Nevertheless, empirical evidence is scarce, and future researchers may examine this point further. Overall, the findings have indicated that once a stable partnership has been formed, trust does not necessarily breed knowledge transfer.

As with trust, the level of commitment of the supply chain partners had no significant effect on the knowledge acquisition of supply chain firms, as opposed to some previous findings (e.g. Kale et al., 2000; Krause et al., 2007; Modi and Mabert, 2007). Various joint activities, which may facilitate knowledge transfer, seemed not determined by the level of commitment either (see also in Ramasamy et al., 2006). This indicates that trusting one another, or being committed to the relationship does not guarantee that supply chain partners will engage in more learning activities.

Unlike trust, commitment to the partnership represents a longer-term issue (see section 3.6.2). Viewing the partner as trustworthy for the current business is not equivalent to a willingness to continue the relationship. Therefore, firms may find that although they trust the supply chain partner for the current business, whether the relationship will proceed is uncertain. The findings indicate, therefore, that commitment to the relationship plays a more important role in the continuity of the relationship and facilitating ongoing knowledge sharing activities of firms. As suggested by Wu and Cavusgil (2006), the organizational commitment can serve as a key mediator and help to transform firm-idiosyncratic resources into higher rents for the partnership and the firm. A higher level of commitment is more likely to be accompanied with more joint activities, such as dedication of resources and pledges of cooperation, that move the relationship in a closer and more coordinated direction (Spekman, Spear, & Kamauff,



2002). A stable and continuous relationship coupled with a significant level of commitment ensures the successful internalization or dissemination of external knowledge, since firms will not only receive the necessary support to absorb the knowledge, but also see supply chain knowledge as continuous with potential for future use. In this sense it is reasonable to observe committed supply chain partnerships having higher levels of knowledge internalization.

### **11.2.2 Shared Meaning**

Although it was initially proposed that shared meaning will smooth the supply chain partnership and will enable interfirm knowledge transfer (see also in Cummings and Teng, 2003; Awazu, 2004; Hult et al., 2004; Buckley et al., 2006), the empirical data from Baogang's supply chain network did not show much support for the view. Shared meaning had no significant effect on knowledge acquisition, distribution, or utilization. The snowball sampling may have created a possible bias in the sample, in which more mature partnerships are more prevalent than young partnerships. However, this is actually consistent with the intention of the current research, as supply chain partnership is the research subject. Firstly, it is worth noting that the steel industry is a quite mature industry in China, and the business of Baogang has lasted for decades. Therefore, the technological gap is rather small between upstream and downstream firms. There are relatively few secrets between different industrial stages. Secondly, although much has been written about the effect cultural and geographical barriers have on the nature of business relationships (Anderson and Weitz, 1989), in the current research, responding firms are generally located in the same region, therefore there is little difference between firms in national culture or business norms. Thirdly, responding firms have reported partnerships with relatively long histories (nearly 70% of partnerships have lasted 4 years or more as shown in section 8.5). Thus, supply chain partners may have already developed mutual understandings about the business. This is actually reflected in the relatively high mean scores for the shared meaning indicators (see table 9-3).

All the conditions mentioned above resulted in the responding supply chain partnerships in Baogang's supply chain having reasonable levels of shared meaning generally. This, however, appears to have limited the relative importance of shared meaning to the different levels of knowledge transfer. To the mature partnerships covered in the current research, shared meaning seems no longer a main facilitator of knowledge exchange, as opposed to the findings of some previous studies in which interfirm partnerships with varied levels of relationship magnitude were examined (Mowery et al., 1996; Cummings and Teng, 2003; Awazu, 2004). Shared understanding in Baogang's supply chain network is generally high. Partners in Baogang's supply chain may no longer worry about limited understandings of each other's business, either technologically or managerially.

### **11.2.3 Interdependence**

Among all the partnership magnitude measures, interdependence was the most influential factor. Significant effects have been found on knowledge acquisition, knowledge distribution, and knowledge utilization. Consistent with findings from previous research, the level of interdependence between supply chain partners has served as a significant predictor to the level of knowledge acquisition (Mowery et al., 1996; Dussauge et al., 2000). Higher levels of interdependence imply the relative importance of partners to each other's business, and the potential contributions from both sides. It also removes a knowledge senders' cautiousness about the uncertainty of the knowledge receiver's perception and interpretation of the shared knowledge (Minbaeva, 2007). Consequently, more interactions are encouraged to harness the ongoing cooperation. This calls upon various joint activities, which enable knowledge exchange and sharing.

As oppose to some previous findings (e.g. Dyer and Nobeoka, 2000; Cummings and Teng, 2003), interdependence showed negative effects on knowledge distribution

activities, which suggests that interdependence doesn't necessarily facilitate knowledge internalization in partner firms in Baogang's supply chain. This may be because knowledge distribution of firms is largely an internal behaviour, and higher levels of interdependence may therefore migrate the knowledge internalization activities to the stage of knowledge acquisition where partner firms have more interactions. Hence, issues will be addressed when people from both parties are present together. Partners are more likely to bring issues to situations and occasions where problems can be solved jointly, facilitating a more instant grasp of ideas and fruitful understanding of issues. The positive link between interdependence and knowledge acquisition, and the negative effect of interdependence on knowledge distribution, jointly supports such a view. Although migration of knowledge transfer is not covered in the current research, the empirical findings stimulate future effort to explore the issue further.

Outside the initial hypotheses, the empirical findings from Baogang's supply network have demonstrated positive links between interdependence and knowledge utilization. It is reasonable to argue that in supply chain partnerships, the relative importance of the other party's business to one's own business (i.e. the level of interdependence) also raises the importance of supply chain knowledge to one's own business. Consequently, firms will develop more interest in the acquisition of the knowledge of supply chain partners, and the application of supply chain knowledge will be more valued. In other words, management is less likely to take the risk of ignoring supply chain knowledge - supply chain knowledge will be more influential in the decision-making of the management and the daily operations of the business.

### **11.3 Influence of Balanced Power on Supply Chain Knowledge Transfer**

Higher levels of balanced power are expected to cultivate a sense of equity between partners and thus reduce the opportunistic behaviours of supply chain partners and

stimulate the development of more effective supply chain partnerships (Provan and Skinner, 1989; Maloni and Benton, 2000). Two dimensions of balanced power, availability of alternatives and restraint in use of power, were initially proposed to have positive effects on knowledge acquisition and knowledge utilization. However, the empirical findings from the survey of Baogang's supply chain have demonstrated quite different situations. Availability of alternatives showed negative relationship with knowledge acquisition and knowledge utilization, whilst restraint in use of power only showed positive effects on knowledge acquisition. Possible explanations for these unexpected findings are presented in the following sub-sections.

### **11.3.1 Availability of Alternatives**

The empirical results demonstrated that the availability of alternatives could be a factor that works in two modes in relation to knowledge transfer. On the one hand, it will be recalled that power-created dependence can lead to opportunism by partners and subsequently dissolve many of the relational elements necessary for the development of effective buyer-supplier relationships (Maloni and Benton, 2000). Thus, the availability of alternatives reduces such dependence and creates an atmosphere of fair play (Ganesan, 1994), leading researchers to believe that a more balanced relationship due to alternative choices of partners is likely to foster the cooperative relationship between partners, and consequently higher levels of knowledge exchange (Anderson and Weitz, 1989; Provan and Skinner, 1989; Maloni and Benton, 2000).

On the other hand, more available alternatives also means that firms could easily switch to other partners. Firms having more alternative partners also implies that firms have less loyalty to the current partnership. Consequently, reduced dependence on a partner may also reduce a firm's long-term orientation towards the existing partner (Ganesan, 1994). If this is the case, a firm with a greater number of available supply chain partners may have a lower level of interdependence with the partner firm and a lower level of commitment over the partnership. Interestingly, in the survey data of

Baogang's supply chain this view was actually supported by the negative correlation of availability of alternatives with interdependence ( $r=-0.47$ , as indicated in section 9.5) and with commitment ( $r=-0.59$ , as indicated in section 9.5). Therefore, the empirical results suggested that partners with more alternative choices will be reluctant to engage in closer knowledge sharing activities with each other, and hence commit less effort into putting knowledge transfer into practice. This confirmed the findings of Peterson et al. (2008), who indicated that buyer firms facing high supplier dependency would undertake socialization processes to mitigate the dependency and generate relational capital.

Overall, the effect of availability of alternatives really depends on the degree of trade-off between the two possible effects discussed here. In Baogang's supply chain network, given that respondents were asked to report on the most important supply chain partners, it is very likely for the supply chain partner referred to to be more irreplaceable (as is reflected by the relatively low mean scores in the availability of alternatives indicators, see table 9-3). The research finding suggests that, in the supply chain of Baogang, firms are more likely to engage in knowledge transfer activities with their irreplaceable partners.

### **11.3.2 Restraint in Use of Power**

As mentioned in section 3.6.3, absolute equality in influential power between supply chain partners is very rare in reality. Partner firms often end up having one partner more influential than another. In a scenario of high respect for hierarchy and formal power, knowledge senders may be reluctant to share crucial knowledge for fear of losing a position of privilege and superiority (Minbaeva, 2007). Although objective inequality is sometimes unavoidable, a stronger partner willing to suppress its excessive power for the good of the partnership will help to create a sense of equality between the partners (Maloni and Benton, 2000). Under such circumstances, partners will be more willing to exchange ideas and knowledge (Dyer and Nobeoka, 2000). The

empirical results from the current study provided further evidence for the proposition of Buckley (2006) and Muthusamy et al. (2008) that shared power is essential for learning and knowledge transfer between alliance partners. In the supply chain network of Baogang, although the responding firms generally reported that their supply chain partners are less replaceable, they also reported that restraints in power use did exist within partnerships, as illustrated by the negative correlations between the two constructs ( $r=-0.44$ , as indicated in section 9.5). Willingness of the stronger party to use its power in a more constructive way will create a more cooperative atmosphere in the partnership (Dyer and Nobeoka, 2000). For Baogang, such an atmosphere has actually stimulated more joint activities of knowledge exchange. Therefore, within Baogang's supply chain network, subjective restraint in power use is playing a positive role in promoting knowledge transfer activities.

## **11.4 Stages of Knowledge Transfer and Firm Performance**

In the current research, knowledge transfer was not treated as a black box, rather it was divided into three stages of knowledge transfer activities, with the specific intention to differentiate the knowledge transfer processes. Distinctions were drawn between each stage so that the author could monitor the nature of each knowledge transfer process more closely. Each stage of knowledge transfer was expected to have a positive influence on the supply chain performance of firms and overall market performance of the focal firm. Positive relationships were also expected between each stage of knowledge transfer. The empirical results of Baogang's supply chain provided partial support for these views (see section 10.4).

### **11.4.1 Stages of Knowledge Transfer**

Positive relationships exist between knowledge acquisition, knowledge distribution and knowledge utilization in the context of Baogang's supply network, confirming the findings of previous studies (e.g. Crossan and Berdrow, 2003; Dyer and Hatch, 2006;

Molina et al., 2007). The empirical results also provided further evidence to the Knowledge Accessing Theory of Grant and Baden-Fuller (2004). According to Grant and Baden-Fuller (2004, p.61), “alliances contribute to the efficiency in the application of knowledge; first, by improving the efficiency with which knowledge is integrated into the production of complex goods and services, and second, by increasing the efficiency with which knowledge is utilized.” In the supply network of Baogang, knowledge acquisition, knowledge internalization, and knowledge utilization were enabled by the various relationship factors between supply chain partners. The positive links between each stage of knowledge transfer suggests that they comprise an integrated process.

According to Molina et al. (2007) once the knowledge has been transferred to the organization, it can lead – as long as the knowledge is relevant to more than one group within the firm – to a “cascade” of transfers in that organization. Therefore, it is reasonable to observe more knowledge been distributed within partner firms when more knowledge acquisition activity occurs in Baogang’s supply network. Moreover, Crossan and Berdrow (2003, p.1102) suggested that “activities associated with exploitation are well articulated and considered logical, having emerged through the processes of exploration – intuition, interpreting, integrating, and institutionalizing”. The positive relationship between knowledge distribution and knowledge utilization in the context of the Baogang supply network suggested that utilization of supply chain knowledge is more likely to occur when knowledge has been widely disseminated, well understood, and internalized by the recipient firm.

#### **14.4.2 Impact on Firm Performance**

Contrary to some previous findings (e.g. Kotabe et al., 2003; Li et al., 2006; Modi and Mabert, 2007; Molina et al., 2007; Cousins et al., 2008; Lawson et al., 2009), limited evidence was gained on the positive impact of knowledge acquisition on either the supply chain performance of the firm or the market performance of the firm. It appears

when knowledge acquisition is differentiated from knowledge distribution in the process of knowledge transfer, knowledge acquisition is no longer a direct facilitator to performance improvement. A possible explanation is that knowledge acquisition is actually the means to achieve commercial benefits but not the end. Although there was a significant link between knowledge acquisition and knowledge distribution, knowledge acquisition itself does not necessarily breed higher levels of performance in firms directly.

The positive effects of knowledge distribution on supply chain performance and market performance enhance the view that internal learning is beneficial to the firm (Argote and Ingram, 2000; Hult et al., 2004; Molina et al., 2007). The findings support the proposition that, as a precursor to putting knowledge gained to actual use, the process of absorbing and integrating new knowledge is itself an organizational capability, which may enhance the firm's ability to establish and sustain its competitive advantage (Grant, 1996b). Knowledge transfer from the outside allows the firm to increase its fund of knowledge, and make more knowledge available. According to Molina et al. (2007), in a given situation, having more knowledge available makes it possible to find a solution that should be at least as good as and usually better than the possibilities without this external knowledge. This will make the average productivity greater in the organization, especially if it is combined with internal knowledge transfer. This will increase the inimitability of the focal firm and improve the sustainability of the firm's competitive advantage (Molina et al., 2007).

Furthermore, since knowledge can be found in individuals, an organization could integrate such knowledge by combining a variety of individual skills to create revenues and pooling various functional and personal expertise to make strategic moves (Eisenhardt and Martin, 2000). Continuous learning and dissemination of knowledge keeps the firm updated about current practice within the supply chain. Hence firms are more capable of coping with rapidly changing business situations, which benefits firms in supply chain operations as well as overall market performance. Moreover, given the



finding of the positive influence of knowledge distribution on knowledge utilization, attempts to disseminate knowledge within the organization not only enhance the focal firm's immediate capabilities to do business, but also strengthen its capabilities to better exploit existing or new knowledge.

To firms in Baogang's supply chain network, effective use of supply chain knowledge tends to directly enhance its supply chain performance (see also in Droge et al., 2003). Research findings indicated that although utilization of supply chain knowledge does not necessarily improve market performance directly, as was suggested by some previous studies (Teece et al., 1997; Soekijad and Andriessen, 2003), it will still improve supply chain performance, which consequently results in higher market performance (e.g. Li et al., 2006; Lawson et al., 2009). Therefore, the empirical results generally supported the view that partners firms in a supply network do benefit from knowledge transfer activities, given that valuable knowledge and best practices could be well embedded in the industry network (Walter et al., 2007). Nevertheless, the lack of a direct impact of knowledge acquisition and knowledge utilization activities on market performance, will potentially increase the difficulties for managers and employees within the focal firm to build consistent relationships between actions and desired outcomes (Sorenson, 2003), which will increase the barrier to effective knowledge transfer activities.

### **11.5 Short Partnership vs. Long Partnership**

Different results based on short duration partnerships or long duration partnerships in Baogang's supply chain were observed. Figure 11-2 and 11-3 illustrate the significant relationships in the two samples.

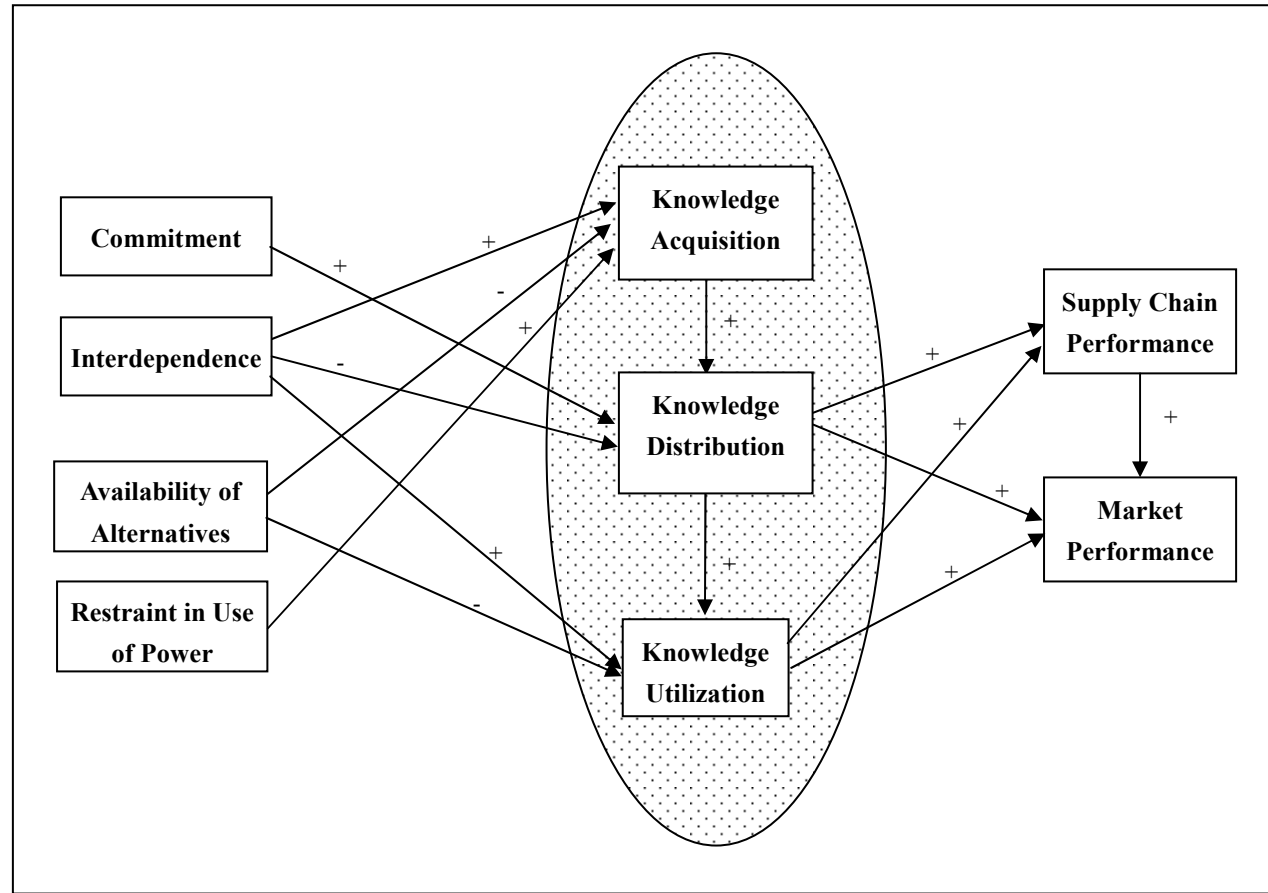


Figure 11-2 Significant Relationships in the Whole Model, Short Duration Sample

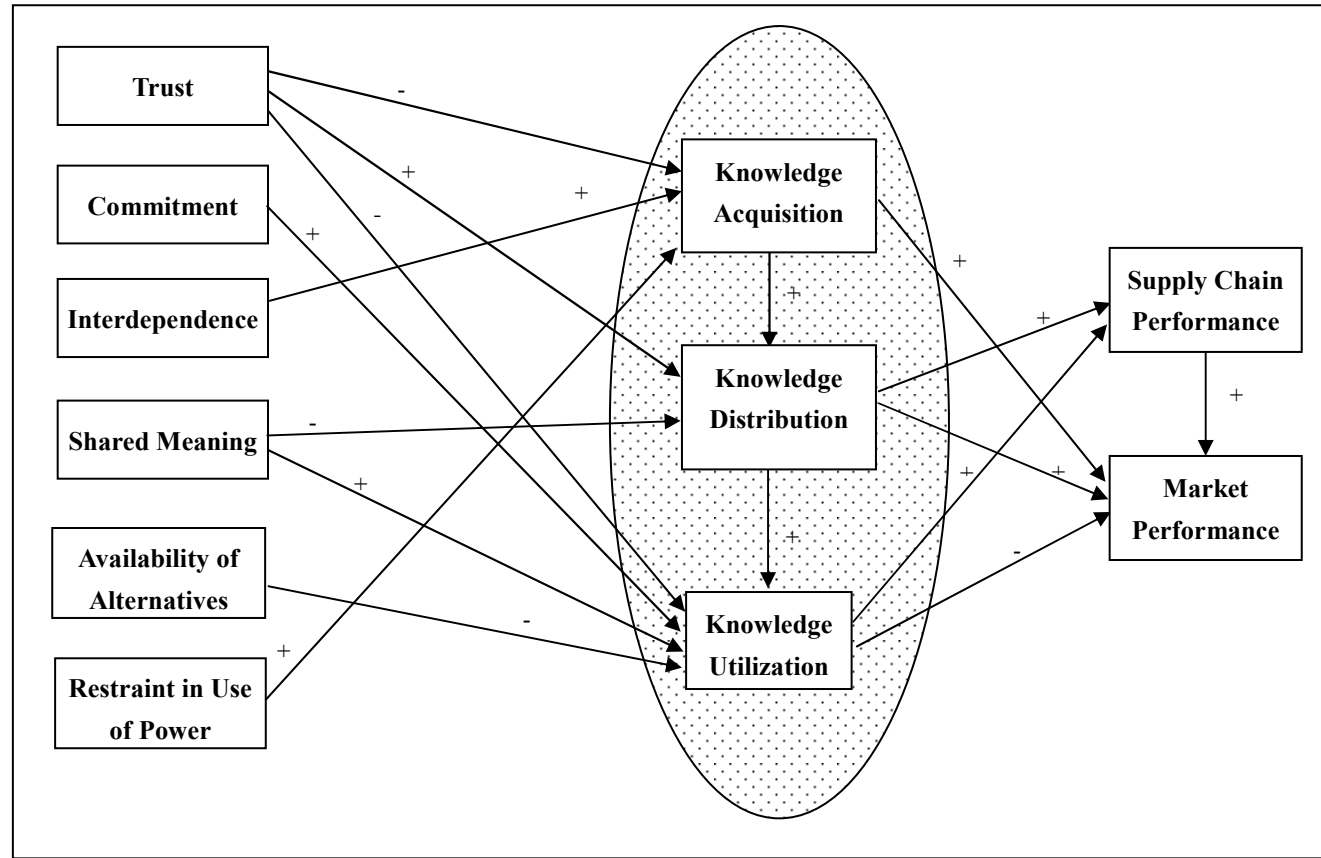


Figure 11-3 Significant Relationships in the Whole Model, Long Duration Sample

For older partnerships, trust and shared meaning play controversial roles in the process of knowledge transfer. For older partnerships, trust is no longer a promoting factor for knowledge acquisition and knowledge utilization. This again confirms the view of Cousins (2002) that the issue of managing long-term inter-organizational relationships goes beyond the matter of trust but is rather about how to manage the situation optimally. When trust reaches a very high level, the incentive to acquire external knowledge is reduced (Cousins et al., 2006). For Baogang's supply chain, one possible explanation is that for mature partnerships, since most businesses have become daily routine with many fewer challenges, a high level of trust (either competence or goodwill trust) may cultivate the habit of over-reliance. The culture of "they can do it" tends to dominate the partnership. As a result, unless the unexpected occurs or an explicit requirement arises, joint activities will not take place. For those mature supply chain partnerships in Baogang's supply chain, although mutual trust may stimulate the trust of source information and so the dissemination of supply chain knowledge around the organization, a higher level of trust also means firms will have less incentive to put supply chain knowledge into actual use. This phenomenon does support the view of diminishing returns of trust with respect to the maturity of the partnership, i.e. trust is less significant to mature partnerships than to young partnerships (Cousins, 2002; Cousins et al., 2006).

Furthermore, in more mature supply chain partnerships, shared meaning was found not to be promoting knowledge acquisition or knowledge distribution. One possible explanation could be that for a matured industry like steel producing, there are limited changes in business practices over time. For this reason, shared meaning plays a limited role in daily cooperation between partners. For longer supply chain partnerships in which partners are already familiar with each other's operations, shared meaning is no longer needed to harmonize the cooperative interface.

Nevertheless, the existence of shared meaning (i.e. a shared understanding of the business and mutual goals) between partners was found to lead to a higher level of

supply chain knowledge use. As suggested by Bierly et al. (2000), a key to organizational wisdom is judgment and decision making, which requires an understanding of the complexity of a situation, but also requires the ability to make sense and simplify so that action can be taken. Higher levels of shared meaning usually mean that information from supply chain partnerships are more relevant or ‘make sense’ to the business of the focal firm (Awazu, 2004). Consistently, Williams (2007) found that firms adapt more knowledge when they understand the interactions between different areas of knowledge. Thus, knowledge utilization is more likely to occur when shared meaning is high.

For supply chain partnerships with different duration, knowledge transfer also demonstrated varied effects on a firm’s performance. It appears that knowledge acquisition only benefits a firm’s performance in the case of long duration supply chain partnerships. As mentioned before, knowledge acquisition activities alone do not necessarily promote a firm’s performance. However, as time goes on a firm may develop dynamic capabilities, such as routines of alliance and gaining access to outside knowledge from joint knowledge exchange activities (Eisenhardt and Martin, 2000). Such capabilities enhance the competitive advantage of the focal firm and hence the market performance of the firm. It is important to note that, for longer partnerships, although utilization of supply chain knowledge has been shown to facilitate supply chain performance of firms directly, it did not show direct benefits in their market performance. Given that the business is quite traditional and matured in Baogang’s supply chain, the longer duration of the partnership means that partners will be more familiar with each other’s businesses. Hence, knowledge from supply chain partners will be adding less value to the current business of firms. It could be argued that the less exciting know-how will bring less benefit to firms’ general market performance. Given that knowledge distribution was found to facilitate both supply chain and market performance of firms in both samples, it could be argued that as the partnership continues, it is the development of dynamic capabilities that matters more to the superior performance of firms in Baogang’s supply chain. The findings indicate that

although the use of supply chain knowledge is still beneficial to firms' supply chain operations, in the matured industry context supply chain knowledge use may not generate immediate benefits to the market performance of participating firms. Firms need more exciting new knowledge to stimulate the routinely managed business.

### **11.6 Contracted Partnership vs. Non-contracted Partnership**

When the entire sample was divided into two groups according to the contract status of the partnership, there was evidence of varied effects of relationship factors on the knowledge transfer activities of the responding firms. Figure 11-4 and 11-5 demonstrate the significant relationships in the two samples.

