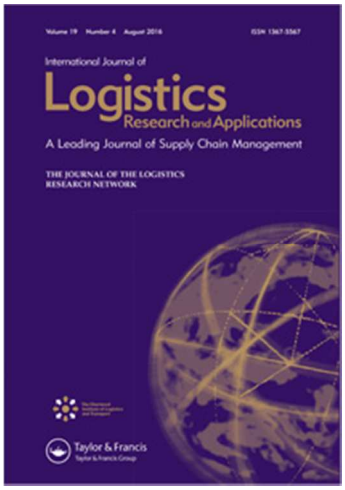

Environmental Supply Chain Management in the Construction Sector: Theoretical Underpinnings

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Environmental Supply Chain Management in the Construction Sector: Theoretical Underpinnings

Environmental implications of a product/project are typically spread across its supply chain, from design through to end-of-life. This is particularly acute for construction sector because of the inherent