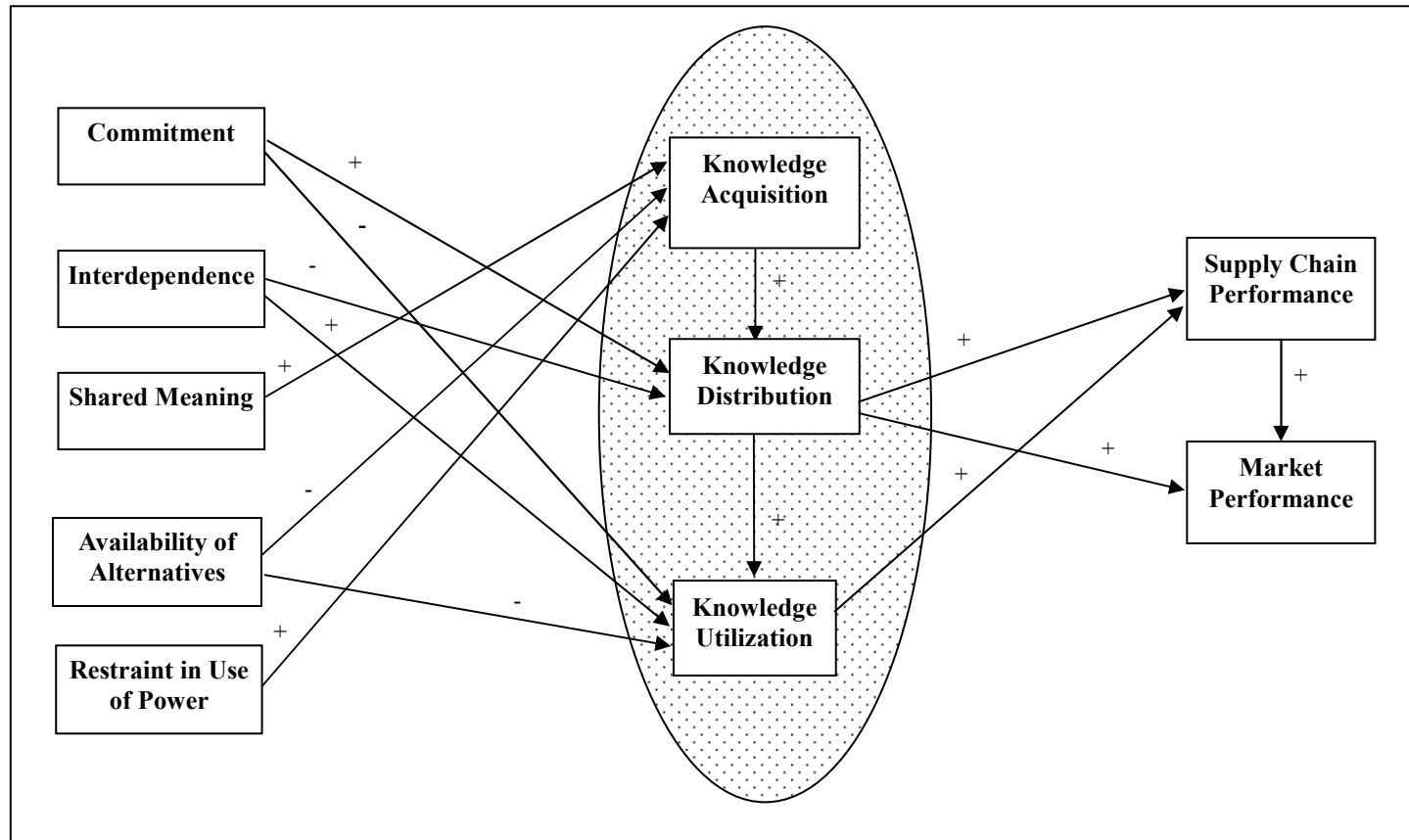


Figure 11-4 Significant Relationships in the Whole Model, Contracted Sample

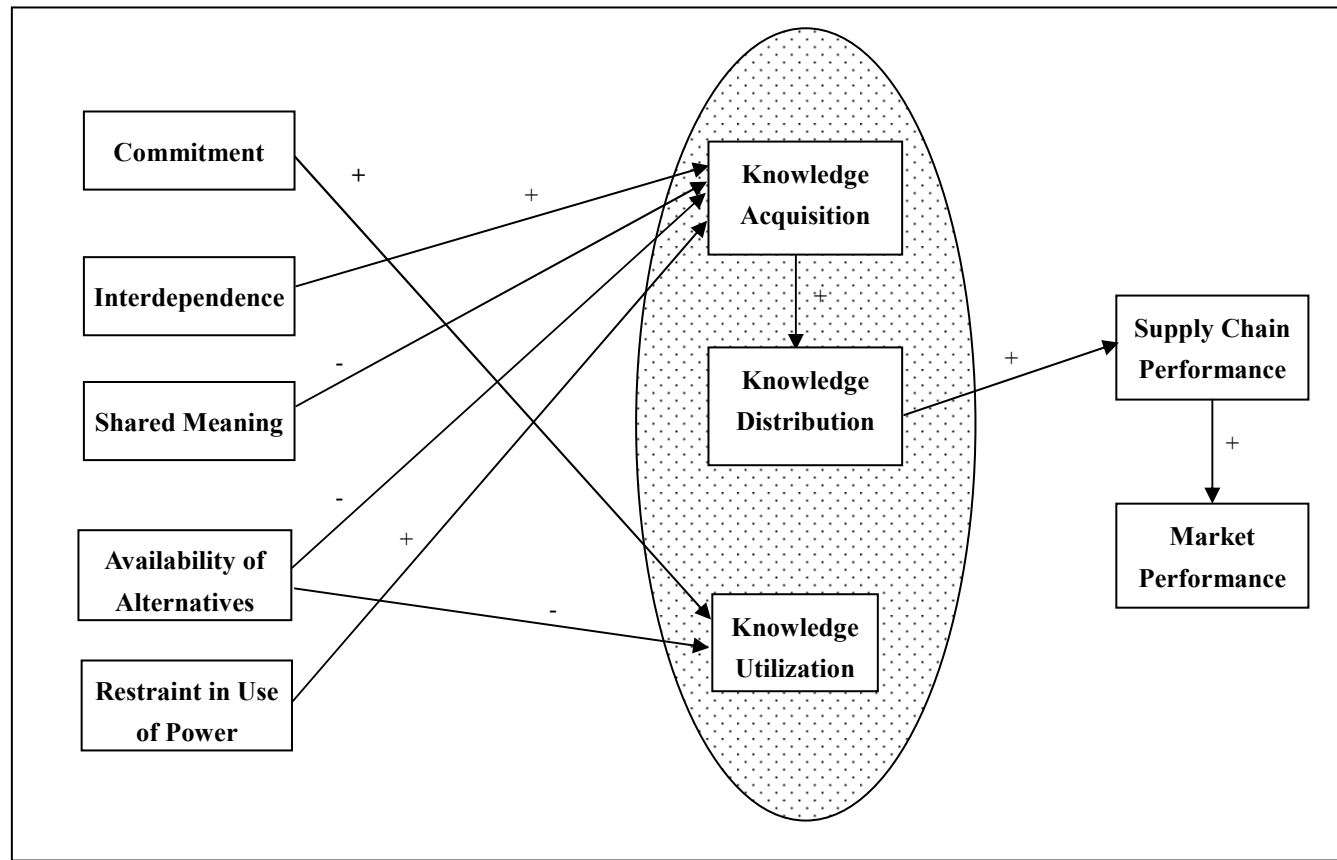


Figure 11-5 Significant Relationships in the Whole Model, Non-contracted Sample



As was shown in the cross-tabulation in section 8.5, partner firms with shorter histories are more likely to rely on a written contract to safeguard the partnership. This observation appears to be linked with interesting findings from the empirical data. Firstly, shared meaning was found to play opposite roles in the knowledge transfer for contracted partnerships and non-contracted partnerships. For firms in contracted partnerships, a higher level of shared meaning between partners did support the knowledge acquisition of focal firms. Surprisingly, for firms without a written contract with supply chain partners, a higher level of shared meaning was linked with less knowledge acquisition. The question arises as to why shared meaning become less important to partnerships without a contract. One possible explanation is that in the supply chain network of Baogang, partnerships which need a written contract to guard the relationship, also requires a higher level of shared understanding to foster the cooperation. Given that the matured partnerships tend to rely less on the written agreements, the need for a written agreement also means that there are still gaps between supply chain partners. On the other hand, where partnerships give less emphasis to a written agreement, this may also indicate that participants have already developed significant levels of common goals and shared understanding of the business. In such circumstances, shared meaning will no longer be a significant factor in the knowledge transfer of supply chain partners.

Secondly, compared with contracted partnerships, for firms without a written contract with supply chain partners, interdependence between partners was found to play a more important role in knowledge acquisition. This suggests that for partners without a written contract, it is the need for a mutual contribution from each party that will guide the joint learning activities. Without the guide of a written agreement, partners are more likely to engage in knowledge exchange activities when both sides can supply valuable input to the relationship (Dussauge et al., 2000).

Thirdly, for supply chain partnerships where a contract is still needed to safeguard the

relationship, commitment to the relationship was found to limit knowledge utilization. Given that commitment is a measure of willingness and an expectation of continuation of the partnership, more commitment from both sides is also accompanied by a sense of stability. For firms in Baogang's supply chain, it seems that such a sense of stability has decreased the need to put supply chain knowledge into immediate use. Although more knowledge will be disseminated within the organization, a more secure partnership will also delay the use of knowledge by partners, since it has become a less urgent task to both parties. On the other hand, where a contract is absent from the supply chain partnership, commitment becomes a more important benchmark for partner firms to evaluate the ongoing relationship. Since the partnership is not bounded by a written agreement, without good commitment from both sides the partnership could end at anytime. Under such circumstances, the level of commitment becomes a main facilitator in the continuity of the partnership and in the firms' willingness to put knowledge into use.

The consistent association between knowledge acquisition and knowledge distribution in both contracted and non-contracted samples confirmed the knowledge creation view, which suggests that the advantages of collaboration extend beyond any formal contract and that knowledge creation activities may emerge from ongoing, informal and unplanned relationships (Hardy et al., 2003). Nevertheless, for firms engaged in non-contracted supply chain partnerships, knowledge distribution did not lead to knowledge utilization. This implies the importance of the written contract in bounding knowledge transfer activities. Although a formal contract is no longer a necessary condition for running the supply chain partnership and cross-boundary knowledge transfer activities, where some form of contract is present, firms are more likely to take external knowledge into their decision making. It is reasonable to argue that when partnerships are loosely bounded without a written contract, the activities of partner firms are also less bounded. Even if the partnership could run smoothly and last for a long time, partner firms may not take the external supply chain knowledge in a serious and systematic manner. Consequently, the effective use of knowledge could be

restricted.

Moreover, having a written contract or not does not limit the benefits that knowledge distribution within a firm can bring to the firm. The findings indicate that, for firms in non-contracted partnerships, even if knowledge distribution does not lead to immediate knowledge use, knowledge dissemination and absorption within the organization can still enhance the supply chain performance of the firm.

## **11.7 Upstream in the Supply Chain vs. Downstream in the Supply Chain**

As Hardy et al. (2003a) highlighted, the position of an actor within a network is associated with specific forms and amounts of capital (economic, social and cultural), which allow actors to direct their own lives and influence others. Equally, the position of the partner firm upstream or downstream in the supply network is likely to lead to different characteristics of interfirm interactions and learning activities. Figure 11-6 and 11-7 illustrate the significant relationships in the upstream and downstream samples.

Upstream in Baogang's supply chain a higher proportion of firms are doing traditional business involving production and processing of raw materials (as was shown in section 8.4). Such businesses are more stable over time and involve less change in process and technology. On the other hand, downstream in the supply chain more firms are involved in production and processing of associated products, such as machinery, automobiles, appliances, which requires much more change and updating of information and technology.

The results of the current study suggested that, upstream in Baogang's supply network, knowledge distribution does not necessarily lead to knowledge utilization. Consistently,

as Nieto and Quevedo (2005) pointed out, technological advances are easier to achieve in some industries than in others, due to the fact that the scientific and technological know-how relevant for each industry advances at different paces and with varying degrees of difficulty. This implies how easy, in terms of time and costs, it is to bring about changes in a given field of practice in a given industry. The empirical findings showed that upstream in Baogang's supply network, because the core businesses of firms lie in the traditional sectors, such as mining, machinery, chemicals, it is rather difficult for upstream partners to make immediate use of supply chain knowledge.

Moreover, knowledge acquisition and knowledge utilization upstream in the supply network has limited effects on firm performance, as opposed to firms downstream in the supply network. This phenomenon partially supports the findings of Hult et al. (2007). According to Hult et al. (2007) firms that focus on developing appropriate knowledge development behaviours are likely to reap greater advantages in turbulent markets, because they are prone to knowledge seeking and establishing the requisite variety needed to operate effectively in turbulent market conditions. As was shown in section 10.4.4, downstream in the supply network, where information and new technology is more essential to the competitiveness of firms, diffused knowledge is more likely to be put into actual use, and such use is more likely to lead to improved supply chain performance. On the other hand, upstream in Baogang's supply chain, knowledge utilization is less certain, which demonstrates the inability of upstream firms' internal mechanisms to exploit new knowledge (e.g. Walter et al., 2007; Easterby-Smith and Prieto, 2008). Nevertheless, more effort in trying to disseminate supply chain knowledge is still beneficial to the performance of upstream partner firms.

As shown in section 8.5, downstream supply chain partnerships tend to be shorter and rely more on written contracts. This is mainly because the businesses downstream in Baogang's supply chain are changing more frequently, thus partner firms need more fixed terms to safeguard the cooperation from uncertainties. Therefore, downstream in

the supply chain, given that the business nature is more varied and volatile, shared meaning is needed to ensure the easy flow of joint knowledge exchange activities (Awazu, 2004). Again, commitment or the expectation of a continuous relationship will delay the necessity of immediate knowledge use, although the relatively more stable relationship will ensure more supply chain knowledge will be disseminated within organizations. On the other hand, upstream supply chain partnership tend to have longer duration, and thus are relatively more mature (see section 8.5). Given that businesses upstream in Baogang's supply chain are more stable and mature, it is indicated from the findings that commitment and shared meaning are no longer playing a positive role in the process of knowledge acquisition. Instead, as was supported by the positive links from trust and interdependence to knowledge acquisition, what upstream firms need in order to harness their joint knowledge transfer activities are mutual trust and the interdependence of each other's capabilities.

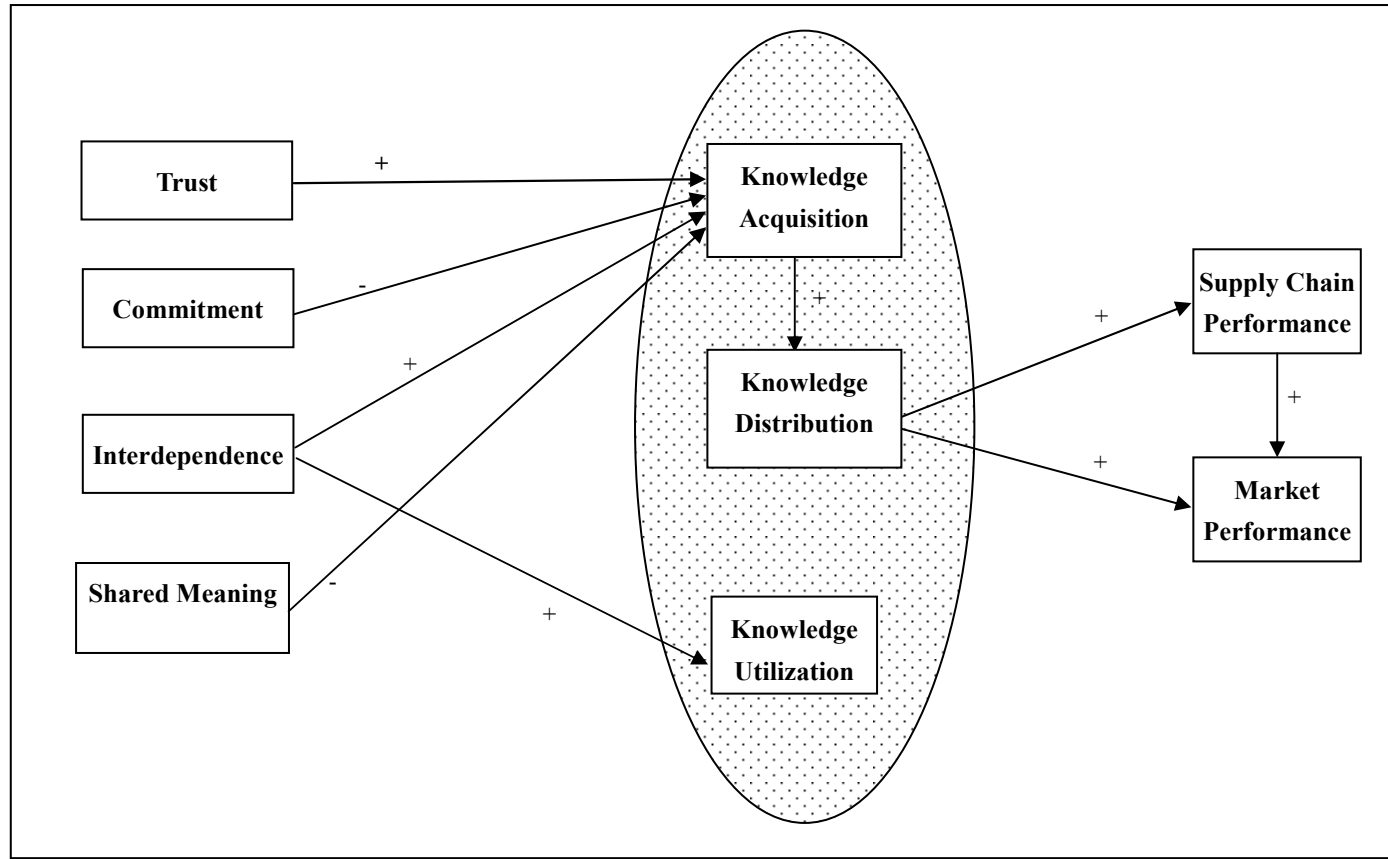


Figure 11-6 Significant Relationships in the Whole Model, Upstream Sample

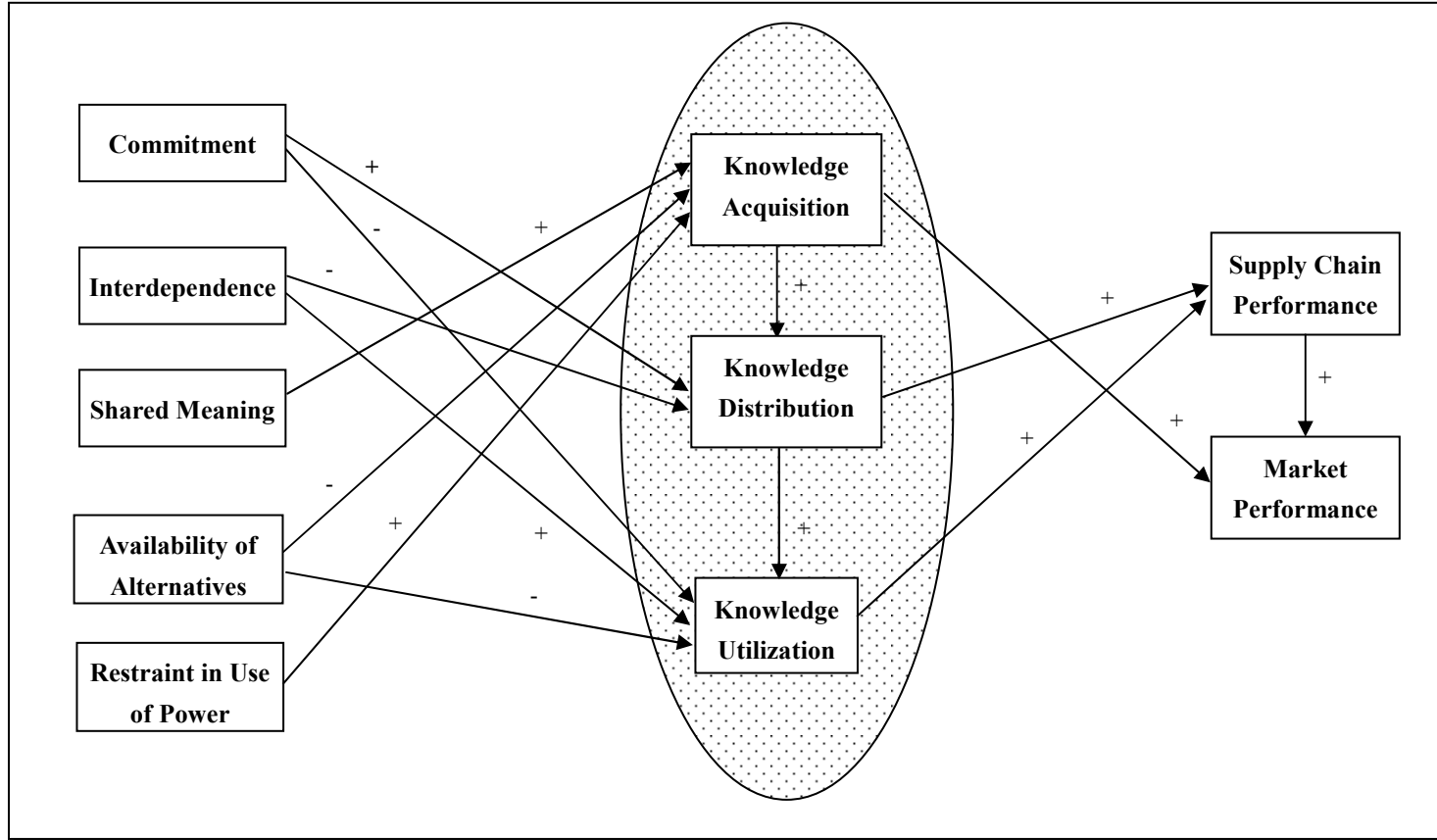


Figure 11-7 Significant Relationships in the Whole Model, Downstream Sample

## 11.8 Comparing Results with Previous Literature

Table 11-2 compares the findings from this current research and findings from previous literature. It demonstrates that some of the empirical findings provided differing evidence from previous literature. Given that the research hypotheses were developed based on previous studies, the findings from Baogang's supply network appeared to challenge some of the classical understanding of interfirm knowledge transfer, for example the role of interfirm trust, shared meaning, and availability of alternatives. It is worth noting, however, that the majority of the previous knowledge transfer studies were based on examinations of dyadic relationships using cross-sectional data (He et al., 2006). The evidence regarding the role of relationship factors was therefore gained mainly from the dyadic relationship context. It appears from the current study that partnership characteristics show different impacts in the supply network context from those in the dyadic supply chain partnership context.

It has been recommended that the potential significance of network context impacting on behaviour in networks needs to be recognized (Harland et al., 2004). According to Uzzi and Lancaster (2003) networks shape knowledge transfer and learning processes by creating channels for knowledge trade and reducing the risk in learning. Dyer and Hatch (2006) found that barriers to knowledge transfer may be embedded in the network context, with the result that networks are a critical unit of analysis for explaining firms' performance, even when networks appear to be similar. For this reason, the conduct and performance of firms can be more fully understood by examining the network of relationships in which they are embedded (Gulati et al., 2000). The current research, therefore, offered some valuable insights into the characteristics of interfirm knowledge transfer in a supply network context.

It is worth noting, however, that different supply networks may have different characteristics (Lamming et al., 2000; Harland et al., 2006). Contextual variables such as market environment, product/process, supply network structure and supply network



strategy, may vary the influence of traditionally recognized relationship factors on the knowledge transfer processes. The nature of the supply network may also be determined by the level of product innovativeness, uniqueness, and complexity (Lamming et al., 2000). Although the current research did not explore all these factors fully, due to the limited space, the empirical findings provide valuable support to the view that the nature of interfirm knowledge transfer varies under different relationship contexts.

Additionally, the supply network of Baogang empirically studied in the current research shared some basic characteristics with an industry cluster as highlighted by the Industry Cluster Theory (Bozarth et al., 2007). The supply chain partners examined in the current study not only interact in the supply chain network of Baogang, but also do business in a geographically concentrated industrial area (see section 7.3.3). Such an industry cluster may not only enjoy unique benefits of interfirm cooperation but also demonstrates different knowledge transfer characteristics (Bozarth et al., 2007). In this sense, research findings from the current study may have useful implications for the understanding of industry clusters within which supply chain firms establish more stable relationships. Given that the current study is mainly focused on supply chain partnerships in a network context, future research may explore this concept further.

Table 11-2 Comparing Current Research Findings and Findings from Previous Literature

Main dimensions	Findings from previous literature	Sample references	Main findings from current study	Cross referencing
Trust	Important indicator of relationship strength; enhances interfirm interface and trustworthiness of knowledge source; facilitating knowledge acquisition and knowledge distribution.	(Soekijad and Andriessen, 2003); (McEvily et al., 2003); (Chen, 2004); (Ramasamy et al., 2006); (Becerra et al., 2008).	Trust did not show its facilitating role in knowledge transfer in supply chain partnership; trust became less important to mature partnerships, but trust was more important to upstream firms to acquire knowledge.	Sections 11.2.1, 11.5 and 11.7
Commitment	Important indicator of relationship strength; enhances continuity of partnership and interfirm interaction; facilitating knowledge acquisition and knowledge distribution.	(Dyer and Nobeoka, 2000); (Kale et al., 2000); (Spekman, Spear, & Kamauff, 2002); (Krause et al., 2007); (Modi and Mabert, 2007).	Commitment had positive effect on distribution of knowledge from supply chain partners but not on acquisition of knowledge; commitment showed varied effects on knowledge utilization: for longer supply chain partnerships or partnerships without contract, commitment facilitated knowledge utilization; for contracted partnership or downstream partnerships higher level of commitment restricted knowledge utilization.	Sections 11.2.1, 11.5, 11.6, and 11.7
Shared meaning	Important indicator of supply chain partnership strength; bridging gap between partners; creating network identity and harmonize cooperation; facilitating knowledge acquisition and knowledge distribution.	(Dyer and Nobeoka, 2000); (Cummings and Teng, 2003); (Awazu, 2004); (Hult et al., 2004); (Buckley et al., 2006).	Shared meaning did not show facilitating role to knowledge acquisition or internalization; For supply chain partnerships with contract or downstream in the supply network, shared meaning was associated with higher level of knowledge acquisition; but for partnership without contract or upstream in the supply network shared meaning was associated with lower level of knowledge acquisition.	Sections 11.2.2, 11.6, and 11.7
Interdependence	Important indicator of relationship strength; determines the vertical interface between supply chain partners, and potential contributions from	(Dussauge et al., 2000); (Dyer and Nobeoka, 2000); (Cummings and Teng, 2003)	Interdependence consistently facilitated knowledge acquisition; but did not show positive impact on knowledge distribution. Instead interdependence showed	Sections 11.2.3, 11.5, 11.6, and 11.7

	partners; facilitating knowledge acquisition and knowledge distribution.		positive influence on knowledge utilization except for long duration partnerships and non-contracted partnership.	
Availability of alternatives	Indicator of balanced power; reducing over-dependence; reducing inordinate leverage of partnership; reduce fear of obsolescing; facilitating knowledge acquisition and knowledge utilization.	(Anderson and Weitz, 1989); (Makhija and Ganesh, 1997); (Maloni and Benton, 2000).	Negative influence of availability of alternatives on knowledge acquisition and utilization was shown. Availability of alternatives appeared to have no significant effect on any stage of knowledge transfer for upstream partnerships; for sample of long duration partnerships, availability of alternatives had no significant effect on knowledge acquisition.	Sections 11.3.1, 11.5, 11.6, and 11.7
Restraint in use of power	Indicator of balanced power; subject restraint in power use in presence of imbalanced power or using power in more constructive ways; ease up the relationship interface; fostering mutual trust; facilitating knowledge acquisition and knowledge utilization.	(Albino et al., 1999); (Kim et al., 2004); (Buckley et al., 2006); (Muthusamy et al., 2008).	Restraint in use of power showed positive impact on knowledge acquisition consistently in the supply network of Baogang, but not on knowledge utilization; No relationship was found between restrained power use and knowledge transfer in upstream supply chain partnership; overall, knowledge transfer upstream was not affected by the relative power relationship.	Sections 11.3.2, 11.5, 11.6, and 11.7
Knowledge acquisition	Stage of knowledge transfer; mechanisms affected by characteristics of partnership interface; precondition to knowledge distribution within firms; enhances supply chain and market performance.	(Dyer and Hatch, 2006); (Molina et al., 2007); (Modi and Mabert, 2007); (Cousins et al., 2008); (Lawson et al., 2009)	Knowledge acquisition showed positive relationship with knowledge distribution; knowledge acquisition had no impact on supply chain performance or market performance except in long duration partnership and downstream partnerships, for which knowledge acquisition does facilitate market performance.	Sections 11.4.1, 11.4.2, 11.5, 11.6, and 11.7
Knowledge internalization	Stage of knowledge transfer; internal learning and knowledge distribution activity; facilitating higher extent of knowledge utilization; enhancing supply chain and market performance.	(Lane et al., 2001); (Crossan and Berdrow, 2003); (Hult et al., 2004); (Hult et al., 2007); (Molina et al., 2007).	Knowledge distribution had positive relationship with knowledge utilization except in non-contracted and upstream supply chain partnerships; knowledge distribution showed positive impact on both supply	Sections 11.4.1, 11.4.2, 11.5, 11.6, and 11.7

			chain performance and market performance, except in non-contracted partnership and downstream partnership, where knowledge distribution only led to improved supply chain performance.	
Knowledge utilization	Stage of knowledge transfer; applying external knowledge or combining external knowledge with existing knowledge; enhancing supply chain and market performance.	(Teece et al., 1997); (Droge et al., 2003); (Soekijad and Andriessen, 2003); (Williams, 2007).	Positive relationship was found between knowledge utilization and supply chain performance, except for partnerships with no contract or upstream in the supply chain; knowledge distribution also showed positive relationship with market performance for short duration supply chain partnerships.	Sections 11.4.1, 11.4.2, 11.5, 11.6, and 11.7
Supply chain performance	Operational performance through out supply chain operations process; improvement in supply chain performance enhances market performance eventually.	(Tan et al., 1998b); (Li et al., 2006); (Lawson et al., 2009).	Improvement in supply chain performance led to improved market performance in the supply network of Baogang.	Sections 11.4.2, 11.5, 11.6, and 11.7

## 11.9 Summary

Overall, the empirical results have led to findings that deviated from the proposed conceptual model. The unique nature of the business of Baogang's supply chain has given opportunities for some new relationships between various indicators of the characteristics of partnership and supply chain knowledge transfer to occur. Trust, commitment and shared meaning have varied effects on knowledge transfer between supply chain partners. Interdependence appeared to be a more important relationship factor that shapes the knowledge transfer activities of supply chain partners. Two dimensions of balanced power in partnership also showed different impacts on the knowledge transfer process. Consistent with the initial hypothesis, knowledge utilization does lead to superior performance. However, it is the dissemination and distribution of knowledge within organizations that generate more stable benefits to firms' performance. Interestingly, when samples were divided according to the partnership duration, contract status, and location within the supply chain, different findings were reached. This implies the varied nature of supply chain knowledge transfer for different supply chain partnerships. Although sometimes surprising, the research findings have paved the way for interesting recommendations to be derived for both practitioners and researchers.

## **CHAPTER 12 CONCLUSIONS**

### **12.1 Preamble**

This chapter concludes the study by summarizing to the research and main research findings. It uses the research findings to generate some recommendations to practitioners. Moreover, it lists the contributions of this research from theoretical, empirical, and methodological perspectives. This chapter also provides some implications for future researchers into interfirm knowledge transfer. The major limitations of the study are pointed out, and some possible future research directions are recommended.

### **12.2 Summary to the Study**

Although considerable research effort has been spent in the area of interfirm knowledge transfer, relatively few studies have concentrated on supply chain partnerships as the conduit of knowledge exchange. Moreover, few prior studies have given enough attention to the particular characteristics of supply chain partnership. This particular research addressed this issue and attempted to clarify the uniqueness of supply chain partnership and thus the unique characteristics of knowledge transfer in supply chain partnerships as compared to those of other interfirm partnerships, such as joint ventures, R&D partnership, and strategic alliances. Attention was paid to how the characteristics of supply chain partnerships could influence the knowledge transfer process, and how knowledge transfer could benefit the performance of firms in various ways.

An intensive review of prior literature was carried out in the area of relationship marketing, operations and supply chain management, interfirm partnership, and organizational learning. As observed from the literature review, supply chain partnerships are typically formed based on the vertical complementarities of firms. A supply chain partnership does not rely on an explicit written contract to bound the relationship and harness the cooperation, and even if a contract is needed, it is often non-targeted and less

specified. In a supply chain partnership, partner firms are more concentrated on achieving operational efficiency from the partnership, which indirectly enhances tangible performance. Those benefits are often less predictable and less quantifiable. Moreover, unlike other interfirm partnerships, a supply chain partnership can often be multilateral or extended into networks. Because of these characteristics, the author concluded that three dimensions of factors shape the characteristics of supply chain partnerships, i.e. relationship strength/magnitude, balanced power, and partnership duration. These dimensions comprehensively determine the characteristics of supply chain partnerships.

The unique characteristics of supply chain partnerships, as compared to those of other types of interfirm partnerships, also helped the author to draw conclusions from the literature about the characteristics of knowledge transfer in supply chain partnerships. Specifically, in supply chain partnerships, knowledge transfer typically takes place due to the vertical complementarities of partners. It is the interdependence that calls upon the need for knowledge exchange. Due to the loosely bounded nature of supply chain partnerships, knowledge transfer in supply chain partnerships is also non-targeted and less guaranteed. The extension of supply chain partnerships into potential multilateral or network-based relationships also raises the need for knowledge protection. All these characteristics suggested that knowledge transfer in supply chain partnerships is better understood as a multi-stage process rather than a black box. Knowledge acquisition, knowledge internalization and knowledge utilization are the three likely processes through which supply chain knowledge will be put into use by the focal firm.

Based on the research models as well as on research findings derived from previous literature, a theoretical model of knowledge transfer in supply chain partnerships was developed. The model proposed the influence of various partnership attributes on the process of knowledge transfer, as well as the influence of knowledge transfer on a firm's performance. The model depicts the hypotheses of positive effects of stronger and more balanced supply chain partnerships on interfirm knowledge transfer and the benefits which knowledge transfer can bring to a firm's performance.

Through a systematic process of construct operationalization, survey development and execution, empirical data was collected from the supply chain network of Baogang Group. After a series of tests of validity and reliability, as well as cross-validation of measurement models, the empirical data was fitted into structure equation models (SEM) to test the main hypotheses.

### **12.3 Summary of Key Research Findings**

It was quite interesting to see that the empirical testing supported a small number of research hypotheses. As was discussed previously (see section 11.2), the final sample of responding firms contained relatively more mature supply chain partnerships in a mature industry. One of the consequences empirically is that trust and shared meaning have shown limited support of the conduct of knowledge transfer in supply chain partnerships. Generally, partners in Baogang's supply chain seem no longer to worry about trust and shared understanding when considering sharing and transferring knowledge between themselves (see section 11.2.1 and 11.2.2). Despite that, interdependence played a more important role in shaping the supply chain partnership as well as the knowledge exchange activities (see section 11.2.3). As indicated by the research findings, a higher level of mutual dependence appears to increase the willingness of firms to carry out joint exchange activities, and increase the chances that supply chain knowledge will be put into use. This confirmed the view that inter-organizational relationships are not just about trust, but are about the optimal management of situations (Cousins, 2002). It is the mutual contributions that matter more to firms in the context of Baogang's supply network. Consistently, firms were more likely to carry out joint learning activities and also use external knowledge when supply chain partners play an irreplaceable role in their business (see section 11.3.1). However, these irreplaceable partners need to have the intention to restrict their excessive power to ensure knowledge acquisition can be carried out smoothly (see section 11.3.2).



Another interesting finding is that a higher level of interdependence appeared to have migrated learning activities from within the organizations to interfaces between organizations (see section 11.2.3). Supply chain partners are more likely to carry out learning activities jointly rather than within organizations when both parties can offer significant contributions to each other. On the other hand, it was found that higher levels of commitment between partners generally enhance knowledge distribution (see section 11.2.1). Thus it could be argued that a stable and continuous partnership characterized by a higher level of commitment will ensure the participants have a greater chance of absorbing and disseminating more supply chain knowledge.

For the responding firms in general, the three stages of knowledge transfer appeared to be sequential processes, as higher knowledge acquisition lead to higher knowledge distribution, which in turn lead to a higher level of knowledge utilization (see section 10.3.1.2 and 11.4.1). Nevertheless, it was found that knowledge acquisition activities do not directly generate improvement in either supply chain performance or market performance. It was knowledge distribution activities that appeared to enhance a firm's performance more consistently (see section 11.4.2). Immediate use of knowledge does show a positive influence on the supply chain performance of firms, although it does not improve market performance directly (see section 11.4.2). Overall, although firms may benefit differently from each stage of knowledge transfer, knowledge transfer activities did show a positive influence on a firm's performance.

When responding firms were divided according to the duration of their supply chain partnership, it was found that partnerships with longer histories tended to develop from the excessive levels of trust into a culture of over-reliance (see section 11.5). Based on the researching findings, it could be argued that getting used to the partner will limit the incentive of supply chain firms to explore and exploit the partnership further. Nevertheless, it was found that for longer partnerships, a greater level of shared understanding and the stability of the relationship could still enhance the relevance of supply chain knowledge to the focal firm, so that more knowledge could be put into

actual use (see section 11.5). The positive link between knowledge distribution and a firm's performance in the long duration sample implied that when partnerships have lasted for long enough, firms will develop dynamic capabilities from joint learning activities, these capabilities not only enhance the market performance of the firm but also increase the chance that external knowledge will be absorbed within the organization (see section 11.5). Based on the empirical findings it could be argued that for older partnerships, it is those dynamic capabilities developed from the joint knowledge exchange activities, rather than knowledge use, which are more important for the competitive advantage of the firm.

The empirical study acknowledged that supply chain partnerships do not need to rely for the most part on a fixed written contract to secure the partnership (see section 3.5.2). Therefore, the sample of respondents was divided according to the contract status of the partnerships. Given that longer partnerships appeared to have relied less on a written contract, these non-contracted partnerships also tended to be relatively more mature (see section 8.5), such that shared meaning was no longer a facilitator to their joint learning activities. However, for non-contracted partnerships, interdependence on each other's capabilities was still found to be shaping the joint knowledge exchange of partner firms (see section 11.6). Moreover, the empirical findings suggested that commitment played opposite roles in knowledge utilization for the contracted sample and the non-contracted sample (see section 11.6). It could therefore be argued that for partnerships secured by written contracts, an excessive level of commitment delays the immediate use of knowledge. On the other hand, when an explicit contract is absent, commitment from partners appears essential to the continuity of the partnership and also to knowledge use by the supply chain partners. Therefore, it is implied from the empirical findings that, although a written contract is not a necessary condition for effective supply chain partnerships, without the contract supply chain partners may not take external supply chain knowledge seriously into their decision making. This finding helps to support the view that the direct usage of supply chain knowledge is never guaranteed.

Since Baogang's business (Steel Production and Processing) is at the middle of the upstream sector of a supply chain (compared with consumer products or retail), the supply chain network of Baogang contained firms in very different sectors. For instance, upstream of Baogang, firms are doing more business surrounding raw materials, whilst downstream firms are concentrated in more advanced production or processing of products (see section 8.4). The different nature of the businesses also produces different needs for knowledge and information. It was found that downstream in the supply chain, partnerships are relatively shorter and rely more on written contracts, possibly as a consequence of the level of change and uncertainty involved in their businesses (see section 8.5). The current research takes account of the responding firms' location in the supply chain and found that knowledge is more likely to be put into immediate use downstream in the supply chain as opposed to upstream in the supply chain (see section 11.7). The empirical findings further suggest that shared meaning is needed for downstream partnerships to facilitate joint knowledge sharing activities. Moreover, commitment ensures a higher level of knowledge dissemination within organizations but again delays the immediate use of knowledge by downstream partners (see section 11.7). On the other hand, it was found that partnerships upstream in the supply chain lasted for relatively longer and were relatively more mature (see section 8.5). Given this condition, it appeared that upstream firms don't rely on shared meaning or commitment to enable knowledge transfer. However, upstream in the supply chain, interdependence and mutual trust were still found to facilitate the knowledge acquisition activities (see section 11.7).

## **12.4 Implications for Practitioners**

Implications generated from the research findings can be viewed from two perspectives: either in terms of knowledge management or partnership management.

### **12.4.1 Management of Knowledge Transfer**

According to Easterby-Smith and Preito (2008), there is mutual interaction between

learning processes, dynamic capabilities and knowledge management. Managers need to be aware that knowledge transfer is not an isolated mission for the company. It is mostly when knowledge management motivates and supports people and collective activities that dynamic capabilities can be triggered, whilst the dynamic capabilities of a firm will influence the strategic choice between knowledge management initiatives. On the other hand, the dynamic capabilities and knowledge management mechanisms will shape the learning processes within and between organizations (Easterby-Smith and Prieto, 2008). It is believed that the interaction between these factors will determine firms' ability to generate sustained performance improvements. For this reason, managers should work towards creating a learning atmosphere, management routines, and mechanisms to enable dynamic capabilities, knowledge management, and learning processes to facilitate each other (Dosi et al., 2008).

One of the main implications for practitioners, based on the current study (at least in the context of Baogang's supply chain), is that knowledge transfer with supply chain partners does lead to better performance. Even if the knowledge transfer may not bring direct benefits to the market performance, as is always preferred, effective knowledge transfer does lead to improvement in firms' supply chain operations. Such improvement in the longer term will benefit the market performance eventually. For this reason, management should allow knowledge exchange programs to take place with supply chain partners.

However, as highlighted by Sorenson (2003), managers and employees will normally observe the relationship between actions and the outcomes that ensue, and they will select those activities that appear to generate the desired effects most consistently and effectively. Unfortunately, the immediate benefits to market performance of knowledge acquisition and utilization sometimes will not be realized (as least in the context of Baogang's supply network). Consequently, this calls upon management efforts to facilitate the opportunities for operation improvement from knowledge transfer activities to realize its potential. For instance, Lawson et al. (2009) suggested that product development managers should build social ties between inter-organizational development

teams to increase the flow of knowledge which contribute to both product development outcomes and financial performance. Moreover, management needs to be knowledgeable about the firm's resource needs and incorporate that information into the enterprise's programmes to remain competitive (Modi and Mabert, 2007).

Managers need to be aware that learning should be viewed as a social process (Uzzi and Lancaster, 2003), new knowledge often grows out of the ongoing social interaction that occurs in ongoing collaborations (Hardy et al., 2003). Formal socialization mechanisms such as regular team meetings, supplier conferences, cross-functional teams and co-location are recommended to managers as a means of improving business outcomes (Cousins et al., 2008). Nevertheless, managers need to be aware that not only formal mechanisms but also informal mechanisms, such as communication guidelines, social events both during and outside working hours, will facilitate interfirm knowledge transfer (Mason and Leek, 2008; Lawson et al., 2009). As different forms of knowledge may be adopted under informal mechanisms, a firm's knowledge base is more likely to be enriched (Mason and Leek, 2008). It is worth noting that some informal social mechanisms may take place naturally outside of work, but they are better enabled by formal social mechanisms, where opportunities will be created for informal activities to happen (Cousins et al., 2006). Where both hard and soft knowledge transfer mechanisms have been invested in, the effectiveness of the supply network will be better leveraged (Mason and Leek, 2008).

Apart from interfirm joint activities, the importance of boundary spanners and knowledge brokers should not be ignored. This is not only because of their potential to acquire and/or disseminate skills, but also due to the fact that they are more likely to possess technical competency (amongst other things) and as such are more likely to engage in learning and knowledge transfer activities of a technical nature (Giannakis, 2008).

Noticeably, acquiring knowledge is not the end of the mission. Simply putting personnel into knowledge exchange programs or joint learning activities will not naturally lead to

superior performance (Oh et al., 2004). It is when more efforts are put into disseminating and using the knowledge, that supply chain knowledge and best practices will benefit firms more (Molina et al., 2007). In this sense, knowledge transfer should not be viewed as a one-off campaign, rather it should be viewed as a continuous process that managers should pay more attention to.

Managers also need to be aware that knowledge which can be used directly is often rare, or even if is used it may not generate immediate market benefits. However, managers should not ignore the value of continuous updating of supply chain knowledge (e.g. Bessant et al., 2003) and should not hesitate in disseminating relevant knowledge within the organization (e.g. Molina et al., 2007). This is because the process of knowledge transfer and learning may be more valuable to the organization than the knowledge itself. Continuous learning and updating new knowledge are important means to achieve sustainable competitive advantage. Allowing the organization to update its knowledge continuously will strengthen its capabilities to explore more new knowledge and exploit existing knowledge and technology better.

Given that knowledge acquisition activities may not lead to improved performance of firms, managers also need to be aware that firms are not always prepared for knowledge transfer activities. To most within the organization, knowledge transfer may still be an abstract new terminology. People may not see the value of such an activity. The situation may become worse when knowledge utilization is not always linked to immediate benefits to the firm's performance. Managers who want to promote interfirm knowledge transfer activities may find this stressful. Therefore, commitment from top management should be gained first to put knowledge transfer and interfirm learning on the agenda. After that, a shared vision throughout the organization is needed to allow the effective knowledge transfer to happen (Wijk et al., 2008). In this sense, a top-down approach is needed at the beginning of the knowledge transfer program, but once the activities are legitimized a bottom-up approach is preferred.

Moreover, mechanisms for deploying new knowledge should be cultivated in-house. Managers need to be aware of the importance and benefits of putting valuable new knowledge into use and work towards developing a more innovative working environment. Managers should not be afraid of changes in practice. Instead, they should stand back from the daily routine and think more carefully about the adaptation to a changing environment and the possibilities of adopting new ideas (Dosi et al., 2008).

Compared with firms involved in businesses that require frequent updating of technology and processes, firms that are pursuing more traditional businesses are more likely to ignore the value of learning from supply chain partners (as indicated by different effects of knowledge transfer on firm performance upstream and downstream in the supply chain in the case of Baogang). Managers should make more effort to change the organization's attitude and help staff from top to bottom of the organization be aware of the value of continuous learning. Acquisition of new ideas should be highlighted and rewarded. Even if the new idea cannot be put into direct use, providers of such new ideas should not be criticised. Thus, an atmosphere of active learning during supply chain operations can be created.

#### **12.4.2 Management of Supply Chain Partnerships**

As suggested by Cousin and Spekman (2003), cost savings are laudable and necessary but do not afford the full benefits gained from collaborative relationships. The true gains are when technology, expertise, and experience flow among the supply chain partners so that knowledge is shared, even jointly developed, thereby giving the entire supply chain a competitive advantage. Nowadays, as the unit of competition changes from organization against organization to chain against chain under supply chain management, being a learning organization itself will not be sufficient to the complex and dynamic business environment. Instead, being in a learning chain is to be encouraged. Through managing knowledge in supply chains firms will facilitate the innovation and creativity essentially required to thrive in the unpredictable business environment of today (Maqsood et al.,

2007).

Nevertheless, it is important for managers to realize that supply chain partnerships as a conduit of knowledge transfer can be very complicated. Collaborative relationships are only secured when mutual contributions are realized from both sides (Cousins, 2002). Potential contributions from partners are the foundation for successful joint learning activities to occur. Management, therefore, should highlight and make explicit the contributions from each side when they want to explore the possibilities of knowledge transfer with a supply chain partner.

As Hardy et al. (2003) pointed out, when choosing the form of collaboration which is most appropriate for a particular situation, firms should be aware of the necessary tradeoffs between different kinds of effect. To a mature supply chain partnership, a contract becomes less important as the relationship continues. However, managers should know that the absence of a written contract also makes using new knowledge and best practices more difficult (see section 11.6). Even for an already mature supply chain partnership, the management should be aware of the risk of being too familiar with the partner. Although trust is necessary for the ongoing partnership, trust in each other is sometimes not enough for firms to carry out an effective transfer of supply chain knowledge (see section 11.2.1). Over-reliance on trust sometimes may not be a sustainable solution (Cousins, 2002; Cousins et al., 2006). One key principle is that there is always room for improvement and valuable new ideas can always be learned. Therefore, firms that want to promote a higher extent of knowledge transfer activities should think about more proactive approaches and develop some form of written agenda, which is known and agreed by both sides of the partnership. This will legitimise the knowledge transfer practice and make both organizations more aware of the value of such a practice.

Although it would be much easier to manage an equalized partnership, when a partnership is unbalanced, managers from the weaker side need to know that there could be more incentives for them to learn from the stronger party. “Rely on them and learn



from them” is a possible approach to be followed by the weaker party. The weaker party should try its best to exploit the best practices from its stronger counterpart. On the other hand, for the stronger partner, it is important not to abuse its excessive power or ignore the weaker party. Especially for boundary spanners, they should give more chance for the weaker firm to have a say regarding their cooperation and supply chain operations (Buckley et al., 2006). Giving the weaker party the opportunity to get involved is unlikely to endanger the stronger party’s bargaining power. On the contrary, it will allow both sides to have a better chance of improving current practices (Buckley et al., 2006). It is also a good idea for the stronger partner to initiate and invite frequent mutual talks or joint learning activities, where ideas can be exchanged freely, issues can be raised, and remedies can be discussed. This will benefit the supply chain as a whole as well as the individual firm in the long run.

Similarly to the management of internal knowledge transfer activities, the knowledge transfer with external partners will also benefit from various formal and informal socialization mechanisms. Activities such as supplier conferences, conducting on-site visits, joint buyer/supplier teams were all proved to be effective facilitators of supply chain knowledge transfer (Cousins, 2006). Lamming et al. (2005) proposed the concept of jointly managed transparency in the supply interface to help promote a mutual flow of information and knowledge rather than one-way open-book in the buyer-supplier relationship. In the opinion of Lamming et al. (2004, p.301), supply chain partners may “employ two-way transparency as an element of their commercial relationships and that behaving in such a manner need not necessitate risking commercial instability or vulnerability by opening up in a ‘carte blanche’ manner”, instead “significant benefits may accrue to firms as a result”.

Managers in Baogang’s supply network need to realize that the industry cluster in which their businesses are located provides a wide range of potential benefits. Examples of benefits include better access to specialized employees and suppliers, easier knowledge spillovers, more suitable complementarities, higher levels of innovation and business

formation, and better motivation of supply chain partners (Bozarth et al., 2007). Most importantly, valuable knowledge and best practices could be well embedded in the industry network (Walter et al., 2007). Managers should have more proactive attitudes towards supply chain partners within the cluster to exploit the full potential of Baogang's supply network. To Baogang's managers, the existing supply network growing out from its core businesses has provided essential opportunities to leverage its relationship capitals. Given that the firm's resources and capabilities may be relation-specific and embedded in the supply networks (Dyer and Hatch, 2006), the extended supply network upstream and downstream of Baogang's business should be treated as a key strategic resource to not only achieve immediate business gains but also improve its long-term capabilities (Walter et al., 2007).

## **12.5 Contributions of the Study**

The contributions of this study may be viewed from theoretical perspectives, empirical perspectives and methodological perspectives:

- (1) Theoretically, the current research has made a step forward to differentiate supply chain partnerships and knowledge transfer in supply chain partnerships from other types of interfirm partnerships.
- (2) A logical approach was followed to develop a better understanding of the characteristics of supply chain partnerships and the unique characteristics of knowledge transfer in supply chain partnerships. The author progressed from clarifying the characteristics of supply chain partnerships to clarifying the characteristics of knowledge transfer in supply chain partnerships. This could be a useful approach for subsequent researchers in the area, in that the context of the study should be defined before the theoretical model is developed concerning the nature of knowledge transfer practices.
- (3) This study is one of the first studies to have provided a closer look at the process of knowledge transfer. It looked at the ways partnership characteristics could

influence each stage of knowledge transfer, so that the knowledge transfer process is no longer viewed as a black box. The current research echoed the view of Wiig (1997) that knowledge transfer is a complex process that brings knowledge from various sources to where it can be utilized. It also empirically evaluated the conceptualization of the knowledge-based view of the firm (Grant, 1996b), that knowledge transfer involves both transmission and receipt of knowledge, so that flow and absorption of knowledge are separate stages.

- (4) This research has borrowed the concepts from the school of 'Research Use' for the first time to develop Knowledge Utilization scales in the context of supply chain partnerships (see section 7.6.3). This has been a good trial of conceptualizing knowledge use without specifying the particular type of knowledge so as to avoid exclusion of certain knowledge types.
- (5) This study is also one of the first studies that have taken account of the concept of balanced power in the supply chain partnership and explore the influence of the power relationship on the process of interfirm knowledge transfer.
- (6) It has also made the effort to look at both supply chain performance and market performance of the firm in the context of supply chain partnership, rather than just giving emphasis to one or the other aspect of the performance measures.
- (7) A systematic process of literature review and of the theoretical model development is also recommended. Here an exploratory literature review was used at the beginning to determine the key construct of knowledge transfer in supply chain partnerships. A deductive approach to literature review was then used to determine the exact direction of relationships between different constructs. Since the literature review included a large extent of current research in the area, the literature review itself could be used as a reference base for further research in the area.
- (8) Given that the theoretical model was based on literature developed mainly in Western contexts (such as the U.S., Europe, and Japan) the test of the theoretical model in the context of a Chinese supply chain also provided a good opportunity for the author to evaluate the applicability of the knowledge transfer theory to

different national contexts.

- (9) Empirically, the current research has attempted to explore the current knowledge transfer practices of supply chain partnerships within a large supply network. Since the supply chain partnerships are all from the same industrial context, the analysis is more likely to avoid the confounding effects of variation in company practices. Hence, the result is believed to be more consistent.
- (10) Some systematic new insights were gained for the characteristics of supply chain partnerships and the characteristics of knowledge transfer. These could be used as guidelines for researchers and practitioners to develop further understanding on the issue.
- (11) Since most of the previous knowledge transfer studies have concentrated on downstream firms in the supply chain (e.g. Beecham and Cordey-Hayes, 1998; Dyer and Nobeoka, 2000; Hult et al., 2004), this study has provided new insights into the topic by looking at the supply chain of a steel producing firm which is relatively further upstream in the supply chain.
- (12) Given the importance of the Chinese manufacturing industry to the world economy and the increasing role of Chinese firms in the global supply chain, this research has provided some valuable insights into the current knowledge transfer activities of Chinese firms. The research findings could be used not only by Chinese firms but also Western firms to understand the supply chain operations of Chinese firms.
- (13) Methodologically, this research practised the snowball sampling method to explore a big network of supply chain firms. Such a method has been proved to be an efficient way of surveying respondents linked by business connections or within the same business context. It ensured the relevance of the research sample and a reasonable sample size.
- (14) A complete and systematic strategy of construct development, validation, cross-validation, and model testing was followed in the current research to ensure the quality of the survey data and the quality of the analytical results. This process could possibly be followed by future researchers to develop better survey

data and generate more robust statistical results.

- (15) Since the survey was conducted in China, this research followed a systematic approach of translation-back-translation to develop the Chinese version of the survey. Taking account of the fact that not many transnational studies in the area have followed such an approach, this research provides further evidence that such an approach can be a reliable and systematic one to follow.

## **12.6 Implications for Researchers**

There are a number of implications that could be considered by fellow researchers in developing interfirm knowledge transfer studies:

- (1) The current research has provided further evidence that interfirm knowledge transfer is largely contextual (Harland et al., 2004). The nature of interfirm knowledge transfer is dependent upon the characteristics of the interfirm relationship and other contextual factors such as market environment, product/process, and partnership strategy. The same conceptual model may generate different results in different target groups. Therefore, it is essential for researchers to define the context of the interfirm relationship clearly before theoretical or empirical work is conducted. Clarification of the research context is one of the necessary conditions for more robust and generalizable results.
- (2) Interfirm knowledge transfer can be a very complex issue, which is contextual, involves multiple entities and complex mechanisms, and is influenced by various influential factors. In reality, it is difficult to distinguish clearly between various influencing factors. Sometimes researchers may find complex results generated from empirical data. It is a good idea for researchers to be aware of such complexity and be prepared for it at the design stage of the study. More effort is therefore needed to clearly define the construct, to carefully develop the research instrument, and to avoid oversimplifying the issue.
- (3) A reasonable sample size has always been a main restriction for empirical researchers. Getting access to a large number of target respondents is a major

challenge for most researchers. Nonetheless, researchers can avoid the risk of approaching a large number of organizations at one time by getting initial access to one important respondent highly relevant to the study. After the initial support and collaboration is gained, researchers can extend the sample by a snowball sampling method. Although the research sample may not be equally as robust as random sampling, this method has the advantage of obtaining a bigger sample size within the same context. In some cases, depending on the aims of the research, such a method could be an efficient and effective option.

- (4) The deviation of Baogang's survey results from the initial hypotheses underlines the need for careful interpretation of statistical results. As suggested by Buchanan and Bryman (2007), the choice of research methods, shaped by aims, epistemological concerns, and norms of practice, is also influenced by organizational, historical, political, ethical, evidential, and personal factors. Because many researchers still rely on a one-off survey to collect cross-sectional data, most of the time the data collected is only a snapshot of a fraction of the reality (although many researchers may claim an adequate representation of the research population), which involves addressing coherently the organizational, historical, political, ethical, evidential, and personal factors relevant to an investigation. In this sense, the deviation of survey results in one single study does not mean that the initial hypotheses are wrong. As long as the hypotheses are based on an extensive review of previous literature, the results could be a reflection of the particular situation of the target research group.

## **12.7 Limitations**

As with most empirical studies this research has its limitations:

- (1) Similar to many survey-based empirical studies, this research also suffers from common method bias to some extent. In this research respondents were asked to rate not only scales of partnership characteristics, but also scales of knowledge

transfer and performance of firms. As suggested by Podsakoff et al. (2003, p. 882) one of the main sources of common method bias is the common rater effects which refer to the artificial covariance between the predictor and criterion variables produced by the fact that the same respondent is providing the measure of both these variables. However, due to the restrictions of time and resources available to a single researcher, obtaining measures from different sources is not realistic. Nonetheless, this researcher still tried possible remedies to improve the situation, for example by following a total design method, carefully designing the scale, and trying to randomize the items. All the efforts ensured that the common rater effects were kept at a minimum level.

- (2) Another related issue is referred to as key informant bias. Although the key informant method is often deemed to be acceptable (Chau and Tam, 1997), the richness of the information from only one informant from each respondent company is still questionable. As the firm was chosen as the unit of analysis, the perceptions of only one manager do not necessarily represent the situation of the whole organization (Tornatzky and Klein, 1982). Thus, it is often deemed better to include several respondents from different levels of the responding firm, and even have interviews with the respondents to get richer views on the companies' real situation. However, given the resource and time limit this was not achievable.
- (3) In addition, the snowball sampling method also created a possible problem in getting a greater proportion of more favourable responses. Since the survey was promoted through a central responding firm, most of the respondents had interrelationships with each other. Therefore, when distributing the survey, respondents may have had concerns over accidental disclosure of their responses to related firms. Thus, they may have provided more desirable answers to the survey. However, since anonymity of individual responses was largely ensured during the survey process, this effect was kept to a minimum.
- (4) Although the snowball sampling method is an effective way of generating a good sample size within a large supply chain network, this method also created a possible bias in the sample selection. The initial group of respondents were asked

to report on one of the most important supply chain partners they had. However, it was more likely for them to select partnerships that they knew better and thus were relatively more mature. This really created a dilemma for the author. On the one hand, the author wants to survey a sample with a varied level of characteristics like a spectrum. On the other hand, the author has to ensure the sample size is reasonable. In this research, to ensure a good sample size, the author had to sacrifice some level of variety of partnership. This however could also be considered as a strength of this study, since more partnerships were included in the sample.

- (5) Since knowledge transfer is a dynamic process, the cross-sectional method of survey study limited the capability of this study to identify changes in the factors in the process of knowledge transfer. To better monitor the process of how interfirm relationships evolve and how the knowledge transfer processes develop, a longitudinal method would be a useful complementary method.
- (6) Mainly due to the limit of time and access to the target research sample, this research did not carry out a large-scale pilot study before the main fieldwork. Therefore, only a small scale of pilot test and interview were conducted.
- (7) Ideally both measurement model and the structural equation model should be cross-validated to ensure the quality of test results (Joreskog and Sorbom, 1989). However, only the measurement model was cross-validated in the current research. The limited sample size and the relatively large number of variables involved in the conceptual model restricted the multi-sample cross-validation of the structural equation models. Nevertheless, Expected Cross-validation Index (ECVI) (Browne and Cudeck, 1989) was used to evaluate the stability of the structural equation model across samples.
- (8) Finally, because this study was carried out in the supply chain network of Baogang Group, the results of this study may be contextual, which could limit the generalizability of the research results into other industry contexts. However, this is a common issue in the area of business and management research.



## 12.8 Directions for Future Research

The current study mainly focused on the interfirm partnership characteristics. Since nature of intra-organizational management could also influence the process of inter-organizational knowledge transfer, future research could place more emphasis on how internal factors, such as shared vision within organizations, open mindedness and the learning intention of the organization, and its absorptive capacity, could affect the interfirm knowledge transfer in supply chain partnerships. Furthermore, given that ‘availability of alternatives’ and ‘restraint in use of power’ have demonstrated varied effects on supply chain knowledge transfer, they could possibly be treated as two different factors. Further research could turn its attention to identifying the more consistent attributes of the power relationship and its influence on interfirm knowledge transfer. Moreover, this research has made a good initial attempt at examining the nature of knowledge utilization, and future researchers could explore the issue further to gain more insight into the mechanisms of knowledge utilization, the factors influencing it and the ways they could benefit the firm’s performance.

It is worth noting that although some of the relationship factors were found to be non-significant in the current research, it does not mean that they will be non-significant in other research contexts as well (for example, in a different industry sector, at a different location in the supply chain, and in a different national context). To ensure the theoretical model is more robust and more generalizable, future research is encouraged to extend the study into other industry contexts. For instance, researchers could explore the knowledge transfer in a supply chain which is more downstream in the industrial process (compared to Baogang’s supply chain). Alternatively, researchers could examine the theoretical model in other industrial sectors to verify the applicability of the theoretical model in other industry contexts.

Since this research was conducted within one industrial district, there was not much difference between supply chain partners in terms of culture and physical distance. Given

that supply chain operations are engaging more and more international players, future research could extend the sample into an international supply chain context. Thus researchers could explore what the supply chain knowledge transfer mechanism will be in an international context and how cultural differences and physical distances will moderate the knowledge transfer process in those supply chain partnerships.

Finally, a longitudinal study could be carried out in the future to explore the development of supply chain partnerships and how knowledge transfer mechanisms build up over time. More insights could therefore be gained into the dynamic process of knowledge transfer and the processes through which business organizations change and gain from knowledge transfer activities.

## REFERENCES

- Albino, V., Garavelli, A. C., and Schiuma, G. (1999). Knowledge transfer and inter-firm relationships in industrial districts: The role of the leader firm. *Technovation*, **19**, 53-63.
- Allison, P. D. (2002). *Missing data*. Thousand Oaks, CA: Sage Publications.
- Almeida, P. (1996). Knowledge sourcing by foreign multinationals: Patent citation analysis in the U.S. Semiconductor industry. *Strategic Management Journal*, **17**(Winter special issue), 155-165.
- Amara, N., Ouimet, M., and Landry, R. (2004). New evidence on instrumental, conceptual, and symbolic utilization of university research in government agencies. *Science Communication*, **26**(1), 75-106.
- Anand, B. N., and Khanna, T. (2000). Do firms learn to create value? The case of alliances. *Strategic Management Journal*, **21**(3), 295-315.
- Anastas, J. W., and MacDonald, M. L. (1994). *Research design for social work and the human services*. New York: Lexington.
- Andersen, P. H., and Christensen, P. R. (2000). Inter-partner learning in global supply chains: Lessons from novo nordisk. *European Journal of Purchasing & Supply Management*, **6**, 105-116.
- Andersen, P. H., and Kumar, R. (2006). Emotions, trust and relationship development in business relationships: A conceptual model for buyer-seller dyads. *Industrial Marketing Management*, **35**(4), 522-535.
- Anderson, E., and Weitz, B. (1989). Determinants of continuity in conventional industrial channel dyads. *Marketing Science*, **8**(4), 310-323.
- Anderson, E., and Weitz, B. (1992). The use of pledges to build and sustain commitment in distribution channels. *Journal of Marketing Research*, **29**(1), 18-34.
- Anderson, J. C., and Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin*, **103**, 411-423.

- Anderson, J. C., and Narus, J. A. (1990). A model of distributor firm and manufacturer firm working partnerships. *Journal of Marketing*, **54**(1), 42-58.
- Appleyard, M. M. (1996). How does knowledge flow? Interfirm patterns in the semiconductor industry. *Strategic Management Journal*, **17**(Winter special issue), 137-154.
- Argote, L., and Ingram, P. (2000). Knowledge transfer: A basis for competitive advantage in firms. *Organizational Behavior and Human Decision Processes*, **82**(1), 150-169.
- Argote, L., McEvily, B., and Reagans, R. (2003a). Introduction to the special issue on managing knowledge in organizations: Creating, retaining, and transferring knowledge. *Management Science*, **49**(4), 5-8.
- Argote, L., McEvily, B., and Reagans, R. (2003b). Managing knowledge in organizations: An integrative framework and review of emerging themes. *Management Science*, **49**(4), 571-582.
- Argyres, N. S., and Silverman, B. S. (2004). R&D, organization structure, and the development of corporate technological knowledge. *Strategic Management Journal*, **25**(8-9), 929-958.
- Argyris, C., and Schon, D. A. (1978). *Organizational learning*. Reading, MA: Addison-Wesley.
- Aulakh, P. S., and Kotabe, M. (1997). Antecedents and performance implications of channel integration in foreign markets. *Journal of International Business Studies*, **28**(1), 145-175.
- Awazu, Y. (2004). Informal network players, knowledge integration, and competitive advantage. *Journal of Knowledge Management*, **8**(3), 62-70.
- Bagchi, P. K., and Virum, H. (1996). European logistics alliances: A management model. *International Journal of Logistics Management*, **7**(1), 93-108.
- Bagozzi, R. P., and Yi, Y. (1988). On the evaluation of structural equation models. *Journal of Academy of Marketing Science*, **16**(1), 74-94.
- Bagozzi, R. P., Yi, Y., and Phillips, L. W. (1991). Assessing construct validity in organizational research. *Administrative Science Quarterly*, **36**, 421-458.

- Ballou, R. H. (2004). *Business logistics/supply chain management: Planning, organizing, and controlling the supply chain* (5th ed.). New Jersey, Upper Saddle River: Pearson Education International.
- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, **17**(1), 99-120.
- Barney, J. B. (1996). The resource-based theory of the firm. *Organization Science*, **7**(5), 469.
- Bates, H., and Slack, N. (1998). What happens when the supply chain manages you? A knowledge-based response. *European Journal of Purchasing & Supply Management*, **4**(1), 63-72.
- Beamon, B. M. (1999). Measuring supply chain performance. *International Journal of Operations & Production Management*, **19**(3/4), 275-292.
- Becerra, M., Lunnan, R., and Huemer, L. (2008). Trustworthiness, risk, and the transfer of tacit and explicit knowledge between alliance partners. *Journal of Management Studies*, **45**(4), 691-713.
- Beecham, M. A., and Cordey-Hayes, M. (1998). Partnering and knowledge transfer in the UK motor industry. *Technovation*, **18**(3), 191-205.
- Belderbos, R. (2003). Entry mode, organizational learning, and R&D in foreign affiliates: Evidence from Japanese firms. *Strategic Management Journal*, **24**(3), 235-259.
- Bender, S., and Fish, A. (2000). Transfer of knowledge and the retention of expertise: The continuing need for global assignments. *Journal of Knowledge Management*, **4**(2), 125-137.
- Benson, J., and Bandalos, D. L. (1992). Second-order confirmatory factor analysis of the reaction to test scale with cross-validation. *Multivariate Behavioral Research*, **27**(3), 459-487.
- Bentler, P. M. (1989). *EQS structural equations program manual*. Los Angeles: BMDP Statistical Software.
- Bentler, P. M., and Bonnett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, **88**(3), 588-606.
- Bessant, J., Kaplinsky, R., and Lamming, R. C. (2003). Putting supply chain learning into

- practice. *International Journal of Operations & Production Management*, **23**(2), 167-184.
- Beyer, H. M., and Trice, H. M. (1982). The utilization process: A conceptual framework and synthesis of empirical findings. *Administrative Science Quarterly*, **27**, 591-622.
- Bhattacharya, R., and Devinney, T. M. (1998). A formal model of trust based on outcomes. *Academy of Management Review*, **23**(3), 459-472.
- Bhattacharjee, A. (2002). Individual trust in online firms: Scale development and initial test. *Journal of Management Information Systems*, **19**(1), 211-241.
- Bierly, P. E., Kessler, E. H., and Christensen, E. W. (2000). Organizational learning, knowledge and wisdom. *Journal of Organizational Change Management*, **13**(6), 595-618.
- Boland, R. J., Singh, J., Salipante, P., Aram, J. D., Fay, S. Y., and Kanawattanachai, P. (2001). Knowledge representations and knowledge transfer. *Academy of Management Journal*, **44**(2), 393-417.
- Bollen, K. A., and Hoyle, R. H. (1990). Perceived cohesion: A conceptual and empirical examination. *Social Forces*, **69**(2), 470-504.
- Boomsma, A., and Hoogland, J. J. (2001). The robustness of LISREL modeling revisited. In S. d. T. R. Cudeck and D. Sorbom (Eds.), *Structural equation models: Present and future. A festschrift in honor of Karl Joreskog* (pp. 139-168). Chicago: Scientific Software International.
- Bornemann, M., and Sammer, M. (2003). Assessment methodology to prioritize knowledge management related activities to support organizational excellence. *Measuring Business Excellence*, **7**(2), 21-28.
- Bowersox, D. J., Closs, D. J., and Cooper, M. B. (2002). *Supply chain logistics management*. London: McGraw-Hill.
- Bowersox, D. J., Closs, D. J., and Stank, T. P. (1999). *21st century logistics: Making supply chain integration a reality*. Oak Brook, IL: Council of Logistics Management.
- Bozarth, C., Blackhurst, J., and Handfield, R. (2007). Following the thread: Industry

- cluster theory, the New England cotton textiles industry, and implications for future supply chain research. *Production and Operations Management*, **16**(1), 154-157.
- Bray, J. H., and Maxwell, S. E. (1985). *Multivariate analysis of variance*. Beverly Hills, CA: Sage Publications.
- Brewer, P. C., and Speh, T. W. (2000). Using the balanced scorecard to measure supply chain performance. *Journal of Business Logistics*, **21**(1), 75-93.
- Browne, M. W. (1984). Asymptotically distribution-free methods in the analysis of covariance structures. *British Journal of Mathematical and Statistical Psychology*, **37**, 62-83.
- Browne, M. W. (1987). Robustness of statistical inference in factor analysis and related models. *Biometrika*, **74**(2), 375-384.
- Browne, M. W., and Cudeck, R. (1989). Single sample cross-validation indices for covariance structures. *Multivariate Behavioral Research*, **24**(4), 445-455.
- Bryant, F. B., Yarnold, P. R., and Michelson, E. A. (1999). Statistical methodology viii: Using confirmatory factor analysis (CFA) in emergency medicine research. *Academic Emergency Medicine*, **6**(1), 54-66.
- Bryman, A., and Bell, E. (2003). *Business research methods*. New York: Oxford University Press.
- Buchanan, D. A., and Bryman, A. (2007). Contextualizing methods choice in organizational research. *Organizational Research Methods*, **10**, 483-501.
- Buckley, P. J., Clegg, J., and Tan, H. (2006). Cultural awareness in knowledge transfer to China - the role of Guanxi and Mianzi. *Journal of World Business*, **41**(3), 275-288.
- Bullinger, H.-J., Kuhner, M., and Hoof, A. V. (2002). Analysing supply chain performance using a balanced measurement method. *International Journal of Production Research*, **40**(15), 3533-3543.
- Burnes, B., and Steve, N. (1996). Understanding supply chain improvement. *European Journal of Purchasing & Supply Management*, **2**(1), 21-30.
- Calantone, R. J., Cavusgil, S. T., and Zhao, Y. (2002). Learning orientation, firm

- innovation capability, and firm performance. *Industrial Marketing Management*, **31**, 515-524.
- Campbell, D. T., and Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin*, **56**(March), 81-105.
- Capello, R. (1999). Spatial transfer of knowledge in high technology milieux: Learning versus collective learning processes. *Regional Studies*, **33**(4), 353-365.
- Cassell, C., and Symon, G. (1994). *Qualitative methods in organizational research: A practical guide*. London: SAGE.
- Cavusgil, S. T., Calantone, R. J., and Zhao, Y. (2003). Tacit knowledge transfer and firm innovation capability. *Journal of Business & Industrial Marketing*, **18**(1), 6-21.
- Chau, P. Y. K., and Tam, K. Y. (1997). Factors affecting the adoption of open systems: An exploratory study. *MIS Quarterly*, **21**(1), 1-21.
- Chen, C.-J. (2004). The effects of knowledge attribute, alliance characteristics, and absorptive capacity on knowledge transfer performance. *R&D Management*, **34**(3), 311-321.
- Cho, D.-S., and Chu, W. (1994). Determinants of bargaining power in OEM negotiations. *Industrial Marketing Management*, **23**, 343-355.
- Chopra, S., and Meindl, P. (2001). *Supply chain management: Strategy, planning, and operation*. Upper Saddle River, N.J.: Prentice Hall.
- Christopher, M. (1998). *Logistics and supply chain management: Strategies for reducing cost and improving service* (2nd ed.). London: FT Prentice Hall.
- CLM. (1998). Oak Brook, IL: Council of Logistics Management.
- Coase, R. H. (1937). The nature of the firm. *Economica*, **4**, 386-405.
- Cohen, W. M., and Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, **35**, 128-152.
- Conner, K. R., and Prahalad, C. K. (1996). A resource-based theory of the firm: Knowledge versus opportunism. *Organization Science*, **7**(5), 477-501.
- Cooper, R. G. (1984). The performance impact of product innovation strategies. *European Journal of Marketing*, **18**(5), 5-54.
- Copacino, W. C. (1996). Seven supply-chain principles. *Traffic Management*, **35**(1), 60.



- Couchman, P. K., and Fulop, L. (2007). *Building effective interorganizational relationships in multi-partner R&D collaborations: Findings from a study of cross-sector R&D projects*. Paper presented at the British Academy of Management 2007 Annual Conference, Warwick University, UK.
- Cousins, P. D. (2002). A conceptual model for managing long-term inter-organisational relationships. *European Journal of Purchasing & Supply Management*, **8**(2), 71-82.
- Cousins, P. D. (2006). The implications of socialization and integration in supply chain management. *Journal of Operations Management*, **24**(5), 604-620.
- Cousins, P. D., Handfield, R. B., Lawson, B., and Petersen, K. J. (2006). Creating supply chain relational capital: The impact of formal and informal socialization processes. *Journal of Operations Management*, **24**(6), 851-863.
- Cousins, P. D., Lawson, B., and Squire, B. (2008). Performance measurement in strategic buyer-supplier relationships: The mediating role of socialization mechanisms. *International Journal of Operations & Production Management*, **28**(3), 238-258.
- Cousins, P. D., and Spekman, R. E. (2003). Strategic supply and the management of inter- and intra-organisational relationships. *Journal of Purchasing and Supply Management*, **9**(1), 19-29.
- Cox, A. (1999). Power, value and supply chain management. *Supply Chain Management: An International Journal*, **4**(4), 167-175.
- Cox, A., Sanderson, I., and Watson, G. (2001). Supply chains and power regimes: Toward an analytic framework for managing extended networks of buyer and supplier relationships. *Journal of Supply Chain Management*, **37**(2), 28-35.
- Creswell, J. W. (1994). *Research design: Qualitative and quantitative approaches*. London: Sage Publications.
- Crone, M., and Roper, S. (2001). Local learning from multinational plants: Knowledge transfers in the supply chain". *Regional Studies*, **35**(6), 535-548.
- Crossan, M. M., and Berdrow, I. (2003). Organizational learning and strategic renewal. *Strategic Management Journal*, **24**(11), 1087-1105.
- Crossan, M. M., and Inkpen, A. C. (1995). The subtle art of learning through alliances.

- Business Quarterly*, **60**(2), 68-78.
- Cudeck, R., and Browne, M. W. (1983). Cross-validation of covariance structures. *Multivariate Behavioral Research*, **18**(2), 147-157.
- Cummings, J. L., and Teng, B.-S. (2003). Transferring R&D knowledge: The key factors affecting knowledge transfer success. *Journal of Engineering and Technology Management*, **20**(1-2), 39-68.
- Curran, P. J., West, S. G., and Finch, J. F. (1996). The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. *Psychological Methods*, **1**(1), 16-29.
- Cyert, R. M., and March, J. G. (1963). *A behavioral theory of the firm*. Englewood Cliffs, NJ: Prentice-Hall.
- Cyert, R. M., and March, J. G. (1992). *A behavioral theory of the firm* (2nd ed.). Oxford: Blackwell Business.
- Darr, E. D., Argote, L., and Epple, D. (1995). The acquisition, transfer, and depreciation of knowledge in service organizations: Productivity in franchises. *Management Science*, **41**(11), 1750-1762.
- Das, T. K., and Teng, B.-S. (1998). Between trust and control: Developing confidence in partner cooperation in alliances. *Academy of Management Review*, **23**(3), 491-512.
- Dasgupta, T. (2003). Using the six-sigma metric to measure and improve the performance of a supply chain. *Total Quality Management*, **14**(3), 355-366.
- Delk, J. W. (2000). International financial management concepts strengthen supply chain links. *Production & Inventory Management Journal*, **41**(2), 59-63.
- Demsetz, H. (1991). The theory of the firm revisited. In O. E. Williamson and S. G. Winter (Eds.), *The nature of the firm* (pp. 159-178). New York: Oxford University Press.
- Deng, X., Doll, W. J., Hendrickson, A. R., and Scazzero, J. A. (2005). A multi-group analysis of structural invariance: An illustration using the technology acceptance model. *Information & Management*, **42**(5), 745-759.
- Deshpande, R., and Zaltman, G. (1982). Factors affecting the use of market research

- information: A path analysis. *Journal of Marketing Research*, **19**(1), 14-31.
- Desouza, K. C., Chattaraj, A., and Kraft, G. (2003). Supply chain perspectives to knowledge management: Research propositions. *Journal of Knowledge Management*, **7**(3), 129-138.
- Didow, N. M., and Franke, G. R. (1984). Measurement issues in time-series research: Reliability and validity assessment in modeling the macroeconomic effects of advertising. *Journal of Marketing Research*, **21**(1), 12-19.
- Dillman, D. A. (1978). *Mail and telephone surveys: The total design method*. New York: Wiley-Interscience.
- Dillman, D. A. (2000). *Mail and Internet surveys: The tailored design method* (2nd ed.). New York: John Wiley & Sons, Inc.
- Dion, P., Banting, P., Picard, S., and Blenkhorn, D. (1992). Jit implementation: A growth opportunity for purchasing. *International Journal of Purchasing and Materials Management*, **28**(4), 33.
- Doney, P. M., and Cannon, J. P. (1997). An examination of the nature of trust in buyer-seller relationships. *Journal of Marketing*, **61**(2), 35-51.
- Dosi, G., Faillo, M., and Marengo, L. (2008). Organizational capabilities, patterns of knowledge accumulation and governance structures in business firms: An introduction. *Organization Studies*, **29**(8-9), 1165-1185.
- Doz, Y. L., Olk, P. M., and Ring, P. S. (2000). Formation processes of R&D consortia: Which path to take? Where does it lead? *Strategic Management Journal*, **21**(3), 239-266.
- Dreyer, D. E. (2000). Performance measurement: A practitioner's perspective. *Supply Chain Management Review*(Fall), 63-68.
- Droge, C., Claycomb, C., and Germain, R. (2003). Does knowledge mediate the effect of context on performance? Some initial evidence. *Decision Sciences*, **34**(3), 541-568.
- Dussauge, P., Garrette, B., and Mitchell, W. (2000). Learning from competing partners: Outcomes and durations of scale and link alliances in Europe, North America and Asia. *Strategic Management Journal*, **21**(2), 99-126.

- Dwyer, R. F., Schurr, P. H., and Oh, S. (1987). Developing buyer-seller relationships. *Journal of Marketing*, **51**(2), 11-27.
- Dyer, J. (1997). Effective interim collaboration: How firms minimize transaction costs and maximise transaction value. *Strategic Management Journal*, **18**(7), 535-556.
- Dyer, J., Cho, D., and Chu, W. (1998). Strategic supplier segmentation: The next 'best practice' in supply chain management. *California Management Review*, **40**(2), 57-76.
- Dyer, J., and Chu, W. (2000). Determinants of trust in supplier-automaker relationships in the US, Japan, and Korea. *Journal of International Business Studies*, **31**(2), 259-285.
- Dyer, J., and Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review*, **23**(4), 660-679.
- Dyer, J. H., and Chu, W. (2003). The role of trustworthiness in reducing transaction costs and improving performance: Empirical evidence from the United States, Japan, and Korea. *Organization Science*, **14**(1), 57-68.
- Dyer, J. H., and Hatch, N. W. (2006). Relation-specific capabilities and barriers to knowledge transfers: Creating advantage through network relationships. *Strategic Management Journal*, **27**(8), 701-719.
- Dyer, J. H., and Nobeoka, K. (2000). Creating and managing a high-performance knowledge-sharing network: The Toyota case. *Strategic Management Journal*, **21**(3), 345-367.
- Easterby-Smith, M., and Prieto, I. M. (2008). Dynamic capabilities and knowledge management: An integrative role for learning? *British Journal of Management*, **19**(3), 235-249.
- Eisenhardt, K. M., and Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, **21**(10-11), 1105-1121.
- Ellram, L. (1992). International purchasing alliances: An empirical study. *International Journal of Logistics Management*, **3**(1), 23-36.
- Ellram, L., and Krause, D. R. (1994). Supplier partnerships in manufacturing versus

- non-manufacturing firms. *International Journal of Logistics Management*, **5**(1), 43-53.
- Ellram, L. M. (1995). A managerial guideline for the development and implementation of purchasing partnerships. *International Journal of Purchasing and Materials Management*, **31**(3), 10-16.
- Emerson, R. M. (1962). Power-dependence relations. *American Sociological Review*, **27**, 31-40.
- Ethiraj, S. K., Kale, P., Krishnan, M. S., and Singh, J. V. (2005). Where do capabilities come from and how do they matter? A study in the software services industry. *Strategic Management Journal*, **26**(1), 25-45.
- Evans, J. (1983). Criteria of validity: Exploring the relationship between ethnographic and quantitative approaches. In M. Hammersley (Ed.), *The ethnography of schooling*. Driffield: Nafferton Books.
- Fiala, P. (2005). Information sharing in supply chains. *Omega-International Journal of Management Science*, **33**(5), 419-423.
- Fornell, C., and Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, **18**(1), 39-50.
- Fornell, C., and Yi, Y. (1992). Assumptions of the two-step approach to latent variable modeling. *Sociological Methods & Research*, **20**(1), 291-320.
- Frankel, R., Whipple, J. S., and Frayer, D. J. (1996). Formal versus informal contracts: Achieving alliance success. *International Journal of Physical Distribution & Logistics Management*, **26**(3), 47-63.
- Fynes, B., and Voss, C. (2002). The moderating effect of buyer-supplier relationships on quality practices and performance. *International Journal of Operations & Production Management*, **22**(6), 589-613.
- Gadde, L. E., and Snehota, I. (2000). Making the most of supplier relationships. *Industrial Marketing Management*, **29**, 305-316.
- Ganesan, S. (1994). Determinants of long-term orientation in buyer-seller relationships. *Journal of Marketing*, **58**, 1-19.

- Gardner, J. T., Cooper, M. C., and Noordewier, T. (1994). Understanding shipper-carrier and shipper-warehouser relationships: Partnership revisited. *Journal of Business Logistics*, **15**(2), 121-143.
- Gentry, J. J. (1996). The role of carriers in buyer-supplier strategic partnerships: A supply chain management approach. *Journal of Business Logistics*, **17**(2), 35-55.
- Geyskens, I., Steenkamp, J.-B. E. M., Scheer, L. K., and Kumar, N. (1996). The effects of trust and interdependence on relationship commitment: A trans-atlantic study. *International Journal of Research in Marketing*, **13**(4), 303-317.
- Giannakis, M. (2008). Facilitating learning and knowledge transfer through supplier development. *Supply Chain Management: An International Journal*, **13**(1), 62-72.
- Golicic, S. L., Foggin, J. H., and Mentzer, J. T. (2003). Relationship magnitude and its role in interorganizational relationship structure. *Journal of Business Logistics*, **24**(1), 57-75.
- Graham, T. S., Daugherty, P., and Dudley, W. N. (1994). The long-term strategic impact of purchasing partnerships. *International Journal of Purchasing & Material Management*, **30**(4), 13-18.
- Grant, R. M. (1996a). Prospering in dynamically competitive environments: Organizational capability as knowledge integration. *Organization Science*, **7**(4), 375-387.
- Grant, R. M. (1996b). Toward a knowledge-based theory of the firm. *Strategic Management Journal*, **17**(Winter special issue), 109-122.
- Grant, R. M., and Baden-Fuller, C. (1995). A knowledge-based theory of inter-firm collaboration. *Academy of Management Best Paper Proceedings*, **55**, 17-21.
- Grant, R. M., and Baden-Fuller, C. (2004). A knowledge accessing theory of strategic alliances. *Journal of Management Studies*, **41**(1), 61-84.
- Gulati, R. (1995). Social structure and alliance formation patterns: A longitudinal analysis. *Administrative Science Quarterly*, **40**(4), 619-652.
- Gulati, R., and Lawrence, P. (1999). *Organizing vertical networks: A design perspective*. Paper presented at the Special issue Conference on Strategic Networks, Kellogg School, Northwestern University.

- Gulati, R., Lawrence, P. R., and Puranam, P. (2005). Adaptation in vertical relationships: Beyond incentive conflict. *Strategic Management Journal*, **26**(5), 415-440.
- Gulati, R., Nohria, N., and Zaheer, A. (2000). Strategic networks. *Strategic Management Journal*, **21**(3), 203-215.
- Gunasekaran, A., Patel, C., and Tirtiroglu, E. (2001). Performance measures and metrics in a supply chain environment. *International Journal of Operations & Production Management*, **21**(1/2), 71-87.
- Gupta, A. K., and Govindarajan, V. (2000). Knowledge flows within multinational corporations. *Strategic Management Journal*, **21**, 473-496.
- Hair, J. F., Anderson, R. E., Tatham, R. L., and Black, W. C. (1995). *Multivariate data analysis: With readings* (4th ed.). London: Prentice Hall.
- Hair, J. F., Anderson, R. E., Tatham, R. L., and Black, W. C. (1998). *Multivariate data analysis* (5th ed.). London: Prentice-Hall.
- Hallikas, J., Puumalainen, K., Vesterinen, T., and Virolainen, V.-M. (2005). Risk-based classification of supplier relationships. *Journal of Purchasing and Supply Management*, **11**(2-3), 72-82.
- Hamel, G. (1991). Competition for competence and inter-partner learning within international strategic alliances. *Strategic Management Journal*, **12**, 133-139.
- Handfield, R. B., and Lawson, B. (2007). Integrating suppliers into new product development. *Research-Technology Management*, **50**(5), 44-51.
- Handfield, R. B., and Nichols, E. L. (2002). *Supply chain redesign: Transforming supply chains into integrated value systems*. Upper Saddle River, NJ: Financial Times Prentice Hall.
- Handfield, R. B., Ragatz, G. L., Petersen, K. J., and Monczka, R. M. (1999). Involving suppliers in new product development. *California Management Review*, **42**(1), 59-82.
- Hardwick, R., and Ford, D. (1986). Industrial buyer resources and responsibilities and the buyer seller relationship. *Industrial Marketing and Purchasing*, **1**(3), 35-48.
- Hardy, C., Phillips, N., and Lawrence, T. B. (2003). Resources, knowledge and influence: The organizational effects of interorganizational collaboration. *Journal of*

- Management Studies*, **40**(2), 321-347.
- Harland, C., Zheng, J., Johnsen, T., and Lamming, R. (2004). A conceptual model for researching the creation and operation of supply networks. *British Journal of Management*, **15**(1), 1-21.
- Harland, C. M. (1996). Supply chain management: Relationships, chains and networks. *British Journal of Management*, **7**, S63-S80.
- Harland, C. M., Lamming, R., Zheng, J., and Johnsen, T. (2006). A taxonomy of supply networks. *Journal of Supply Chain Management*, **37**(4), 21-27.
- Harland, C. M., Lamming, R. C., and Cousins, P. D. (1999). Developing the concept of supply strategy. *International Journal of Operations & Production Management*, **19**(7), 650-674.
- Harwick, T. (1997). Optimal decision-making for the supply chain. *APICS-The Performance Advantage*, **7**(1), 42-44.
- Hatch, N. W., and Dyer, J. H. (2004). Human capital and learning as a source of sustainable competitive advantage. *Strategic Management Journal*, **25**(12), 1155-1178.
- Hayward, M. L. A. (2002). When do firms learn from their acquisition experience? Evidence from 1990 to 1995. *Strategic Management Journal*, **23**(1), 21-39.
- He, Q., Ghobadian, A., and Galleary, D. (2006). *Interfirm knowledge transfer: A review of research methodologies*. Paper presented at the British Academy of Management 2006 Conference, Belfast, UK.
- Heide, J. B. (1994). Interorganizational governance in marketing channels. *Journal of Marketing*, **58**(1), 71-85.
- Heide, J. B., and John, G. (1988). The role of dependence balancing in safeguarding transaction-specific assets in conventional channels. *Journal of Marketing*, **52**(1), 20.
- Heide, J. B., and Miner, A. S. (1992). The shadow of the future: Effects of anticipated interaction and frequency of contact on buyer-seller cooperation. *Academy of Management Journal*, **35**(2), 265-291.
- Helleloid, D., and Simonin, B. L. (1994). Organizational learning and a firm's core



- competence. In G. Hamel and A. Heene (Eds.), *Competence based competition* (Vol. 213-239). New York: Wiley.
- Helper, S. (1991). Strategy and irreversibility in supplier relations: The case of the U.S. automobile industry. *Business History Review*, **65**(4), 781-824.
- Ho, D. C. K., Au, K. F., and Newton, E. (2002). Empirical research on supply chain management: A critical review and recommendations. *International Journal of Production Research*, **40**(17), 4415-4430.
- Houston, M. B., and Johnson, S. A. (2000). Buyer-supplier contracts versus joint ventures: Determinants and consequences of transaction structure. *Journal of Marketing Research*, **37**(1), 1-15.
- Hu, L., and Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods*, **3**, 424-453.
- Huber, G. P. (1991). Organizational learning: The contributing processes and the literatures. *Organization Science*, **2**(1), 88-115.
- Hughes, C. (2003). Introduction to research methodologies. *University of Warwick Web Site*, <http://www2.warwick.ac.uk/fac/soc/sociology/staff/academic/hugesc/h...>
- Hult, G. T. M. (2003). An integration of thoughts on knowledge management. *Decision Sciences*, **34**(2), 189-195.
- Hult, G. T. M., Ferrell, O. C., and Hurley, R. F. (2002a). Global organizational learning effects on cycle time performance. *Journal of Business Research*, **55**(5), 377-387.
- Hult, G. T. M., Hurley, R. F., Giunipero, L. C., and Nichols, E. L. (2000a). Organizational learning in global purchasing: A model and test of internal users and corporate buyers. *Decision Sciences*, **31**(2), 293-325.
- Hult, G. T. M., Ketchen, D., and Arrfelt, M. (2007). Strategic supply chain management: Improving performance through a culture of competitiveness and knowledge development. *Strategic Management Journal*, **28**(10), 1035-1052.
- Hult, G. T. M., Ketchen, D. J., and Nichols, E. L. (2002b). An examination of cultural competitiveness and order fulfillment cycle time within supply chains. *Academy of Management Journal*, **45**(3), 577-586.

- Hult, G. T. M., Ketchen, D. J., and Nichols, E. L. (2003). Organizational learning as a strategic resource in supply management. *Journal of Operations Management*, **21**(5), 541-556.
- Hult, G. T. M., Ketchen, D. J., and Slater, S. F. (2004). Information processing, knowledge development, and strategic supply chain performance. *Academy of Management Journal*, **47**(2), 241-253.
- Hult, G. T. M., Ketchen, J., David J., Cavusgil, S. T., and Calantone, R. J. (2006). Knowledge as a strategic resource in supply chains. *Journal of Operations Management*, **24**(5), 458-475.
- Hult, G. T. M., Nichols, E. L., Giunipero, L. C., and Hurley, R. F. (2000b). Global organizational learning in the supply chain: A low versus high learning study. *Journal of International Marketing*, **8**(3), 61-83.
- Humphreys, P. K., Li, W. L., and Chan, L. Y. (2004). The impact of supplier development on buyer-supplier performance. *Omega-International Journal of Management Science*, **32**(2), 131-143.
- Ingham, M., and Mothe, C. (1998). How to learn in R&D partnerships? *R&D Management*, **28**(4), 249.
- Inkpen, A. C. (1998). Learning and knowledge acquisition through international strategic alliances. *Academy of Management Executive*, **12**(4), 69-80.
- Inkpen, A. C., and Beamish, P. W. (1997). Knowledge, bargaining power, and the instability of international joint ventures. *Academy of Management Review*, **22**(1), 177-202.
- Inkpen, A. C., and Crossan, M. M. (1995). Believing is seeing: Joint ventures and organization learning. *Journal of Management Studies*, **32**(5), 595-618.
- Inkpen, A. C., and Dinur, A. (1998). Knowledge management processes and international joint venture. *Organization Science*, **9**(4), 454-468.
- Inkpen, A. C., and Tsang, E. W. K. (2005). Social capital, networks, and knowledge transfer. *Academy of Management Review*, **30**(1), 146-165.
- Ittner, C. D., and Larcker, D. F. (1997). The performance effects of process management techniques. *Management Science*, **43**(4), 522-535.

- Jaworski, B. J., and Kohli, A. K. (1993). Market orientation: Antecedents and consequences. *Journal of Marketing*, **57**(3), 53-70.
- Jayaram, J., Vickery, S. K., and Droge, C. (2000). The effect of information system infrastructure and process improvements on supply-chain time performance. *International Journal of Physical Distribution & Logistics Management*, **30**(3/4), 314-330.
- Johnson, J. L., and Sohi, R. S. (2003). The development of interfirm partnering competence: Platforms for learning, learning activities, and consequences of learning. *Journal of Business Research*, **56**(9), 757-766.
- Joreskog, K. G. (2005). *Structural equation modeling with ordinal variables using LISREL*. Lincolnwood, IL: Scientific Software International, Inc.
- Joreskog, K. G., and Sorbom, D. (1989). *LISREL 7: A guide to the program and applications* (2nd ed.). Chicago, Illinois: SPSS Inc.
- Joreskog, K. G., and Sorbom, D. (2004). *LISREL 8.70*. Lincolnwood, IL, USA: Scientific Software International, Inc.
- Kale, P., Dyer, J., and Singh, H. (2001). Value creation and success in strategic alliances: Alliance skills and the role of alliance structure and systems. *European Management Journal*, **19**(5), 463-471.
- Kale, P., Singh, H., and Perlmutter, H. (2000). Learning and protection of proprietary assets in strategic alliances: Building relational capital. *Strategic Management Journal*, **21**(3), 217-237.
- Kalwani, M., and Narayandas, N. (1995). Long-term manufacturer-supplier relationships: Do they pay off for supplier firms? *Journal of Marketing*, **59**(1), 1-16.
- Kasarda, J. (2001). Introduction to the supply chain. In J. B. Ayers (Ed.), *Handbook of supply chain management* (pp. 3-8). London: St. Lucie Press.
- Katz, R., and Allen, T. J. (1982). Investigating the not invented here (NIH) syndrome: A look at the performance, tenure, and communication patterns of 50 R&D project groups. *R&D Management*, **12**(1), 7-19.
- Kim, A., and Lim, E.-Y. (1999, April 19-23, 1999). *How critical is back translation in cross-cultural adaptation of attitude measures?* Paper presented at the Annual

- Meeting of the American Educational Research Association, Montreal, Quebec, Canada.
- Kim, H., Hoskisson, R. E., and Wan, W. P. (2004). Power dependence, diversification strategy, and performance in keiretsu member firms. *Strategic Management Journal*, **25**(7), 613-636.
- Kline, R. (1998). *Principles and practices of structural equation modeling*. New York: The Guilford Press.
- Knemeyer, A. M., Corsi, T. M., and Murphy, P. R. (2003). Logistics outsourcing relationships: Customer perspectives. *Journal of Business Logistics*, **24**(1), 77-109.
- Knight, L. A. (2000). Learning to collaborate: A study of individual and organizational learning, and interorganizational relationships. *Journal of Strategic Marketing*, **8**, 121-138.
- Kogut, B. (1988). Joint ventures: Theoretical and empirical perspectives. *Strategic Management Journal*, **9**(4), 319-332.
- Kogut, B. (2000). The network as knowledge: Generative rules and the emergence of structure. *Strategic Management Journal*, **21**(3), 405-425.
- Kogut, B., Sham, W., and Walker, G. (1993). Competitive cooperation in biotechnology: Learning through networks? In N. Nohria and R. Eccles (Eds.), *Networks and organizations: Structure, form, and action* (pp. 348-365). Boston: Harvard Business School Press.
- Kogut, B., and Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science*, **3**(3), 383-397.
- Kogut, B., and Zander, U. (1996). What firms do? Coordination, identity and learning. *Organization Science*, **7**(5), 502-518.
- Koka, B. R., and Prescott, J. E. (2002). Strategic alliances as social capital: A multidimensional view. *Strategic Management Journal*, **23**(9), 795-816.
- Kotabe, M., Martin, X., and Domoto, H. (2003). Gaining from vertical partnerships: Knowledge transfer, relationship duration, and supplier performance improvement in the U.S. and Japanese automotive industries. *Strategic*

- Management Journal*, **24**(4), 293-316.
- Kraatz, M. S. (1998). Learning by association? Interorganizational network and adaptation to environment change. *Academy of Management Journal*, **41**(5), 621-643.
- Krause, D. R., and Ellram, L. M. (1997). Success factors in supplier development. *International Journal of Physical Distribution & Logistics Management*, **27**(1), 39-52.
- Krause, D. R., Handfield, R. B., and Tyler, B. B. (2007). The relationships between supplier development, commitment, social capital accumulation and performance improvement. *Journal of Operations Management*, **25**(2), 528-545.
- Kumar, N., Scheer, L. K., and Steenkamp, J. E. M. (1995). The effects of perceived interdependence on dealer attitudes. *Journal of Marketing Research*, **32**, 348-358.
- Lam, A. (1997). Embedded firms, embedded knowledge: Problems of collaboration and knowledge transfer in global cooperative ventures. *Organization Studies*, **18**(6), 973-996.
- Lambe, C. J., and Spekman, R. E. (1997). Alliances, external technology acquisition, and discontinuous technological change. *Journal of Product Innovation Management*, **14**(2), 102-116.
- Lambert, D. M., Emmelhainz, M. A., and Gardner, J. T. (1996). Developing and implementing supply chain partnerships. *The International Journal of Logistics Management*, **7**(2), 1-17.
- Lambert, D. M., Emmelhainz, M. A., and Gardner, J. T. (1999). Building successful logistics partnerships. *Journal of Business Logistics*, **20**(1), 165-181.
- Lambert, D. M., Knemeyer, A. M., and Gardner, J. T. (2004). Supply chain partnerships: Model validation and implementation. *Journal of Business Logistics*, **25**(2), 21-42.
- Lamming, R. (2005). Supplier relationship management. In K. U. Anwendungen (Ed.), *Perspektiven des supply management* (pp. 81-94). Berlin Heidelberg: Springer.
- Lamming, R., Caldwell, N., Harrison, D., and Phillips, W. (2006). Transparency in supply relationships: Concept and practice. *Journal of Supply Chain Management*,

37(4), 4-10.

- Lamming, R., Caldwell, N., Phillips, W., and Harrison, D. (2005). Sharing sensitive information in supply relationships: The flaws in one-way open-book negotiation and the need for transparency. *European Management Journal*, **23**(5), 554-563.
- Lamming, R., Johnsen, T., Zheng, J., and Harland, C. M. (2000). An initial classification of supply networks. *International Journal of Operations & Production Management*, **20**(6), 675-691.
- Lamming, R. C., Caldwell, N., and Harrison, D. (2004). Developing the concept of transparency for use in supply relationships. *British Journal of Management*, **15**, 291-302.
- Landeros, R., and Monczka, R. M. (1989). Cooperative buyer/seller relationships and a firm's competitive posture. *Journal of Purchasing and Materials Management*, **25**(3), 9-18.
- Lane, P. J., and Lubatkin, M. (1998). Relative absorptive capacity and interorganizational learning. *Strategic Management Journal*, **19**(5), 461-478.
- Lane, P. J., Salk, J. E., and Lyles, M. A. (2001). Absorptive capacity, learning, and performance in international joint ventures. *Strategic Management Journal*, **22**(12), 1139-1161.
- Larsen, J. K. (1985). Effect of time on information utilization. *Knowledge: Creation, Diffusion, Utilization*, **7**(2), 143-159.
- Lascelles, D. M., and Dale, B. G. (1989). The buyer-supplier relationship in total quality management. *Journal of Purchasing and Materials Management*, **25**(2), 10-19.
- Lawson, B., Petersen, K., Cousins, P. D., and Handfield, R. B. (2009). Knowledge sharing in interorganizational product development teams: The effect of formal and informal socialization mechanisms. *Journal of Product Innovation Management*, **26**(2), 156-172.
- Lawson, C., and Lorenz, E. (1999). Collective learning, tacit knowledge and regional innovative capacity. *Regional Studies*, **33**(4), 305-317.
- Lee, S., and Hershberger, S. (1990). A simple rule for generating equivalent models in covariance structure modeling. *Multivariate Behavioral Research*, **25**(3),

313-334.

- Lemke, F., Goffin, K., and Szwejcowski, M. (2003). Investigating the meaning of supplier-manufacturer partnerships: An exploratory study. *International Journal of Physical Distribution & Logistics Management*, **33**(1), 12-35.
- Leonard-Barton, D. (1995). *Wellsprings of knowledge*. Boston, MA: Harvard Business School Press.
- Leonard-Barton, D., and Deschamps, I. (1988). Managerial influence in the implementation of new technology. *Management Science*, **34**(10), 1252-1265.
- Levin, D. Z. (2002). The strength of weak ties you can trust: The mediating role of trust in effective knowledge transfer. *Academy of Management Proceedings 2002, MOC: DI*.
- Levinson, N. S., and Asahi, M. (1996). Cross-national alliances and interorganizational learning. *Organizational Dynamics*, **24**, 51-63.
- Li, S., Ragu-Nathan, B., Ragu-Nathan, T. S., and Rao, S. S. (2006). The impact of supply chain management practices on competitive advantage and organizational performance. *Omega-International Journal of Management Science*, **34**(2), 107-124.
- Liebesskind, J. P. (1996). Knowledge, strategy, and the theory of the firm. *Strategic Management Journal*, **17**(Winter special issue), 93-107.
- Lorange, P. (1996). Developing learning partnership. *The Learning Organization*, **3**(2), 11-19.
- Love, P. E. D., and Gunasekaran, A. (1999). Learning alliances: A customer-supplier focus for continuous improvement in manufacturing. *Industrial and Commercial Training*, **31**(3), 88-96.
- Love, P. E. D., Irani, Z., Cheng, E., and Li, H. (2002). A model for supporting inter-organizational relations in the supply chain. *Engineering, Construction and Architectural Management*, **9**(1), 2-15.
- Lummus, R. R., and Vokurka, R. J. (1999). Defining supply chain management: A historical perspective and practical guidelines. *Industrial Management & Data Systems*, **99**(1), 11-17.

- Macbeth, D. K., and Ferguson, N. (1994). *Partnership sourcing: An integrated supply chain approach*. London: FT Pitman Publishing.
- Madhavan, R., and Grover, R. (1998). From embedded knowledge to embodied knowledge: New product development as knowledge management. *Journal of Marketing*, **62**(4), 1-12.
- Makhija, M. V., and Ganesh, U. (1997). The relationship between control and partner learning in learning-related joint ventures. *Organization Science*, **8**(5), 508-527.
- Maloni, M., and Benton, W. C. (2000). Power influences in the supply chain. *Journal of Business Logistics*, **21**(1), 49-73.
- Maqsood, T., Walker, D., and Finegan, A. (2007). Extending the "knowledge advantage": Creating learning chains. *The Learning Organization*, **14**(2), 123-141.
- Marsh, H. W., and Hoceuar, D. (1983). Confirmatory factor analysis of multitrait-multi method matrices. *Journal of Educational Measurement*, **20**, 231-248.
- Marsh, H. W., and Hoceuar, D. (1994). Confirmatory factor analysis models of factorial invariance: A multifaceted approach. *Structural Equation Modeling*, **1**(10), 5-34.
- Mason, K. J., and Leek, S. (2008). Learning to build a supply network: An exploration of dynamic business models. *Journal of Management Studies*, **45**(4), 774-799.
- Maxwell, B. (1996). Translation and cultural adaptation of the survey instruments. In M. O. Martin and D. L. Kelly (Eds.), *Third international mathematics and science study (TIMSS) technical report, volume i: Design and development*. Chestnut Hill, MA: Boston College.
- McCullen, P., and Towill, D. (2002). Diagnosis and reduction of bullwhip in supply chains. *Supply Chain Management: An International Journal*, **7**(3), 164-179.
- McEvily, B., Perrone, V., and Zaheer, A. (2003). Trust as an organizing principle. *Organization Science*, **14**(1), 91-103.
- McHugh, M. (2003). Buyer-supplier relationships and organizational health. *Journal of Supply Chain Management: A Global Review of Purchasing & and Supply*, **39**(2), 15-26.
- Medsker, G. J., Williams, L. J., and Holahan, P. J. (1994). A review of current practices for evaluating causal models in organizational behavior and human resources



- management research. *Journal of Management*, **20**(2), 439-464.
- Mels, G. (2004). *LISREL 8.7 for windows: Getting started guide*. Lincolnwood, IL: Scientific Software International, Inc.
- Menon, A., and Varadarajan, P. R. (1992). A model of marketing knowledge use within firms. *Journal of Marketing*, **56**(4), 53.
- Menon, T., and Pfeffer, J. (2003). Valuing internal vs. External knowledge: Explaining the preference for outsiders. *Management Science*, **49**(4), 497-513.
- Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., et al. (2001). Defining supply chain management. *Journal of Business Logistics*, **22**(2), 1-25.
- Mentzer, J. T., Min, S., and Zacharia, Z. G. (2000). The nature of interfirm partnering in supply chain management. *Journal of Retailing*, **76**(4), 549-568.
- Mills, J., Schmitz, J., and Frizelle, G. (2004). A strategic review of "supply networks". *International Journal of Operations & Production Management*, **24**(10), 1012-1036.
- Minbaeva, D. B. (2007). Knowledge transfer in multinational corporations. *Management International Review*, **47**(4), 567-593.
- Mintzberg, H., Dougherty, D., Jorgensen, J., and Westley, F. (1996). Some surprising things about collaboration: Knowing how people make contact makes its work better. *Organizational Dynamics*, **25**, 60-70.
- Miyamoto, T., and Rexha, N. (2004). Determinants of three facets of customer trust - a marketing model of Japanese buyer-supplier relationship. *Journal of Business Research*, **57**(3), 312-319.
- Moberg, C. R., and Speh, T. W. (2003). Evaluating the relationship between questionable business practices and the strength of supply chain relationships. *Journal of Business Logistics*, **24**(2), 1-19.
- Modi, S. B., and Mabert, V. A. (2007). Supplier development: Improving supplier performance through knowledge transfer. *Journal of Operations Management*, **25**, 42-64.
- Mody, A. (1993). Learning through alliances. *Journal of Economic Behavior and Organization*, **20**(2), 151-170.

- Mohr, J., and Sengupta, S. (2002). Managing the paradox of inter-firm learning: The role of governance mechanisms. *Journal of Business & Industrial Marketing*, **17**(4), 282-301.
- Mohr, J., and Spekman, R. E. (1994). Characteristics of partnership success: Partnership attributes, communication behavior, and conflict resolution techniques. *Strategic Management Journal*, **15**(2), 135-152.
- Molina, L. M., Llorens-Montes, J., and Ruiz-Moreno, A. (2007). Relationship between quality management practices and knowledge transfer. *Journal of Operations Management*, **25**(3), 682-701.
- Monczka, R. M., Callahan, T. J., and Nichols, E. L. (1995). Predictors of relationships among buying and supplying firms. *International Journal of Physical Distribution & Logistics Management*, **25**(10), 45-59.
- Monczka, R. M., Petersen, K. J., and Handfield, R. B. (1998). Success factors in strategic supplier alliances: The buying company perspective. *Decision Sciences*, **29**(3), 553-578.
- Moore, G. C., and Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, **2**(3), 192-222.
- Moorman, C., Deshpande, R., and Zaltman, G. (1993). Factors affecting trust in market research relationships. *Journal of Marketing*, **57**(1), 81-101.
- Moorman, C., Zaltman, G., and Deshpande, R. (1992). Relationship between providers and users of marketing research: The dynamics of trust within and between organizations. *Journal of Marketing Research*, **29**(3), 314-329.
- Morash, E. A. (2001). Supply chain strategies, capabilities, and performance. *Transportation Journal*, 37-54.
- Morgan, R. M., and Hunt, S. D. (1994). The commitment-trust theory of relationship marketing. *Journal of Marketing*, **58**(3), 20-38.
- Mowday, R., Steers, R., and Porter, L. (1979). The measurement of organizational commitment. *Journal of Vocational Behavior*, **14**, 224-247.
- Mowery, D. C., Oxley, J. E., and Silverman, B. S. (1996). Strategic alliances and

- interfirm knowledge transfer. *Strategic Management Journal*, **17**(Winter special issue), 77-91.
- Mulaik, S. A., James, L. R., Van Alstine, J., Bennett, N., Lind, S., and Stilwell, C. D. (1989). Evaluation of goodness-of-fit indices for structural equation models. *Psychological Bulletin*, **105**(3), 430-445.
- Muller, M. M., Johansen, J., and Boer, H. (2003). Managing buyer-supplier relationships and inter-organisational competence development. *Integrated Manufacturing Systems*, **14**(4), 369-379.
- Murray, J. Y. (2001). Strategic alliance-based global sourcing strategy for competitive advantage: A conceptual framework and research propositions. *Journal of International Marketing*, **9**(4), 30-58.
- Muthusamy, S. K., Hur, D., and Palanisamy, R. (2008). Leveraging knowledge in buyer-supplier alliances: A theoretical integration. *International Journal of Management and Decision Making*, **9**(6), 600-616.
- Muthusamy, S. K., and White, M. A. (2005). Learning and knowledge transfer in strategic alliances: A social exchange view. *Organization Studies*, **26**(3), 415-441.
- Muthusamy, S. K., and White, M. A. (2006). Does power sharing matter? The role of power and influence in alliance performance. *Journal of Business Research*, **59**(7), 811-819.
- Nelson, R., and Winter, S. (1982). *An evolutionary theory of economic change*. Cambridge, MA: Belknap.
- New, S. (1998). The implications and reality of partnership. In B. Burnes and B. Dale (Eds.), *Working in partnership: Best practice in customer-supplier relations* (pp. 9-20). Hampshire, UK: Gower Publishing Ltd.
- Nickerson, J. A., and Zenger, T. R. (2004). A knowledge-based theory of the firm - the problem-solving perspective. *Organization Science*, **15**(6), 617-632.
- Nieto, M., and Quevedo, P. (2005). Absorptive capacity, technological opportunity, knowledge spillovers, and innovative effort. *Technovation*, **25**(10), 1141-1157.
- Nishiguchi, T. (1994). *Strategic industrial sourcing*. Oxford: Oxford University Press.
- Nobeoka, K., Dyer, J. H., and Madhok, A. (2002). The influence of customer scope on

- supplier learning and performance in the Japanese automobile industry. *Journal of International Business Studies*, **33**(4), 717-736.
- Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, **5**(1), 14-37.
- Oh, C. H., Chung, M. H., and Labianca, G. (2004). Group social capital and group effectiveness: The role of information socializing ties. *Academy of Management Journal*, **47**(6), 860-896.
- Oxley, J. E., and Sampson, R. C. (2004). The scope and governance of international R&D alliances. *Strategic Management Journal*, **25**(8/9), 723-749.
- Parkhe, A. (1993). Strategic alliance structuring: A game theoretic and transaction cost examination of interfirm cooperation. *Academy of Management Journal*, **36**(4), 794.
- Pekar, P., and Allio, R. (1994). Making alliances work: Guidelines for success. *Long Range Planning*, **27**(4), 54-65.
- Penrose, E. T. (1959). *The theory of growth of the firm*. London: Basil Blackwell.
- Peteraf, M. A. (1993). The cornerstones of competitive advantage: A resource-based view. *Strategic Management Journal*, **14**, 179-192.
- Petersen, K., Handfield, R. B., Lawson, B., and Cousins, P. D. (2008). Buyer dependency and relational capital formation: The mediating effects of socialization processes and supplier integration. *Journal of Supply Chain Management*, **44**(4), 53-65.
- Petersen, K. J., Handfield, R. B., and Ragatz, G. L. (2005). Supplier integration into new product development: Coordinating product, process and supply chain design. *Journal of Operations Management*, **23**(2-4), 371-388.
- Petrovic, D., Roy, R., and Petrovic, R. (1998). Modeling and simulation of a supply chain in an uncertain environment. *European Journal of Operational Research*, **109**, 299-309.
- Phillips, L. W. (1981). Assessing measurement error in key informant reports: A methodological note on organizational analysis in marketing. *Journal of Marketing Research*, **16**, 395-415.
- Pierce, J. L., Kostova, T., and Dirks, K. T. (2001). Toward a theory of psychological

- ownership in organizations. *Academy of Management Review*, **26**(2), 298-311.
- Podsakoff, P. M., and Dalton, D. R. (1987). Research methodology in organizational studies. *Journal of Management*, **13**(2), 419-441.
- Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., and Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, **88**(5), 879-903.
- Polanyi, M. (1962). *Personal knowledge: Toward a post-critical philosophy*. Chicago, IL: University of Chicago Press.
- Porter, M. E. (1980). *Competitive strategy: Techniques for analyzing industrial and competitors*: The Free Press.
- Porter, M. E. (1985). *Competitive advantage: Creating and sustaining superior performance*. New York: Free Press.
- Powell, W. W. (1987). Hybrid organizational arrangements: New form or transition? *California Management Review*, **30**, 67-87.
- Powell, W. W., Koput, K. W., and Smith-Doerr, L. (1996). Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. *Administrative Science Quarterly*, **41**, 116-145.
- Power, D. J., Sohal, A. S., and Rahman, S.-U. (2001). Critical success factors in agile supply chain management: An empirical study. *International Journal of Physical Distribution & Logistics Management*, **31**(4), 247-265.
- Probst, G., Raub, S., and Romhardt, K. (2003). *Managing knowledge: Building blocks for success*. Chichester: John Wiley & Sons.
- Provan, K. G., and Skinner, S. J. (1989). Interorganizational dependence and control as predictors of opportunism in dealer-supplier relations. *Academy of Management Journal*, **32**(1), 202.
- Ramasamy, B., Goh, K. W., and C.H.Yeung, M. (2006). Is Guanxi (relationship) a bridge to knowledge transfer? *Journal of Business Research*, **59**(1), 130-139.
- Ramdas, K., and Spekman, R. E. (2000). Chain or shackles: Understanding what drives supply-chain performance. *Interfaces*, **30**(4), 3-21.
- Ramsay, J. (1996). Power measurement. *European Journal of Purchasing & Supply*

- Management*, **2**(2-3), 129-143.
- Rich, R. F. (1991). Knowledge creation, diffusion, and utilization: Perspectives of the founding editor of knowledge. *Knowledge: Creation, Diffusion, Utilization*, **12**(3), 319-337.
- Rich, R. F. (1997). Measuring knowledge utilization: Processes and outcomes. *Knowledge & Policy*, **10**(3), 11-24.
- Ritcher, F.-J., and Vettel, K. (1995). Successful joint ventures in Japan: Transferring knowledge through organizational learning. *Long Range Planning*, **28**(3), 37-45.
- Robinson, R. B., and Pearce, J. A. (1988). Planned patterns of strategic behavior and their relationship to business-unit performance. *Strategic Management Journal*, **9**, 43-60.
- Robson, C. (1993). *Real world research: A resource for social scientists and practitioner-researchers*. Oxford, UK: Blackwell.
- Robson, C. (2002). *Real world research* (2nd ed.). London: Blackwell.
- Rogers, D. S., and Tibben-Lembke, R. (1998). *Going backwards: Reverse logistics trends and practices*. Pittsburgh, USA: Reverse Logistics Executive Council.
- Rousseau, D. M., Sitkin, S. B., Burt, R. S., and Camerer, C. (1998). Not so different after all: A cross-discipline view of trust. *Academy of Management Review*, **23**(3), 393-404.
- Sako, M. (1992). *Prices, quality and trust*. Cambridge: Cambridge University Press.
- Salvador, F., Forza, C., Rungtusanatham, M., and Choi, T. Y. (2001). Supply chain interactions and time-related performances. *International Journal of Operations & Production Management*, **21**(4), 461.
- Sampson, R. C. (2005). Experience effects and collaborative returns in R&D alliances. *Strategic Management Journal*, **26**(11), 1009-1031.
- Santos-Vijande, M. L., Sanzo-Perez, M. J., Alvarez-Gonzalez, L. I., and Vazquez-Casielles, R. (2005). Organizational learning and market orientation: Interface and effects on performance. *Industrial Marketing Management*, **34**(3), 187-202.
- Satorra, A., and Bentler, P. M. (1988). *Scaling corrections for chi-square statistics in*

- covariance structure analysis*. Alexandria, VA: American Statistical Association.
- Saunders, M., Lewis, P., and Thornhill, A. (2000). *Research methods for business students* (2nd ed.). Harlow, England: Prentice Hall.
- Scannell, T. V., Vickery, S. K., and Droge, C. (2000). Upstream supply chain management and competitive performance in the automotive supply industry. *Journal of Business Logistics*, **21**(1), 23-48.
- Schumacker, R. E., and Lomax, R. G. (2004). *A beginner's guide to structural equation modeling* (2nd ed.). London: Lawrence Erlbaum Associates, Publishers.
- Schurr, P. H., and Ozanne, J. L. (1985). Influences on exchange processes: Buyers' preconceptions of a seller's trustworthiness and bargaining toughness. *Journal of Consumer Research*, **11**(4), 939-953.
- Selnes, F. (1998). Antecedents and consequences of trust and satisfaction in buyer-seller relationships. *European Journal of Marketing*, **32**(3/4), 305-322.
- Shan, W. (1990). An empirical analysis of organizational strategies by entrepreneurial high technology firms. *Strategic Management Journal*, **11**(2), 129-139.
- Shook, C. L., Ketchen, D. J., Hult, G. T. M., and Kacmar, K. M. (2004). An assessment of the use of structural equation modeling in strategic management research. *Strategic Management Journal*, **25**, 397-404.
- Simonin, B. L. (1997). The importance of collaborative know-how: An empirical test of the learning organization. *Academy of Management Journal*, **40**(5), 1150-1174.
- Simonin, B. L. (1999a). Ambiguity and the process of knowledge transfer in strategic alliances. *Strategic Management Journal*, **20**, 595-623.
- Simonin, B. L. (1999b). Ambiguity and the process of knowledge transfer in strategic alliances. *Strategic Management Journal*, **20**(7), 595-623.
- Slater, S. F., and Narver, J. C. (1994). *Market oriented isn't enough: Build a learning organization*. Cambridge, MA: Marketing Science Institute.
- Soekijad, M., and Andriessen, E. (2003). Conditions for knowledge sharing in competitive alliances. *European Management Journal*, **21**(5), 578-587.
- Sorenson, O. (2003). Interdependence and adaptability: Organizational learning and the long-term effect of integration. *Management Science*, **49**(4), 446-463.

- Sornn-Friese, H., and Sorensen, J. S. (2005). Linkage lock-in and regional economic development: The case of the oresund medi-tech plastics industry. *Entrepreneurship and Regional Development*, **17**(4), 267-291.
- Spek, R. v. d., and Spijkervet, A. (1997). Knowledge management: Dealing intelligently with knowledge. In J. Liebowitz and L. C. Wilcox (Eds.), *Knowledge management and its integrative elements* (pp. 31-59). Boca Raton, Florida: CRC Press.
- Spekman, R. E., Jr, J. W. K., and Myhr, N. (1998a). An empirical investigation into supply chain management: A perspective on partnerships. *International Journal of Physical Distribution & Logistics Management*, **28**(8), 630-650.
- Spekman, R. E., Kamauff, J. W., and Myhr, N. (1998b). An empirical investigation into supply chain management: A perspective on partnerships. *International Journal of Physical Distribution & Logistics Management*, **28**(8), 630-650.
- Spekman, R. E., Spear, J., and Kamauff, J. (2002). Supply chain competency: Learning as a key component. *Supply Chain Management: An International Journal*, **7**(1), 41-55.
- Spender, J.-C. (1996). Making knowledge the basis of a dynamic theory of the firm. *Strategic Management Journal*, **17**(Winter special issue), 45-62.
- Spender, J.-C., and Grant, R. M. (1996). Knowledge and the firm: Overview. *Strategic Management Journal*, **17**(Winter special issue), 5-9.
- Squire, B., Cousins, P. D., and Brown, S. (2008). Cooperation and knowledge transfer within buyer-supplier relationships: The moderating properties of trust, relationship duration and supplier performance. *British Journal of Management*, **coming soon**.
- Stuart, F. I. (1997). Supply-chain strategy: Organizational influence through supplier alliances. *British Journal of Management*, **8**(3), 223-236.
- Stuart, I. (1993). Supplier partnerships: Influencing factors and strategic benefits. *International Journal of Purchasing and Materials Management*, **29**(4), 22-28.
- Stuart, T. E. (2000). Interorganizational alliances and the performance of firms: A study of growth and innovation rates in a high-technology industry. *Strategic*



- Management Journal*, **21**(8), 791-811.
- Suh, T., and Kwon, I.-W. G. (2006). Matter over mind: When specific asset investment affects calculative trust in supply chain partnership. *Industrial Marketing Management*, **35**(2), 191-201.
- Szulanski, G. (1996). Exploring internal stickiness: Impediments to the transfer of best practice within the firm. *Strategic Management Journal*, **17**(Summer special issue), 173-176.
- Tan, K. C., Handfield, R. B., and Krause, D. R. (1998a). Enhancing the firm's performance through quality and supply base management: An empirical study. *International Journal of Production Research*, **36**(10), 2813-2837.
- Tan, K. C., Kannan, V. R., and Handfield, R. B. (1998b). Supply chain management: Supplier performance and firm performance. *International Journal of Purchasing & Material Management*, **34**(3), 2-9.
- Tan, K. C., Kannan, V. R., Handfield, R. B., and Ghosh, S. (1999). Supply chain management: An empirical study of its impact on performance. *International Journal of Operations & Production Management*, **19**(10), 1034-1052.
- Tan, K. C., Lyman, S. B., and Wisner, J. D. (2002). Supply chain management: A strategic perspective. *International Journal of Operations & Production Management*, **22**(6), 614-631.
- Teece, D. J., Pisano, G., and Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, **18**(7), 509-533.
- Tiemessen, I., Lane, H. W., Crossan, M. M., and Inkpen, A. C. (1997). Knowledge management in international joint ventures. In P. Beamish and J. Killings (Eds.), *Cooperative strategies, North American perspectives* (pp. 370-399). San Francisco, CA: New Lexington Press.
- Tornatzky, L. G., and Klein, K. J. (1982). Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. *IEEE Transactions on Engineering Management*, **29**(1), 28-45.
- Towill, D. R. (1996). Industrial dynamics modeling of supply chains. *International Journal of Physical Distribution & Logistics Management*, **26**(2), 23-43.

- Trochim, W. (2000). *The research methods knowledge base* (2nd ed.). Cincinnati, OH: Atomic Dog Publishing.
- Trott, P., Cordey-Hayes, M., and Seaton, R. A. F. (1995). Inward technology transfer as an interactive process. *Technovation*, **15**(25-43).
- Tsang, E. W. K. (2002). Acquiring knowledge by foreign partners from international joint ventures in a transition economy: Learning-by-doing and learning myopia. *Strategic Management Journal*, **23**(9), 835-854.
- Turnbull, P., and Ford, D. (1996). Interaction, relationships and networks in business markets: An evolving perspective. *Journal of Business & Industrial Marketing*, **11**(3/4), 44-62.
- Uzzi, B., and Lancaster, R. (2003). Relational embeddedness and learning: The case of bank loan managers and their clients. *Management Science*, **49**(4), 383-399.
- Vazquez-Casielles, R., Santos, M. L., and Alvarez-Gonzalez, L. I. (2001). Market orientation, innovation and competitive strategies in industrial firms. *Journal of Strategic Marketing*, **9**(1), 69-90.
- Venkatraman, N., and Ramanujam, V. (1986). Measurement of business performance in strategy research: A comparison of approaches. *Academy of Management Review*, **1**(4), 801-814.
- Vrijhoel, R., and Koskela, L. (2000). The four roles of supply chain management in construction. *European Journal of Purchasing & Supply Management*, **6**, 169-178.
- Wallentin, F. (2004). *Confirmatory factor analysis with ordinal variables: A simulation study*. Paper presented at the 24th Biennial Conference of the Society for Multivariate Analysis in the Behavioral Sciences (SMABS 2004), Friedrich Schiller University Jena, Germany.
- Walter, J., Lechner, C., and Kellermanns, F. W. (2007). Knowledge transfer between and within alliance partners: Private versus collective benefits of social capital. *Journal of Business Research*, **60**(7), 698-710.
- Walton, L. W. (1996). Partnership satisfaction: Using underlying dimensions of supply chain partnership to measure current and expected levels of satisfaction. *Journal*

- of Business Logistics*, **17**(2), 57-75.
- Wang, P., Tong, T. W., and Koh, C. P. (2004). An integrated model of knowledge transfer from MNC parent to China subsidiary. *Journal of World Business*, **39**(2), 168-182.
- Webster, F. E. (1992). The changing role of marketing in the corporation. *Journal of Marketing*, **56**(4), 1-17.
- Webster, M. (2002). Supply system structure, management and performance: A conceptual model. *International Journal of Management Reviews*, **4**(4), 353-369.
- Weiss, C. H. (1980). Knowledge creep and decision accretion. *Knowledge: Creation, Diffusion, Utilization*, **1**(3), 381-404.
- Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, **5**(2), 171-180.
- Wheaton, B., Muthen, B., Alwin, D. F., and Summers, G. F. (1977). Assessing reliability and stability in panel models. *Sociological Methodology*, **8**, 84-136.
- Wiig, K. M. (1997). Roles of knowledge-based systems in support of knowledge management. In J. Liebowitz and L. C. Wilcox (Eds.), *Knowledge management and its integrative elements* (pp. 69-88). Boca Raton, Florida: CRC Press.
- Wijk, R. V., Jansen, J. J. P., and Lyles, M. A. (2008). Inter- and intra-organizational knowledge transfer: A meta-analytic review and assessment of its antecedents and consequences. *Journal of Management Studies*, **45**(4), 830-853.
- Williams, C. (2007). Transfer in context: Replication and adaptation in knowledge transfer relationships. *Strategic Management Journal*, **28**(9), 867-889.
- Williams, O. E. (1985). *The economic institutions of capitalism*. New York: Free Press.
- Williamson, O. E. (1975). *Market and hierarchies*. Englewood Cliffs, NJ: Prentice-Hall.
- Wilson, D. T. (1995). An integrated model of buyer-seller relationships. *Journal of the Academy of Marketing Science*, **23**(4), 335-345.
- Wilson, E. J., and Vlosky, R. P. (1997). Partnering relationship activities: Building theory from case study research. *Journal of Business Research*, **39**(1), 59-70.
- Wisner, J. D. (2003). A structural equation model of supply chain management strategies and firm performance. *Journal of Business Logistics*, **24**(1), 1-26.

- Wong, A., and Fung, P. (1999). Total quality management in the construction industry in Hong Kong: A supply chain management perspective. *Total Quality Management*, **10**(2), 199-208.
- Wu, F., and Cavusgil, S. T. (2006). Organizational learning, commitment, and joint value creation in interfirm relationships. *Journal of Business Research*, **59**(1), 81-89.
- Wu, S.-H., and Hsu, F. B. (2001). Towards a knowledge-based view of OEM relationship building: Sharing of industrial experiences in Taiwan. *International Journal of Technology Management*, **22**(5-6), 503-523.
- Yan, A., and Gray, B. (1994). Bargaining power, management control and performance in United States-China joint ventures: A comparative case study. *Academy of Management Journal*, **37**(6), 1478-1517.
- Yilmaz, C., Alpan, L., and Ergun, E. (2005a). Cultural determinants of customer- and learning-oriented value systems and their joint effects on firm performance. *Journal of Business Research*, **58**(10), 1340-1352.
- Yilmaz, C., Sezen, B., and Ozdemir, O. (2005b). Joint and interactive effects of trust and (inter) dependence on relational behaviors in long-term channel dyads. *Industrial Marketing Management*, **34**, 235-248.
- Yin, R. K. (2003). *Case study research: Design and methods* (3rd ed.). California: Sage Publications.
- Yu, Z., Yan, H., and Cheng, T. C. E. (2001). Benefits of information sharing with supply chain partnership. *Industrial Management & Data Systems*, **101**(3), 114-119.
- Zaheer, A., McEvily, B., and Perrone, V. (1998). Does trust matter? Exploring the effects of interorganizational and interpersonal trust on performance. *Organization Science*, **9**(2), 123.
- Zhao, Z., Anand, J., and Mitchell, W. (2005). A dual networks perspective on inter-organizational transfer of R&D capabilities: International joint ventures in the Chinese automotive industry. *Journal of Management Studies*, **42**(1), 127-160.

## FURTHER READINGS

- Ahmed, P. K., Kok, L. K., and Loh, A. Y. E. (2002). *Learning through knowledge management*. Oxford: Butterworth-Heinemann.
- Allison, P. D. (2002). *Missing data*. Thousand Oaks, CA: Sage Publications.
- Anastas, J. W., and MacDonald, M. L. (1994). *Research design for social work and the human services*. New York: Lexington.
- Anderson, J. C., and Gerbing, D. W. (1992). Assumptions and comparative strengths of the two-step approach: Comment on Fornell and Yi. *Sociological Methods & Research*, **20**(1), 321-333.
- Argyris, C. (1990). *Overcoming organizational defences*. Needham, MA: Allyn and Bacon.
- Argyris, C., and Schon, D. A. (1978). *Organizational learning*. Reading, MA: Addison-Wesley.
- Armstrong, J. S., and Overton, T. (1977). Estimating nonresponse bias in mail surveys. *Journal of Marketing Research*, **14**(3), 396-402.
- Ayers, J. B. (2001). *Handbook of supply chain management*. London: St. Lucie Press.
- Bagozzi, R. P., Yi, Y., and Phillips, L. W. (1991). Assessing construct validity in organizational research. *Administrative Science Quarterly*, **36**, 421-458.
- Baily, P., Farmer, D., Jessop, D., and Jones, D. (2005). *Purchasing principles and management* (9th ed.). Harlow England: Prentice Hall.
- Ballou, R. H. (2004). *Business logistics/supply chain management: Planning, organizing, and controlling the supply chain* (5th ed.). New Jersey, Upper Saddle River: Pearson Education International.
- Bandalos, D. L. (1993). Factors influencing cross-validation of confirmatory factor analysis models. *Multivariate Behavioral Research*, **28**(3), 351.
- Beal, G., Dissanayake, W., and Konoshima, S. (1986). *Knowledge generation, exchange and utilization*. Boulder, Co: The Westview Press.
- Beamish, P. W., and Killing, J. P. (Eds.). (1997a). *Cooperative strategies: European*

- perspectives*. San Francisco: The New Lexington Press.
- Beamish, P. W., and Killing, J. P. (Eds.). (1997b). *Cooperative strategies: North American perspectives*. San Francisco: The New Lexington Press.
- Benson, J., and Bandalos, D. L. (1992). Second-order confirmatory factor analysis of the reaction to test scale with cross-validation. *Multivariate Behavioral Research*, **27**(3), 459-487.
- Boomsma, A., and Hoogland, J. J. (2001). The robustness of LISREL modeling revisited. In S. d. T. R. Cudeck and D. Sörbom (Eds.), *Structural equation models: Present and future. A festschrift in honor of Karl Jöreskog* (pp. 139–168). Chicago: Scientific Software International.
- Bowersox, D. J., Closs, D. J., and Cooper, M. B. (2002). *Supply chain logistics management*. London: McGraw-Hill.
- Bowersox, D. J., Closs, D. J., and Stank, T. P. (1999). *21st century logistics: Making supply chain integration a reality*. Oak Brook, IL: Council of Logistics Management.
- Bray, J. H., and Maxwell, S. E. (1985). *Multivariate analysis of variance*. Beverly Hills, CA: Sage Publications.
- Browne, M. W., and Cudeck, R. (1989). Single sample cross-validation indices for covariance structures. *Multivariate Behavioral Research*, **24**(4), 445–455.
- Browne, M. W., and Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen and J. S. Long (Eds.), *Testing structural equation models* (pp. 136-162). Newbury Park, CA: Sage.
- Bryant, F. B., Yarnold, P. R., and Michelson, E. A. (1999). Statistical methodology: Viii. Using confirmatory factor analysis (CFA) in emergency medicine research. *Academic Emergency Medicine*, **6**(1), 54-66.
- Bryman, A. (1989). *Research methods and organization studies*. London: Unwin Hyman.
- Bryman, A., and Bell, E. (2003). *Business research methods*. New York: Oxford University Press.
- Bryman, A., and Cramer, D. (2001). *Quantitative data analysis with SPSS release 10 for windows*. New York: Routledge.

- Burnes, B., and Dale, B. (Eds.). (1998). *Working in partnership: Best practice in customer-supplier relations*. Hampshire, UK: Gower Publishing Ltd.
- Byrne, B. M. (2001). *Structural equation modeling with Amos : Basic concepts, applications and programming*. London: Lawrence Erlbaum.
- Byrne, B. M. (2001). Structural equation modeling with Amos, EQS, and LISREL: Comparative approaches to testing for the factorial validity of a measuring instrument. *International Journal of Testing*, **1**(1), 55-86.
- Cassell, C., and Symon, G. (1994). *Qualitative methods in organizational research: A practical guide*. London: SAGE.
- Chatfield, C., and Collins, A. J. (1995). *Introduction to multivariate analysis*. London: Chapman & Hall.
- Child, D. (1990). *The essentials of factor analysis* (2nd ed.). London: Cassell.
- Chopra, S., and Meindl, P. (2001). *Supply chain management: Strategy, planning, and operation*. Upper Saddle River, N.J.: Prentice Hall.
- Chou, C.-P., and Bentler, P. M. (1993). Invariant standardized estimated parameter change for model modification in covariance structure analysis. *Multivariate Behavioral Research*, **28**(1), 97.
- Christopher, M. (1998). *Logistics and supply chain management: Strategies for reducing cost and improving service* (2nd ed.). London: FT Prentice Hall.
- Coase, R. (1937). The nature of the firm. *Economica*, **4**(16), 386-405.
- Contractor, F. J., and Lorange, P. (1988). *Co-operative strategies in international business: Joint ventures and technology partnerships between firms*. Lexington, MA: Lexington Books.
- Cooper, D. R., and Schindler, P. S. (2003). *Business research methods*: McGraw-Hill.
- Creswell, J. W. (1994). *Research design: Qualitative and quantitative approaches*. London: Sage Publications.
- Curran, P. J., West, S. G., and Finch, J. F. (1996). The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. *Psychological Methods*, **1**(1), 16-29.
- Cyert, R. M., and March, J. G. (1963). *A behavioral theory of the firm*. Englewood Cliffs,

- NJ: Prentice-Hall.
- Cyert, R. M., and March, J. G. (1992). *A behavioral theory of the firm* (2nd ed.). Oxford: Blackwell Business.
- DeGroot, M. H. (1986). *Probability and statistics* (2nd ed.). Wokingham: Addison-Wesley.
- Dillenbourg, P., Baker, M., Blaye, A., and O'Malley, C. (1996). The evolution of research on collaborative learning. In E. Spada and P. Reiman (Eds.), *Learning in humans and machine: Towards an interdisciplinary learning science* (pp. 189-211). Oxford: Elsevier.
- Dillman, D. A. (1978). *Mail and telephone surveys: The total design method*. New York: Wiley-Interscience.
- Dillman, D. A. (2000). *Mail and Internet surveys: The tailored design method* (2nd ed.). New York: John Wiley & Sons, Inc.
- Eisenhardt, K. M. (1989). Building theories from case study research. *The Academy of Management Review*, **14**(4), 532-550.
- Evans, J. (1983). Criteria of validity: Exploring the relationship between ethnographic and quantitative approaches. In M. Hammersley (Ed.), *The ethnography of schooling*. Driffield: Nafferton Books.
- Field, A. (2000). *Discovering statistics using SPSS for windows*. London: SAGE.
- Flora, D. B., and Curran, P. J. (2004). An empirical evaluation of alternative methods of estimation for confirmatory factor analysis with ordinal data. *Psychological Methods*, **9**(4), 466-491.
- Fornell, C., and Yi, Y. (1992a). Assumptions of the two-step approach to latent variable modeling. *Sociological Methods & Research*, **20**(1), 291-320.
- Fornell, C., and Yi, Y. (1992b). Assumptions of the two-step approach: Reply to Anderson and Gerbing. *Sociological Methods & Research*, **20**(1), 334-339.
- Forrester, J. W. (1961). *Industrial dynamics*. Cambridge, MA: MIT Press.
- Forsythe, J. B. (1977). Obtaining cooperation in a survey of business executives. *Journal of Marketing Research*, **14**(3), 370-373.
- Garson, G. D. (2001). *Guide to writing empirical papers, theses and dissertations*: CRC



Press.

- Ghauri, P., and Gronhaug, K. (2002). *Research methods in business studies: A practical guide* (2nd ed.). Harlow, England: Prentice Hall.
- Goffin, R. D., and Jackson, D. N. (1992). Analysis of multitrait-multirater performance appraisal data: Composite direct product method versus confirmatory factor analysis. *Multivariate Behavioral Research*, **27**(3), 363.
- Gray, B. (1989). *Collaborating*. San Francisco: Jossey-Bass.
- Grayson, K., and Rust, R. (2001). Interrater reliability. *Journal of Consumer Psychology*, **10**(1/2), 71-73.
- Hair, J. F., Anderson, R. E., Tatham, R. L., and Black, W. C. (1998). *Multivariate data analysis* (5th ed.). London: Prentice-Hall.
- Handfield, R. B., and Nichols, E. L. (2002). *Supply chain redesign: Transforming supply chains into integrated value systems*. Upper Saddle River, NJ: Financial Times Prentice Hall.
- Hartley, J. F. (1994). Case studies in organizational research. In C. Cassell and G. Symon (Eds.), *Qualitative methods in organizational research: A practical guide*. London: SAGE.
- Helleloid, D., and Simonin, B. L. (1994). Organizational learning and a firm's core competence. In G. Hamel and A. Heene (Eds.), *Competence based competition* (Vol. 213-239). New York: Wiley.
- Hohmann, H.-H., and Welter, F. (Eds.). (2005). *Trust and entrepreneurship: A west-east perspective*. Cheltenham, UK: Edward Elgar.
- Houston, M. J. N., John R.. (1977). The effects of source and appeal on mail survey response. *Journal of Marketing Research*, **14**(3), 374-378.
- Hu, L., and Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods*, **3**, 424-453.
- Iacobucci, D. (2001). Methodological and statistical concerns of the experimental behavioral researcher: Introduction. *Journal of Consumer Psychology*, **10**(1/2), 1-2.

- Joreskog, K. G. (2005). *Structural equation modeling with ordinal variables using LISREL*. Lincolnwood, IL: Scientific Software International, Inc.
- Jöreskog, K. G. (1990). New developments in LISREL: Analysis of ordinal variables using polychoric correlations and weighted least squares. *Quality and Quantity*, **24**(4), 387-404.
- Joreskog, K. G., and Sorbom, D. (1989). *LISREL 7: A guide to the program and applications* (2nd ed.). Chicago, Illinois: SPSS Inc.
- Joreskog, K. G., and Sorbom, D. (1993). *LISREL 8: User's reference guide*. Mooresville, IN: Scientific Software.
- Joreskog, K. G., and Sorbom, D. (1996). *Prelis 2: User's reference guide*: Scientific Software International.
- Joreskog, K. G., and Sorbom, D. (2004). *LISREL 8.70*. Lincolnwood, IL, USA: Scientific Software International, Inc.
- Kim, A., and Lim, E.-Y. (1999, April 19-23, 1999). *How critical is back translation in cross-cultural adaptation of attitude measures?* Paper presented at the Annual Meeting of the American Educational Research Association, Montreal, Quebec, Canada.
- Kline, R. (1998). *Principles and practices of structural equation modeling*. New York: The Guilford Press.
- Kogut, B., Sham, W., and Walker, G. (1993). Competitive cooperation in biotechnology: Learning through networks? In N. Nohria and R. Eccles (Eds.), *Networks and organizations: Structure, form, and action* (pp. 348-365). Boston: Harvard Business School Press.
- Lamming, R. C. (1993). *Beyond partnership: Strategies for innovation and lean supply*. London: Prentice Hall.
- Leonard-Barton, D. (1995). *Wellsprings of knowledge*. Boston, MA: Harvard Business School Press.
- Liebowitz, J., and Wilcox, L. C. (Eds.). (1997). *Knowledge management and its integrative elements*. Boca Raton, Florida: CRC Press.
- Lysons, K., and Farrington, B. (2006). *Purchasing and supply chain management* (7th

- ed.). Harlow, England: Prentice Hall.
- Macbeth, D. K., and Ferguson, N. (1994). *Partnership sourcing: An integrated supply chain approach*. London: FT Pitman Publishing.
- Maxwell, B. (1996). Translation and cultural adaptation of the survey instruments. In M. O. Martin and D. L. Kelly (Eds.), *Third international mathematics and science study (TIMSS) technical report, volume i: Design and development*. Chestnut Hill, MA: Boston College.
- May, T. (1997). *Social research: Issues, methods and process* (2nd ed.). Buckingham: Open University Press.
- Medsker, G. J., Williams, L. J., and Holahan, P. J. (1994). A review of current practices for evaluating causal models in organizational behavior and human resources management research. *Journal of Management*, **20**(2), 439-464.
- Mels, G. (2004). *LISREL 8.7 for windows: Getting started guide*. Lincolnwood, IL: Scientific Software International, Inc.
- Mulaik, S. A., James, L. R., Van Alstine, J., Bennett, N., Lind, S., and Stilwell, C. D. (1989). Evaluation of goodness-of-fit indices for structural equation models. *Psychological Bulletin*, **105**(3), 430-445.
- Nelson, R., and Winter, S. (1982). *An evolutionary theory of economic change*. Cambridge, MA: Belknap.
- Netemeyer, R., Bentler, P., Bagozzi, R., Cudeck, R., Cote, J., Lehmann, D., et al. (2001). Structural equations modeling. *Journal of Consumer Psychology*, **10**(1/2), 83-100.
- Neuendorf, K. A. (2002). *The content analysis guidebook*. London: Sage Publications.
- Nishiguchi, T. (1994). *Strategic industrial sourcing*. Oxford: Oxford University Press.
- Nonaka, I., and Takeuchi, H. (1995). *The knowledge-creating company*. New York: Oxford University Press.
- Nonaka, I., and Teece, D. J. (Eds.). (2001). *Managing industrial knowledge: Creation, transfer and utilization*. London: Sage.
- Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). New York: McGraw-Hill.
- Penrose, E. T. (1959). *The theory of growth of the firm*. London: Basil Blackwell.
- Phillips, L. W. (1981). Assessing measurement error in key informant reports: A

- methodological note on organizational analysis in marketing. *Journal of Marketing Research*, **16**, 395-415.
- Polanyi, M. (1962). *Personal knowledge: Toward a post-critical philosophy*. Chicago, IL: University of Chicago Press.
- Porter, M. E. (1980). *Competitive strategy: Techniques for analyzing industrial and competitors*. New York: Free Press.
- Porter, M. E. (1985). *Competitive advantage: Creating and sustaining superior performance*. New York: Free Press.
- Probst, G., Raub, S., and Romhardt, K. (2003). *Managing knowledge: Building blocks for success*. Chichester: John Wiley & Sons.
- Raju, N. S., Laffitte, L. J., and Byrne, B. M. (2002). Measurement equivalence: A comparison of methods based on confirmatory factor analysis and item response theory. *Journal of Applied Psychology*, **87**(3), 517-529.
- Remenyi, D., Williams, B., Money, A., and Swarts, E. (1998). *Doing research in business and management: An introduction to process and method*. London: SAGE.
- Robson, C. (1993). *Real world research: A resource for social scientists and practitioner-researchers*. Oxford, UK: Blackwell.
- Robson, C. (2002). *Real world research* (2nd ed.). London: Blackwell.
- Rogers, D. S., and Tibben-Lembke, R. (1998). *Going backwards: Reverse logistics trends and practices*. Pittsburgh, USA: Reverse Logistics Executive Council.
- Rogers, E. W., and Boswell, W. (1998). *Knowledge utilization: The missing link between strategic human resource management and organizational performance*. New York: Managerial and Organizational Cognition, Stern School of Business, New York University.
- Sako, M. (1992). *Prices, quality and trust*. Cambridge: Cambridge University Press.
- Satorra, A., and Bentler, P. M. (1988). *Scaling corrections for chi-square statistics in covariance structure analysis*. Alexandria, VA: American Statistical Association.
- Satorra, A., and Bentler, P. M. (1994). Corrections to test statistics and standard errors in covariance structure analysis. In A. V. Eye and C. C. Clogg (Eds.), *Latent variables analysis: Applications for developmental research* (pp. 399-419).

- Thousand Oaks, CA: Sage.
- Saunders, M., Lewis, P., and Thornhill, A. (2000). *Research methods for business students* (2nd ed.). Harlow, England: Prentice Hall.
- Schumacker, R. E., and Lomax, R. G. (2004). *A beginner's guide to structural equation modeling* (2nd ed.). London: Lawrence Erlbaum Associates, Publishers.
- Scott, W. R. (2008). *Institutions and organizations: Ideas and interests* (3rd ed.). London: Sage.
- Sharma, S. (1996). *Applied multivariate techniques*. New York: John Wiley & Sons, Inc.
- Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E. (2008). *Designing and managing the supply chain: Concepts, strategies and case studies* (3rd ed.). New York: MacGraw-Hill.
- Slater, S. F., and Narver, J. C. (1994). *Market oriented isn't enough: Build a learning organization*. Cambridge, MA: Marketing Science Institute.
- Stewart, D., Barnes, J., Cudeck, R., Cote, J., and Malthouse, E. (2001). Factor analysis. *Journal of Consumer Psychology*, **10**(1/2), 75-82.
- Stewart, D. W., and Shamdasani, P. N. (1990). *Focus groups: Theory and practice*. London: SAGE.
- Thompson, J. D. (1967). *Organizations in action*. New York: McGraw-Hill.
- Tomarken, A. J., and G.Waller, N. (2005). Structural equation modeling: Strengths, limitations, and misconceptions. *Annual Review of Clinical Psychology*, **1**, 31-65.
- Ullman, J. B. (2006). Structural equation modeling: Reviewing the basics and moving forward. *Journal of Personality Assessment*, **87**(1), 35-50.
- Vittadini, G. (1989). Indeterminacy problems in the LISREL model. *Multivariate Behavioral Research*, **24**(4), 397.
- Von-Hippel, E. (1988). *The sources of innovation*. New York: Oxford University Press.
- Wallentin, F. (2004). *Confirmatory factor analysis with ordinal variables: A simulation study*. Paper presented at the 24th Biennial Conference of the Society for Multivariate Analysis in the Behavioral Sciences (SMABS 2004), Friedrich Schiller University Jena, Germany.
- Weber, R. P. (1990). *Basic content analysis* (2nd ed.). Newbury Park, CA.: Sage

Publications.

Weiss, C. H. (1980). Knowledge creep and decision accretion. *Knowledge: Creation, Diffusion, Utilization*, **1**(3), 381-404.

Weiss, C. H. (Ed.). (1997). *Using social research in public policy making*. Lexington, Mass: Lexington Books.

Williams, O. E. (1979). Transaction-cost economics: The governance of contractual relations. *Journal of Law and Economics*, **22**(2), 233-261.

Williams, O. E. (1985). *The economic institutions of capitalism*. New York: Free Press.

Williamson, O. E. (1975). *Market and hierarchies*. Englewood Cliffs, NJ: Prentice-Hall.

Yin, R. K. (1994). *Case study research: Design and methods* (2nd ed.). California: Sage Publications.

Yin, R. K. (2003). *Case study research: Design and methods* (3rd ed.). California: Sage Publications.

## **APPENDICES**

### **APPENDIX 1 ENGLISH VERSION OF SURVEY (NON-RANDOMIZED)**

# **Survey of Knowledge Transfer** **in Supply Chain Partnership**

## **Instructions:**

**Please answer this questionnaire based on your own perceptions in anonymity. This questionnaire will take approximately 15 minutes to answer.**

**(For definitions of key terms please refer to the Appendix)**

**The result of the survey will only be used for academic research purposes.**

**Individual answers will be kept confidential.**



**Middlesex  
University**



## **Terms and Definitions**

**Supply Chain:** *in a typical supply chain, raw materials are procured and items are produced at one or more factories, shipped to warehouses for intermediate storage, and then shipped to retailers or customers. A supply chain may consist of suppliers, manufacturing centers, warehouses, distribution centers, and retail outlets.*

**Supply Chain Partnership:** *an enduring relationship between your firm and the firm in the successive stages of the industry chain based on vertical complementarities, and which yields a competitive advantage resulting in greater business performance than would be achieved by the single firm alone.*

**Knowledge Transfer:** *in this survey knowledge is mainly referred to as best practices, management approaches, production or management technologies, marketing know how, etc. which are beneficial to the development of the business. Knowledge transfer is therefore referred to as the process of flowing or sharing of such knowledge between firms during the daily cooperation or transactions.*

**Total Cycle Time:** *the time from a customer order has been received until the order has been fulfilled.*

**Order Lead-time:** *the time used to process a customer order.*

**Supplier Lead-time:** *the time a supplier used from receiving an order until delivering of supplies.*

**Product Development Cycle Time:** *the time used to develop a new product.*

**Purchase Order Cycle Time:** *the time used to process a purchasing order by the firm.*

**Production/Process Cycle Time:** *the time from receiving a production order until the completion of the production.*

**Delivery Lead-time:** *the time used to deliver the product to the customer.*

**Return on Total Asset:** *the ratio between net profit of the year and the total assets, the higher the ratio the better and more efficient the use of firm's assets.*

## Section 1: Supply Chain Relationship between Your Firm and Baogang

### 1-1 Is your firm a part of or a subsidiary of Baogang?

Yes ☐ No ☐ Don't Know ☐

**Note:** If answered "Yes" please go to Section 2 directly.

If answered "No" or "Don't Know" please continue to the next question.

### 1-2 Does your firm directly sell products or services to Baogang?

Yes ☐ No ☐ Don't Know ☐

### 1-3 Does your firm directly purchase products or services from Baogang?

Yes ☐ No ☐ Don't Know ☐

### 1-4 How long has your firm been doing business with Baogang?

(Please tick the appropriate answer)

Less than 1 year ..... ☐ 1

1-3 years ..... ☐ 2

4-6 years ..... ☐ 3

7-9 years ..... ☐ 4

10 years or more ..... ☐ 5

Don't know ..... ☐ 6

Not Applicable ..... ☐ 7

### 1-5 Does your firm have written contract or agreement with Baogang?

(Please tick the appropriate answer)

Yes ☐ No ☐ Don't Know ☐ Not Applicable ☐

### 1-6 Do you consider the relationship between your firm and Baogang as a supply chain partnership?

Yes ☐ No ☐ Don't Know ☐

**Note:** If answered "Yes" please go to Section 3 directly after answering question 1-7.

If answered "No" or "Don't Know" please go to Section 2.

### 1-7 If so, how long did this partnership last?

(Please tick the appropriate answer)

Less than 1 year ..... ☐ 1

1-3 years ..... ☐ 2

- 4-6 years..... ☐ 3  
 7-9 years..... ☐ 4  
 10 years or more ..... ☐ 5  
 Don't know ..... ☐ 6  
 Not Applicable ..... ☐ 7

## Section 2: About an Important Supply Chain Partner of Your Firm

**Your firm might have a number of partners either upstream or downstream in the supply chain in relation to the business of Baogang. Please choose the most important supply chain partners your firm has direct contact with to answer this questionnaire from your organization's point of view. Please answer the following questionnaire always with regard to this partner firm.**

**2-1 Which of the following statement best describe the business relationship between your firm and this supply chain partner?** (Please tick the appropriate answer)

- This partner SUPPLIES goods and services to our firm..... ☐ 1  
 This partner PURCHASES goods and services from our firm..... ☐ 2

Others please specify: \_\_\_\_\_

**2-2 Does your firm have written contract or agreement with this supply chain partner?**  
 (Please tick the appropriate answer)

Yes ☐                      No ☐                      Don't Know ☐

**2-3 How long has your firm been doing business with this supply chain partner?**  
 (Please tick the appropriate answer)

- Less than 1 year ..... ☐ 1  
 1-3 years..... ☐ 2  
 4-6 years..... ☐ 3  
 7-9 years..... ☐ 4  
 10 years or more ..... ☐ 5  
 Don't know ..... ☐ 6

**2-4 How long have your firm been a formal partner with this supply chain firm?**  
 (Please tick the appropriate answer)

- Less than 1 year ..... ☐ 1  
 1-3 years..... ☐ 2  
 4-6 years..... ☐ 3  
 7-9 years..... ☐ 4  
 10 years or more ..... ☐ 5

Don't know ..... ☐ 6

**2-5 How many employees does your supply chain partner have approximately?**

(Please tick one appropriate box)

- Less than 50 employees ..... ☐ 1  
50 to 99 employees ..... ☐ 2  
100 to 199 employees ..... ☐ 3  
200 to 499 employees ..... ☐ 4  
500 or more employees ..... ☐ 4  
Don't know ..... ☐ 5

**2-6 What is the main sector this partner belongs to?**

Please specify here: \_\_\_\_\_

**2-7 Could you please provide the name of this partner, if you can?**

Please specify here: \_\_\_\_\_

**Section 3: Nature of Relationship with This Partner**

If your firm has supply chain partnership with Baogang, please answer the following questions in regard to the partnership between your firm and Baogang;  
If your firm has no supply chain partnership with Baogang or your firm is a subsidiary of Baogang, please answer following questions in regard to the partnership between your firm and the supply chain partner you have chosen in Section 2

**3-1 Interdependence: to what extent do you agree or disagree with the following statement?**

(Please circle one number for each statement. 7=Agree Strongly; 4=neither agree nor disagree; 1=Strongly Disagree; DK= Don't Know)

The design of products requires contributions from both parties      7   6   5   4   3   2   1   DK

The production of products requires ongoing contributions from both parties      7   6   5   4   3   2   1   DK

It takes a significant amount of time and effort to understand our firm's specific requirements for products      7   6   5   4   3   2   1   DK   NA

It takes a significant amount of time and effort to understand this partner firm's specific requirements for products      7   6   5   4   3   2   1   DK   NA

Our firm and this partner are reliant on each other for the success of our respective businesses 7 6 5 4 3 2 1 DK

### 3-2 **Trust:** to what extent do you agree or disagree with the following statement?

(Please circle one number for each statement. 7= strongly agree; 4=neither agree nor disagree; 1=strongly disagree; DK= Don't Know)

This partner keeps promises it makes to our firm	7	6	5	4	3	2	1	DK
We believe the information this partner provides us	7	6	5	4	3	2	1	DK
This partner is <u>not</u> always honest with us	7	6	5	4	3	2	1	DK
This partner is genuinely concerned that our firm's business succeeds	7	6	5	4	3	2	1	DK
We trust this partner keeps our best interests in mind	7	6	5	4	3	2	1	DK
When making important decisions, this partner considers our welfare as well as its own	7	6	5	4	3	2	1	DK
This partner is trustworthy	7	6	5	4	3	2	1	DK
We find it necessary to be cautious with this partner	7	6	5	4	3	2	1	DK

### 3-3 **Commitment:** to what extent do you agree or disagree with the following statement?

(Please circle one number for each statement. 7= strongly agree; 4=neither agree nor disagree; 1=strongly disagree; DK= Don't Know)

We expect the relationship to continue for a long time	7	6	5	4	3	2	1	DK
We expect the relationship to strengthen over time	7	6	5	4	3	2	1	DK
We expect to increase our purchases/supplies with this partner in the future	7	6	5	4	3	2	1	DK
We are willing to put considerable effort and investment into building business with this partner	7	6	5	4	3	2	1	DK
We have invested a lot of effort in the relationship with this partner	7	6	5	4	3	2	1	DK
The business relationship with this partner firm can well be described as being a "partnership"	7	6	5	4	3	2	1	DK
The parties make plans not only for the terms of current transaction, but also for the continuance of the relationship	7	6	5	4	3	2	1	DK

**3-4 Shared Meaning: to what extent do you agree or disagree with the following statement?**

(Please circle one number for each statement. 7= strongly agree; 4=neither agree nor disagree;  
1=strongly disagree; DK= Don't Know)

Our firm and this partner develop a shared understanding of the available supply chain information	7	6	5	4	3	2	1	DK
Our firm and this partner develop a shared understanding of the implications of a supply chain activity	7	6	5	4	3	2	1	DK
Our firm and this partner have a shared continuous improvement philosophy	7	6	5	4	3	2	1	DK
We share a similar sense of fair play with this partner	7	6	5	4	3	2	1	DK
We have a high level of shared understanding about key supply chain issues	7	6	5	4	3	2	1	DK
Within this supply chain we have a shared vision or mission statement	7	6	5	4	3	2	1	DK

**3-5 Availability of Alternatives: to what extent do you agree or disagree with the following statement?**

(Please circle one number for each statement. 7= strongly agree; 4=neither agree nor disagree;  
1=strongly disagree; DK= Don't Know)

If our relationship were discontinued with this partner, we would have difficulty in making up the sales volume in our trading area	7	6	5	4	3	2	1	DK
This partner is crucial to our future performance	7	6	5	4	3	2	1	DK
It would be difficult for us to replace this partner	7	6	5	4	3	2	1	DK
We are dependent on this partner	7	6	5	4	3	2	1	DK
We do not have a good alternative to this partner	7	6	5	4	3	2	1	DK
This partner is important to our business	7	6	5	4	3	2	1	DK

**3-6 Restraint in Use of Power: to what extent do you agree or disagree with the following statement?**

(Please circle one number for each statement. 7= strongly agree; 4=neither agree nor disagree;  
1=strongly disagree; DK= Don't Know)

Both parties feel it is important <u>not</u> to use any proprietary information to the other party's <u>disadvantage</u>	7	6	5	4	3	2	1	DK
--	---	---	---	---	---	---	---	----

A characteristics of the relationship is that neither party is expected to make demands that might be damaging to the other 7 6 5 4 3 2 1 DK

Both parties expect the more powerful party to restrain the use of its power in attempting to get its way 7 6 5 4 3 2 1 DK

## Section 4: Learning and Interfirm Knowledge Transfer Activities

If your firm has supply chain partnership with Baogang, please answer the following questions in regard to the partnership between your firm and Baogang;  
If your firm has no supply chain partnership with Baogang or your firm is a subsidiary of Baogang, please answer following questions in regard to the partnership between your firm and the supply chain partner you have chosen in Section 2

### 4-1 Knowledge Acquisition: to what extent do you agree or disagree with the following statement?

(Please circle one number for each statement. 7= strongly agree; 4=neither agree nor disagree; 1=strongly disagree; DK= Don't Know)

Our firm and this partner meet regularly to find out what products we need in the future 7 6 5 4 3 2 1 DK

Our firm and the partner do a lot of in-house research on products we may need 7 6 5 4 3 2 1 DK

Our firm and this partner poll participants regularly to assess the quality of our supply chain services 7 6 5 4 3 2 1 DK

Our firm and this partner periodically review the likely effect of changes in the supply chain environment 7 6 5 4 3 2 1 DK

Formal routines between our firm and this supply chain partner exist to uncover faulty assumptions about the supply chain 7 6 5 4 3 2 1 DK

### 4-2 Knowledge Distribution: to what extent do you agree or disagree with the following statement?

(Please circle one number for each statement. 7= strongly agree; 4=neither agree nor disagree; 1=strongly disagree; DK= Don't Know)

Information about a supply chain partner's performance is disseminated to other departments regularly 7 6 5 4 3 2 1 DK

We discuss any new developments in our supply chain relationships with other departments 7 6 5 4 3 2 1 DK

We openly discuss supply chain relationship management issues with others 7 6 5 4 3 2 1 DK

If something important happens with the supply chain everyone involved is quickly informed 7 6 5 4 3 2 1 DK

**4-3 Instrumental Use of Knowledge: to what extent do you agree or disagree with the following statement?**

(Please circle one number for each statement. 7= strongly agree; 4=neither agree nor disagree; 1=strongly disagree; DK= Don't Know)

Without the information from supply chain partners, some of the decisions made in our company would have been very difficult 7 6 5 4 3 2 1 DK

The majority of information about the supply chain partner was ignored 7 6 5 4 3 2 1 DK

Knowledge generated from supply chain processes has been used in resolving some key issues of our company 7 6 5 4 3 2 1 DK

Knowledge from supply chain partners has been used in improving the performance of our company 7 6 5 4 3 2 1 DK

Knowledge gained from supply chain processes has been used in the daily operation of our company 7 6 5 4 3 2 1 DK

Some of the decisions made in our company were based on information from supply chain partners 7 6 5 4 3 2 1 DK

**4-4 Conceptual Use of Knowledge: to what extent do you agree or disagree with the following statement?**

(Please circle one number for each statement. 7= strongly agree; 4=neither agree nor disagree; 1=strongly disagree; DK= Don't Know)

The use of knowledge acquired from supply chain partners served to shed light on problems in our firm 7 6 5 4 3 2 1 DK

Our firm uses knowledge from supply chain partners to make situations more clear 7 6 5 4 3 2 1 DK

Our firm highlights the importance of knowledge generated from supply chain processes in making decisions 7 6 5 4 3 2 1 DK

Knowledge from supply chain partners is used to enrich the knowledge base of our firm 7 6 5 4 3 2 1 DK



Actions taken in our company have been influenced by information from supply chain processes

7 6 5 4 3 2 1 DK

**4-5 Symbolic Use of Knowledge: to what extent do you agree or disagree with the following statement?**

(Please circle one number for each statement. 7= strongly agree; 4=neither agree nor disagree; 1=strongly disagree; DK= Don't Know)

The use of knowledge acquired from supply chain partners served to confirm choices already made in our company

7 6 5 4 3 2 1 DK

Information gained from supply chain partners has been used to confirm decisions already made in our company.

7 6 5 4 3 2 1 DK

Knowledge from supply chain partners reinforces prior decisions of our company

7 6 5 4 3 2 1 DK

Knowledge from supply chain partners have been used to legitimize decisions of our company

7 6 5 4 3 2 1 DK

## Section 5: Firm and Supply Chain Performance

**Please indicate the level of your firm's performance on each of the following dimensions  
Compared to that of Major Industry Competitors**

**5-1 Planning performance:**

(Please circle one number for each statement: 7=Above Average; 1=Below Average; DK= Don't Know )

Total cycle time

7 6 5 4 3 2 1 DK

Order lead-time

7 6 5 4 3 2 1 DK

Information carrying cost

7 6 5 4 3 2 1 DK

**5-2 Sourcing Performance:**

(Please circle one number for each statement: 7=Above Average; 1=Below Average; DK= Don't Know )

Achievement of defect free deliveries of supplier

7 6 5 4 3 2 1 DK

Purchase order cycle time	7	6	5	4	3	2	1	DK
---------------------------	---	---	---	---	---	---	---	----

### 5-3 Production Performance:

(Please circle one number for each statement: 7=Above Average; 1=Below Average; DK= Don't Know )

Production/Process cycle time	7	6	5	4	3	2	1	DK
-------------------------------	---	---	---	---	---	---	---	----

Extent of co-operation to improve quality	7	6	5	4	3	2	1	DK
---	---	---	---	---	---	---	---	----

Capacity utilization	7	6	5	4	3	2	1	DK
----------------------	---	---	---	---	---	---	---	----

### 5-4 Delivery Performance:

(Please circle one number for each statement: 7=Above Average; 1=Below Average; DK= Don't Know )

Delivery lead-time	7	6	5	4	3	2	1	DK
--------------------	---	---	---	---	---	---	---	----

Delivery reliability	7	6	5	4	3	2	1	DK
----------------------	---	---	---	---	---	---	---	----

Responsiveness to urgent deliveries	7	6	5	4	3	2	1	DK
-------------------------------------	---	---	---	---	---	---	---	----

### 5-5 Customer Service Performance:

(Please circle one number for each statement: 7=Above Average; 1=Below Average; DK= Don't Know )

Customer query time	7	6	5	4	3	2	1	DK
---------------------	---	---	---	---	---	---	---	----

Flexibility to meet particular customer needs	7	6	5	4	3	2	1	DK
---	---	---	---	---	---	---	---	----

Overall customer service levels	7	6	5	4	3	2	1	DK
---------------------------------	---	---	---	---	---	---	---	----

### 5-6 Financial and Market Performance:

(Please circle one number for each statement: 7=Above Average; 1=Below Average; DK= Don't Know )

Market share	7	6	5	4	3	2	1	DK
--------------	---	---	---	---	---	---	---	----

Return on total assets	7	6	5	4	3	2	1	DK
------------------------	---	---	---	---	---	---	---	----

Average annual market share growth (over the past three years)	7	6	5	4	3	2	1	DK
--	---	---	---	---	---	---	---	----

Average annual sales growth (over the past three years)	7	6	5	4	3	2	1	DK
---	---	---	---	---	---	---	---	----

Average annual growth in return on total assets (over the	7	6	5	4	3	2	1	DK
---	---	---	---	---	---	---	---	----

past three years)

Overall product quality 7 6 5 4 3 2 1 DK

Overall competitive position 7 6 5 4 3 2 1 DK

## Section 6: About Your Firm and You

The following questions are for general analytical purposes only. They will not be used to identify any individuals.

### 6-1 What is the main sector your firm belongs to?

Please specify here: \_\_\_\_\_

### 6-2 How many employees does your firm have approximately?

(Please tick one appropriate box)

- Less than 50 employees ..... ☐ 1  
50 to 99 employees ..... ☐ 2  
100 to 199 employees ..... ☐ 3  
200 to 499 employees ..... ☐ 4  
500 or more employees ..... ☐ 5

### 6-3 Which of the following best describes your role in your firm?

(Please tick one appropriate box or provide details)

- Operating staff ..... ☐ 1  
Administrative staff ..... ☐ 2  
First line manager ..... ☐ 3  
Senior manager ..... ☐ 4  
CEO/Chairman/Managing director ..... ☐ 5  
Others (please specify) \_\_\_\_\_

### 6-4 Which part of the supply chain process your job is mainly involved in?

(Please tick appropriate box or provide details)

- Design and Development ..... ☐ 1  
Purchasing or Procurement ..... ☐ 2  
Production ..... ☐ 3  
Distribution ..... ☐ 4  
Customer Service ..... ☐ 5  
Finance ..... ☐ 6  
Not Applicable ..... ☐ 7

Others (please specify)\_\_\_\_\_

**6-5 How long have you been working at the current position in your firm?**

(Please tick one appropriate box)

Less than 6 months ..... ☐ 1

7 months to 1 year..... ☐ 2

1-2 years..... ☐ 3

3-4 years..... ☐ 4

5 years or more ..... ☐ 5

**6-6 Would you like an abstract of findings of this study?**

*If so, please provide your email address or other contact details below*

---

---

---

---

***Thank you for your assistance!***

## APPENDIX 2 TYPICAL EXAMPLES OF LISREL PROGRAM INPUTS

### Stage One: Measurement Model Evaluation

#### Part One: Partnership Nature Scale

##### (1) Confirmatory Factor Analysis of Original Scale: Calibration Sample

RELATIONSHIP ITEMS MODEL R1 - CONFORMATORY FACTOR ANALYSIS  
MODIFICATION, ALL ITEMS INCLUDED, CALIBRATION SAMPLE  
DA NI=35 NO=206 MA=CM  
LA  
INTDP1 INTDP2 INTDP3 INTDP4 INTDP5 TRUST1 TRUST2 TRUST3 TRUST4 TRUST5  
TRUST6 TRUST7 TRUST8 COMIT1 COMIT2 COMIT3 COMIT4 COMIT5 COMIT6 COMIT7  
SHAMG1 SHAMG2 SHAMG3 SHAMG4 SHAMG5 SHAMG6 ALTRN1 ALTRN2 ALTRN3  
ALTRN4 ALTRN5 ALTRN6 RSTPW1 RSTPW2 RSTPW3  
CM FI=RELATIONRH1.COV  
AC FI=RELATIONRH1.ACC  
MO NX=35 NK=6  
LK  
INTERDEP TRUST COMMIT SHAMG ALTRN RSTPW  
PA LX  
5(1 0 0 0 0 0) 8(0 1 0 0 0 0) 7(0 0 1 0 0 0) 6(0 0 0 1 0 0) 6(0 0 0 0 1 0) 3(0 0 0 0 0 1)  
PATH DIAGRAM  
OU SE TV MI SC

##### (2) Cross-validation of Refined Partnership Nature Scale: Test of Equal Pattern

RELATIONSHIP ITEMS MODEL R7 - TESTING EQUAL PATTERNS, GROUP CALIBRATION  
GROUP: CALIBRATION SAMPLE  
DA NG=2 NI=35 NO=206 MA=CM  
LA  
INTDP1 INTDP2 INTDP3 INTDP4 INTDP5 TRUST1 TRUST2 TRUST3 TRUST4 TRUST5  
TRUST6 TRUST7 TRUST8 COMIT1 COMIT2 COMIT3 COMIT4 COMIT5 COMIT6 COMIT7  
SHAMG1 SHAMG2 SHAMG3 SHAMG4 SHAMG5 SHAMG6 ALTRN1 ALTRN2 ALTRN3  
ALTRN4 ALTRN5 ALTRN6 RSTPW1 RSTPW2 RSTPW3  
CM FI=RELATIONRH1.COV  
AC FI=RELATIONRH1.ACC  
SE

1 2 5 6 7 9 10 11 12 14 15 16 17 19 20 21 22 23 24 25 26 27 28 29 31 33 34 35 /  
 MO NX=28 NK=6 TD=SY,FI  
 LK  
 INTERDEP TRUST COMMIT SHAMG ALTRN RSTPW  
 PA LX  
 3(1 0 0 0 0 0) 6(0 1 0 0 0 0) 6(0 0 1 0 0 0) 6(0 0 0 1 0 0) 4(0 0 0 0 1 0) 3(0 0 0 0 0 1)  
 FR TD(1 1) TD(2 2) TD(3 3) TD(4 4) TD(5 5) TD(6 6) TD(7 7) TD(8 8) TD(9 9) TD(10 10)  
 TD(11 11) TD(12 12) TD(13 13) TD(14 14) TD(15 15) TD(16 16) TD(17 17) TD(18 18) TD(19  
 19) TD(20 20) TD(21 21) TD(22 22) TD(23 23) TD(24 24) TD(25 25) TD(26 26) TD(27 27)  
 TD(28 28) TD(25 24) TD(15 11)  
 OU

RELATIONSHIP ITEMS R7 - TESTING EQUAL PATTERNS, GROUP VALIDATION

GROUP: VALIDATION SAMPLE

DA NO=207

LA

INTDP1 INTDP2 INTDP3 INTDP4 INTDP5 TRUST1 TRUST2 TRUST3 TRUST4 TRUST5  
 TRUST6 TRUST7 TRUST8 COMIT1 COMIT2 COMIT3 COMIT4 COMIT5 COMIT6 COMIT7  
 SHAMG1 SHAMG2 SHAMG3 SHAMG4 SHAMG5 SHAMG6 ALTRN1 ALTRN2 ALTRN3  
 ALTRN4 ALTRN5 ALTRN6 RSTPW1 RSTPW2 RSTPW3

CM FI=RELATIONRH2.COV

AC FI=RELATIONRH2.ACC

SE

1 2 5 6 7 9 10 11 12 14 15 16 17 19 20 21 22 23 24 25 26 27 28 29 31 33 34 35 /

MO LX=PS TD=PS

OU

### **(3) Second-order Confirmatory Factor Analysis of Partnership Strength**

SECOND-ORDER CONFORMATORY FACTOR ANALYSIS OF PARTNERSHIP STRENGTH  
 MODIFICATION, INTDP 3, INTDP4, TRUST3, TRUST8, and COMIT5, FREE THETA 15 11,  
 ENTIRE SAMPLE AFTER CROSS VALIDATION

DA NI=35 NO=413 MA=CM

LA

INTDP1 INTDP2 INTDP3 INTDP4 INTDP5 TRUST1 TRUST2 TRUST3 TRUST4 TRUST5  
 TRUST6 TRUST7 TRUST8 COMIT1 COMIT2 COMIT3 COMIT4 COMIT5 COMIT6 COMIT7  
 SHAMG1 SHAMG2 SHAMG3 SHAMG4 SHAMG5 SHAMG6 ALTRN1 ALTRN2 ALTRN3  
 ALTRN4 ALTRN5 ALTRN6 RSTPW1 RSTPW2 RSTPW3

CM FI=REL.COV

AC FI=REL.ACC

SE

1 2 5 6 7 9 10 11 12 14 15 16 17 19 20 21 22 23 24 25 26 /

MO NY=21 NE=4 NK=1 PH=ST GA=FI PS=DI TE=SY,FI

LE  
 INTERDEP TRUST COMMIT SHAMG  
 LK  
 STREGTH  
 PA LY  
 3(1 0 0 0) 6(0 1 0 0) 6(0 0 1 0) 6(0 0 0 1)  
 FR GA(1 1) GA(2 1) GA(3 1) GA(4 1)  
 FR TE(1 1) TE(2 2) TE(3 3) TE(4 4) TE(5 5) TE(6 6) TE(7 7) TE(8 8) TE(9 9) TE(10 10) TE(11  
 11) TE(12 12) TE(13 13) TE(14 14) TE(15 15) TE(16 16) TE(17 17) TE(18 18) TE(19 19)  
 TE(20 20) TE(21 21) TE(15 11)  
 PATH DIAGRAM  
 OU SE TV MI SC

## Part Two: Knowledge Transfer Process Scale

### (1) Second-order CFA of Knowledge Utilization Scale: Calibration Sample

KNOWLEDGE UTILIZATION MODEL U1- A SECOND ORDER FACTOR ANALYSIS,  
 CALIBRATION SAMPLE  
 DA NI=24 NO=206 MA=CM  
 LA  
 KNACQ1 KNACQ2 KNACQ3 KNACQ4 KNACQ5 KNDST1 KNDST2 KNDST3 KNDST4  
 INSTU1 INSTU2 INSTU3 INSTU4 INSTU5 INSTU6 CNCPU1 CNCPU2 CNCPU3 CNCPU4  
 CNCPU5 SYMBU1 SYMBU2 SYMBU3 SYMBU4  
 CM FI=KNTRANSRH1.COV  
 AC FI=KNTRANSRH1.ACC  
 SE  
 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 /  
 MO NY=15 NE=3 NK=1 PH=FI GA=FI PS=DI  
 LE  
 INSTRU CONCPU SYMBLU  
 LK  
 KNUSE  
 PA LY  
 6(1 0 0) 5(0 1 0) 4(0 0 1)  
 FR GA 1 1 GA 2 1 GA 3 1  
 ST 1 ALL  
 VA 1 PH(1 1)  
 Path Diagram  
 OU SE TV MI SC

### (2) Cross-validation of Knowledge Utilization Scale: Test of Equal Pattern

KNOWLEDGE UTILIZATION MODEL U5 - 2nd CFA TESTING EQUAL PATTERNS, GROUP  
CALIBRATION

GROUP: CALIBRATION SAMPLE

DA NG=2 NI=24 NO=206 MA=CM

LA

KNACQ1 KNACQ2 KNACQ3 KNACQ4 KNACQ5 KNDST1 KNDST2 KNDST3 KNDST4

INSTU1 INSTU2 INSTU3 INSTU4 INSTU5 INSTU6 CNCPU1 CNCPU2 CNCPU3 CNCPU4

CNCPU5 SYMBU1 SYMBU2 SYMBU3 SYMBU4

CM FI=KNTRANSRH1.COV

AC FI=KNTRANSRH1.ACC

SE

10 12 15 16 17 18 19 20 21 23 24 /

MO NX=11 NK=3

LK

INSTRU CONCPU SYMBLU

PA LX

3(1 0 0) 5(0 1 0) 3(0 0 1)

VA 1 LX(1 1) LX(4 2) LX(9 3)

OU

KNOWLEDGE UTILIZATION MODEL U5 - 2nd CFA TESTING EQUAL PATTERNS, GROUP  
VALIDATION

GROUP: VALIDATION SAMPLE

DA NO=207

LA

KNACQ1 KNACQ2 KNACQ3 KNACQ4 KNACQ5 KNDST1 KNDST2 KNDST3 KNDST4

INSTU1 INSTU2 INSTU3 INSTU4 INSTU5 INSTU6 CNCPU1 CNCPU2 CNCPU3 CNCPU4

CNCPU5 SYMBU1 SYMBU2 SYMBU3 SYMBU4

CM FI=KNTRANSRH2.COV

AC FI=KNTRANSRH2.ACC

SE

10 12 15 16 17 18 19 20 21 23 24 /

MO LX=PS TD=PS

OU

### **(3) CFA Analysis of Knowledge Transfer Scale: Calibration Sample**

ALL KNOWLEDGE TRANSFER ITEMS MODEL KT1- A CONFORMATORY FACTOR  
ANALYSIS WITH CROSS-VALIDATED REDUCED KNOWLEDGE UTILIZATION ITEMS,  
CALIBRATION SAMPLE

DA NI=12 NO=206 MA=CM

LA



KNACQ1 KNACQ2 KNACQ3 KNACQ4 KNACQ5 KNDST1 KNDST2 KNDST3 KNDST4  
 INSTRU CONCPU SYMBLU  
 CM FI=KNTRANSCVURH1.COV  
 AC FI=KNTRANSCVURH1.ACC  
 MO NX=12 NK=3  
 LK  
 KNACQ KNDIST KNUSE  
 PA LX  
 5(1 0 0) 4(0 1 0) 3(0 0 1)  
 PATH DIAGRAM  
 OU SE TV MI SC

### **(3) Cross-validation of Knowledge Transfer Scale: Test of Equal Patterns**

ALL KNOWLEDGE TRANSFER ITEMS MODEL KT2 - CFA TESTING EQUAL PATTERNS,  
 GROUP CALIBRATION  
 GROUP: CALIBRATION SAMPLE  
 DA NG=2 NI=12 NO=206 MA=CM  
 LA  
 KNACQ1 KNACQ2 KNACQ3 KNACQ4 KNACQ5 KNDST1 KNDST2 KNDST3 KNDST4  
 INSTRU CONCPU SYMBLU  
 CM FI=KNTRANSCVURH1.COV  
 AC FI=KNTRANSCVURH1.ACC  
 SE  
 1 2 3 4 6 7 8 9 10 11 12 /  
 MO NX=11 NK=3  
 LK  
 KNACQ KNDIST KNUSE  
 PA LX  
 4(1 0 0) 4(0 1 0) 3(0 0 1)  
 OU

ALL KNOWLEDGE TRANSFER ITEMS MODEL KT2 – CFA TESTING EQUAL PATTERNS,  
 GROUP VALIDATION  
 GROUP: VALIDATION SAMPLE  
 DA NO=207  
 LA  
 KNACQ1 KNACQ2 KNACQ3 KNACQ4 KNACQ5 KNDST1 KNDST2 KNDST3 KNDST4  
 INSTRU CONCPU SYMBLU  
 CM FI=KNTRANSCVURH2.COV  
 AC FI=KNTRANSCVURH2.ACC  
 SE  
 1 2 3 4 6 7 8 9 10 11 12 /  
 LK

KNACQ KNDIST KNUSE  
MO LX=PS  
OU

## Stage Two: Structural Equation Modeling

### Part One: Relationship between Partnership Nature and Knowledge Transfer Process

#### (1) SEM of Entire Sample

LISREL ANALYSIS OF FULL MODEL PART 1 PARTNERSHIP NATURE AND KNOWLEDGE TRANSFER, MODEL P1M11, MEASUREMENT MODEL CROSS VALIDATED,  
FIX GA(1 3) GA(3 3) GA(1 4) GA(1 2) GA(2 4) GA(2 2) GA(2 6) GA(2 5) GA(3 6) GA(3 4)  
DA NI=41 NO=413 MA=CM  
LA  
SCPERFM MKTPERFM KNACQ1 KNACQ2 KNACQ3 KNACQ4 KNDST1 KNDST2 KNDST3  
KNDST4 INSTRU CONCPU SYMBLU INTDP1 INTDP2 INTDP5 TRUST1 TRUST2 TRUST4  
TRUST5 TRUST6 TRUST7 COMIT1 COMIT2 COMIT3 COMIT4 COMIT6 COMIT7 SHAMG1  
SHAMG2 SHAMG3 SHAMG4 SHAMG5 SHAMG6 ALTRN1 ALTRN2 ALTRN3 ALTRN5 RSTPW1  
RSTPW2 RSTPW3  
CM FI=FULLSCALECV.COV  
AC FI=FULLSCALECV.ACC  
SE  
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37  
38 39 40 41 /  
MO NY=11 NX=28 NE=3 NK=6 BE=FU PS=DI TD=SY,FI TE=SY,FI PH=ST  
LE  
KNACQ KNDIST KNUSE  
LK  
INTERDEP TRUST COMMIT SHAMG ALTRN RSTPW  
PA LY  
4(1 0 0) 4(0 1 0) 3(0 0 1)  
PA LX  
3(1 0 0 0 0 0) 6(0 1 0 0 0 0) 6(0 0 1 0 0 0) 6(0 0 0 1 0 0) 4(0 0 0 0 1 0) 3(0 0 0 0 0 1)  
FR BE(2 1) BE(3 2) TD(1 1) TD(2 2) TD(3 3) TD(4 4) TD(5 5) TD(6 6) TD(7 7) TD(8 8) TD(9 9)  
TD(10 10) TD(11 11) TD(12 12) TD(13 13) TD(14 14) TD(15 15) TD(16 16) TD(17 17) TD(18 18)  
TD(19 19) TD(20 20) TD(21 21) TD(22 22) TD(23 23) TD(24 24) TD(25 25) TD(26 26) TD(27 27)  
TD(28 28) TD(15 11) TD(25 24) TE(1 1) TE(2 2) TE(3 3) TE(4 4) TE(5 5) TE(6 6) TE(7 7) TE(8 8)  
TE(9 9) TE(10 10) TE(11 11)  
VA 1 LY(1 1) LY(5 2) LY(9 3) LX(1 1) LX(4 2) LX(10 3) LX(16 4) LX(22 5) LX(26 6)  
FI GA(1 3) GA(3 3) GA(1 4) GA(1 2) GA(2 4) GA(2 2) GA(2 6) GA(2 5) GA(3 6) GA(3 4)  
PATH DIAGRAM  
OU SE TV EF MI SC AD=OFF

#### (2) SEM of Short Duration Sample

LISREL ANALYSIS OF FULL MODEL PART 1 PARTNERSHIP NATURE AND KNOWLEDGE  
TRANSFER, MODEL P1M10, MEASUREMENT MODEL CROSS VALIDATED, SAMPLE SHORT  
DURATION,

FIX GA(2 5) GA(2 6) GA(3 4) GA(3 2) GA(1 4) GA(1 3) GA(1 2) GA(3 6) GA(2 4)

DA NI=41 NO=213 MA=CM

LA

SCPERFRM MKTPERFM KNACQ1 KNACQ2 KNACQ3 KNACQ4 KNDST1 KNDST2 KNDST3  
KNDST4 INSTRU CONCPU SYMBLU INTDP1 INTDP2 INTDP5 TRUST1 TRUST2 TRUST4  
TRUST5 TRUST6 TRUST7 COMIT1 COMIT2 COMIT3 COMIT4 COMIT6 COMIT7 SHAMG1  
SHAMG2 SHAMG3 SHAMG4 SHAMG5 SHAMG6 ALTRN1 ALTRN2 ALTRN3 ALTRN5 RSTPW1  
RSTPW2 RSTPW3

CM FI=FULLSCALED RS.COV

AC FI=FULLSCALED RS.ACC

SE

3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37  
38 39 40 41 /

MO NY=11 NX=28 NE=3 NK=6 BE=FU PS=DI TD=SY,FI TE=SY,FI PH=ST

LE

KNACQ KNDIST KNUSE

LK

INTERDEP TRUST COMMIT SHAMG ALTRN RSTPW

PA LY

4(1 0 0) 4(0 1 0) 3(0 0 1)

PA LX

3(1 0 0 0 0 0) 6(0 1 0 0 0 0) 6(0 0 1 0 0 0) 6(0 0 0 1 0 0) 4(0 0 0 0 1 0) 3(0 0 0 0 0 1)

FR BE(2 1) BE(3 2) TD(1 1) TD(2 2) TD(3 3) TD(4 4) TD(5 5) TD(6 6) TD(7 7) TD(8 8) TD(9 9)  
TD(10 10) TD(11 11) TD(12 12) TD(13 13) TD(14 14) TD(15 15) TD(16 16) TD(17 17) TD(18 18)  
TD(19 19) TD(20 20) TD(21 21) TD(22 22) TD(23 23) TD(24 24) TD(25 25) TD(26 26) TD(27 27)  
TD(28 28) TD(15 11) TD(25 24) TE(1 1) TE(2 2) TE(3 3) TE(4 4) TE(5 5) TE(6 6) TE(7 7) TE(8 8)  
TE(9 9) TE(10 10) TE(11 11)

VA 1 LY(1 1) LY(5 2) LY(9 3) LX(1 1) LX(4 2) LX(10 3) LX(16 4) LX(22 5) LX(26 6)

FI GA(2 5) GA(2 6) GA(3 4) GA(3 2) GA(1 4) GA(1 3) GA(1 2) GA(3 6) GA(2 4)

PATH DIAGRAM

OU SE TV EF MI SC AD=OFF

### **(3) SEM of Contracted Partnership Sample**

LISREL ANALYSIS OF FULL MODEL PART 1 PARTNERSHIP NATURE AND KNOWLEDGE  
TRANSFER, MODEL P1M11, MEASUREMENT MODEL CROSS VALIDATED, SAMPLE WITH  
CONTRACT,

FIX GA(2 2) GA(3 4) GA(3 6) GA(1 3) GA(2 6) GA(2 5) GA(3 2) GA(1 1) GA(1 2) GA(2 4)

DA NI=41 NO=285 MA=CM

LA

SCPERFRM MKTPERFM KNACQ1 KNACQ2 KNACQ3 KNACQ4 KNDST1 KNDST2 KNDST3  
KNDST4 INSTRU CONCPU SYMBLU INTDP1 INTDP2 INTDP5 TRUST1 TRUST2 TRUST4

TRUST5 TRUST6 TRUST7 COMIT1 COMIT2 COMIT3 COMIT4 COMIT6 COMIT7 SHAMG1  
 SHAMG2 SHAMG3 SHAMG4 SHAMG5 SHAMG6 ALTRN1 ALTRN2 ALTRN3 ALTRN5 RSTPW1  
 RSTPW2 RSTPW3  
 CM FI=FULLSCALECTY.COV  
 AC FI=FULLSCALECTY.ACC  
 SE  
 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37  
 38 39 40 41 /  
 MO NY=11 NX=28 NE=3 NK=6 BE=FU PS=DI TD=SY,FI TE=SY,FI PH=ST  
 LE  
 KNACQ KNDIST KNUSE  
 LK  
 INTERDEP TRUST COMMIT SHAMG ALTRN RSTPW  
 PA LY  
 4(1 0 0) 4(0 1 0) 3(0 0 1)  
 PA LX  
 3(1 0 0 0 0 0) 6(0 1 0 0 0 0) 6(0 0 1 0 0 0) 6(0 0 0 1 0 0) 4(0 0 0 0 1 0) 3(0 0 0 0 0 1)  
 FR BE(2 1) BE(3 2) TD(1 1) TD(2 2) TD(3 3) TD(4 4) TD(5 5) TD(6 6) TD(7 7) TD(8 8) TD(9 9)  
 TD(10 10) TD(11 11) TD(12 12) TD(13 13) TD(14 14) TD(15 15) TD(16 16) TD(17 17) TD(18 18)  
 TD(19 19) TD(20 20) TD(21 21) TD(22 22) TD(23 23) TD(24 24) TD(25 25) TD(26 26) TD(27 27)  
 TD(28 28) TD(15 11) TD(25 24) TE(1 1) TE(2 2) TE(3 3) TE(4 4) TE(5 5) TE(6 6) TE(7 7) TE(8 8)  
 TE(9 9) TE(10 10) TE(11 11)  
 VA 1 LY(1 1) LY(5 2) LY(9 3) LX(1 1) LX(4 2) LX(10 3) LX(16 4) LX(22 5) LX(26 6)  
 FI GA(2 2) GA(3 4) GA(3 6) GA(1 3) GA(2 6) GA(2 5) GA(3 2) GA(1 1) GA(1 2) GA(2 4)  
 OU SE TV EF MI SC AD=OFF

#### **(4) SEM of Upstream Sample**

LISREL ANALYSIS OF FULL MODEL PART 1 PARTNERSHIP NATURE AND KNOWLEDGE  
 TRANSFER, MODEL P1M8, MEASUREMENT MODEL CROSS VALIDATED, SAMPLE  
 UPSTREAM,  
 FIX GA(2 6) GA(1 6) GA(2 2) GA(2 4) GA(3 6) GA(3 3) GA(3 4)  
 DA NI=41 NO=201 MA=CM  
 LA  
 SCPERFRM MKTPERFM KNACQ1 KNACQ2 KNACQ3 KNACQ4 KNDST1 KNDST2 KNDST3  
 KNDST4 INSTRU CONCPU SYMBLU INTDP1 INTDP2 INTDP5 TRUST1 TRUST2 TRUST4  
 TRUST5 TRUST6 TRUST7 COMIT1 COMIT2 COMIT3 COMIT4 COMIT6 COMIT7 SHAMG1  
 SHAMG2 SHAMG3 SHAMG4 SHAMG5 SHAMG6 ALTRN1 ALTRN2 ALTRN3 ALTRN5 RSTPW1  
 RSTPW2 RSTPW3  
 CM FI=FULLSCALEUP.COV  
 AC FI=FULLSCALEUP.ACC  
 SE  
 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37  
 38 39 40 41 /  
 MO NY=11 NX=28 NE=3 NK=6 BE=FU PS=DI TD=SY,FI TE=SY,FI PH=ST

LE  
 KNACQ KNDIST KNUSE  
 LK  
 INTERDEP TRUST COMMIT SHAMG ALTRN RSTPW  
 PA LY  
 4(1 0 0) 4(0 1 0) 3(0 0 1)  
 PA LX  
 3(1 0 0 0 0 0) 6(0 1 0 0 0 0) 6(0 0 1 0 0 0) 6(0 0 0 1 0 0) 4(0 0 0 0 1 0) 3(0 0 0 0 0 1)  
 FR BE(2 1) BE(3 2) TD(1 1) TD(2 2) TD(3 3) TD(4 4) TD(5 5) TD(6 6) TD(7 7) TD(8 8) TD(9 9)  
 TD(10 10) TD(11 11) TD(12 12) TD(13 13) TD(14 14) TD(15 15) TD(16 16) TD(17 17) TD(18 18)  
 TD(19 19) TD(20 20) TD(21 21) TD(22 22) TD(23 23) TD(24 24) TD(25 25) TD(26 26) TD(27 27)  
 TD(28 28) TD(15 11) TD(25 24) TE(1 1) TE(2 2) TE(3 3) TE(4 4) TE(5 5) TE(6 6) TE(7 7) TE(8 8)  
 TE(9 9) TE(10 10) TE(11 11)  
 VA 1 LY(1 1) LY(5 2) LY(9 3) LX(1 1) LX(4 2) LX(10 3) LX(16 4) LX(22 5) LX(26 6)  
 FI GA(2 6) GA(1 6) GA(2 2) GA(2 4) GA(3 6) GA(3 3) GA(3 4)  
 OU SE TV EF MI SC AD=OFF

## **Part Two: Relationship between Knowledge Transfer Process and Firms Performance**

### **(1) SEM of Entire Sample**

LISREL ANALYSIS OF FULL MODEL PART 2 KNOWLEDGE TRANSFER AND PERFORMANCE,  
 MODEL P2M4, MEASUREMENT MODEL CROSS VALIDATED,  
 TRIAL FREE BE (2 1) ONLY, TE=DI,FI, FIX GA(2 3) GA(1 1) GA(2 1)  
 DA NI=41 NO=413 MA=CM  
 LA  
 SCPERFRM MKTPERFM KNACQ1 KNACQ2 KNACQ3 KNACQ4 KNDST1 KNDST2 KNDST3  
 KNDST4 INSTRU CONCPU SYMBLU INTDP1 INTDP2 INTDP5 TRUST1 TRUST2 TRUST4  
 TRUST5 TRUST6 TRUST7 COMIT1 COMIT2 COMIT3 COMIT4 COMIT6 COMIT7 SHAMG1  
 SHAMG2 SHAMG3 SHAMG4 SHAMG5 SHAMG6 ALTRN1 ALTRN2 ALTRN3 ALTRN5 RSTPW1  
 RSTPW2 RSTPW3  
 CM FI=FULLSCALECV.COV  
 AC FI=FULLSCALECV.ACC  
 SE  
 1 2 3 4 5 6 7 8 9 10 11 12 13 /  
 MO NY=2 NX=11 NE=2 NK=3 BE=FU PS=DI,FR PH=ST TE=DI,FI  
 LE  
 SCPFRM MKTPRFM  
 LK  
 KNACQ KNDIST KNUSE  
 PA LX  
 4(1 0 0) 4(0 1 0) 3(0 0 1)  
 VA 1 LX(1 1) LX(5 2) LX(9 3) LY(1 1) LY(2 2)

FR BE(2 1)  
FI GA(2 3) GA(1 1) GA(2 1)  
PATH DIAGRAM  
OU SE TV EF MI SC AD=OFF

### **(2) SEM of Short Duration Sample**

LISREL ANALYSIS OF FULL MODEL PART 2 KNOWLEDGE TRANSFER AND PERFORMANCE,  
MODEL P2M3, MEASUREMENT MODEL CROSS VALIDATED, TRIAL FREE BE (2 1) ONLY,  
TE=DI,FI, SAMPLE SHORT DURATION,  
FIX GA(2 1) GA(1 1)  
DA NI=41 NO=213 MA=CM  
LA  
SCPERFRM MKTPERFM KNACQ1 KNACQ2 KNACQ3 KNACQ4 KNDST1 KNDST2 KNDST3  
KNDST4 INSTRU CONCPU SYMBLU INTDP1 INTDP2 INTDP5 TRUST1 TRUST2 TRUST4  
TRUST5 TRUST6 TRUST7 COMIT1 COMIT2 COMIT3 COMIT4 COMIT6 COMIT7 SHAMG1  
SHAMG2 SHAMG3 SHAMG4 SHAMG5 SHAMG6 ALTRN1 ALTRN2 ALTRN3 ALTRN5 RSTPW1  
RSTPW2 RSTPW3  
CM FI=FULLSCALED RS.COV  
AC FI=FULLSCALED RS.ACC  
SE  
1 2 3 4 5 6 7 8 9 10 11 12 13 /  
MO NY=2 NX=11 NE=2 NK=3 BE=FU PS=DI,FR PH=ST TE=DI,FI  
LE  
SCPFRM MKTPRFRM  
LK  
KNACQ KNDIST KNUSE  
PA LX  
4(1 0 0) 4(0 1 0) 3(0 0 1)  
VA 1 LX(1 1) LX(5 2) LX(9 3) LY(1 1) LY(2 2)  
FR BE(2 1)  
FI GA(2 1) GA(1 1)  
PATH DIAGRAM  
OU SE TV EF MI SC AD=OFF

### **(3) SEM of Contracted Partnership Sample**

LISREL ANALYSIS OF FULL MODEL PART 2 KNOWLEDGE TRANSFER AND PERFORMANCE,  
MODEL P2M3, MEASUREMENT MODEL CROSS VALIDATED, TRIAL FREE BE (2 1) ONLY,  
TE=DI,FI, SAMPLE WITH CONTRACT,  
FIX GA(1 1) GA(2 1)  
DA NI=41 NO=285 MA=CM  
LA

SCPERFRM MKTPERFM KNACQ1 KNACQ2 KNACQ3 KNACQ4 KNDST1 KNDST2 KNDST3  
 KNDST4 INSTRU CONCPU SYMBLU INTDP1 INTDP2 INTDP5 TRUST1 TRUST2 TRUST4  
 TRUST5 TRUST6 TRUST7 COMIT1 COMIT2 COMIT3 COMIT4 COMIT6 COMIT7 SHAMG1  
 SHAMG2 SHAMG3 SHAMG4 SHAMG5 SHAMG6 ALTRN1 ALTRN2 ALTRN3 ALTRN5 RSTPW1  
 RSTPW2 RSTPW3  
 CM FI=FULLSCALECTY.COV  
 AC FI=FULLSCALECTY.ACC  
 SE  
 1 2 3 4 5 6 7 8 9 10 11 12 13 /  
 MO NY=2 NX=11 NE=2 NK=3 BE=FU PS=DI,FR PH=ST TE=DI,FI  
 LE  
 SCPFRM MKTPRFRM  
 LK  
 KNACQ KNDIST KNUSE  
 PA LX  
 4(1 0 0) 4(0 1 0) 3(0 0 1)  
 VA 1 LX(1 1) LX(5 2) LX(9 3) LY(1 1) LY(2 2)  
 FR BE(2 1)  
 FI GA(1 1) GA(2 1)  
 PATH DIAGRAM  
 OU SE TV EF MI SC AD=OFF

#### **(4) SEM of Upstream Sample**

LISREL ANALYSIS OF FULL MODEL PART 2 KNOWLEDGE TRANSFER AND PERFORMANCE,  
 MODEL P2M3, MEASUREMENT MODEL CROSS VALIDATED, TRIAL FREE BE (2 1) ONLY,  
 TE=DI,FI, SAMPLE UPSTREAM,  
 FIX GA(2 3) GA(1 1)  
 DA NI=41 NO=201 MA=CM  
 LA  
 SCPERFRM MKTPERFM KNACQ1 KNACQ2 KNACQ3 KNACQ4 KNDST1 KNDST2 KNDST3  
 KNDST4 INSTRU CONCPU SYMBLU INTDP1 INTDP2 INTDP5 TRUST1 TRUST2 TRUST4  
 TRUST5 TRUST6 TRUST7 COMIT1 COMIT2 COMIT3 COMIT4 COMIT6 COMIT7 SHAMG1  
 SHAMG2 SHAMG3 SHAMG4 SHAMG5 SHAMG6 ALTRN1 ALTRN2 ALTRN3 ALTRN5 RSTPW1  
 RSTPW2 RSTPW3  
 CM FI=FULLSCALEUP.COV  
 AC FI=FULLSCALEUP.ACC  
 SE  
 1 2 3 4 5 6 7 8 9 10 11 12 13 /  
 MO NY=2 NX=11 NE=2 NK=3 BE=FU PS=DI,FR PH=ST TE=DI,FI  
 LE  
 SCPFRM MKTPRFRM  
 LK  
 KNACQ KNDIST KNUSE  
 PA LX



4(1 0 0) 4(0 1 0) 3(0 0 1)  
VA 1 LX(1 1) LX(5 2) LX(9 3) LY(1 1) LY(2 2)  
FR BE(2 1)  
FI GA(2 3) GA(1 1)  
PATH DIAGRAM  
OU SE TV EF MI SC AD=OFF

**APPENDIX 3 A REVIEW PAPER OF RESEARCH  
METHODOLOGIES IN INTERFIRM KNOWLEDGE  
TRANSFER**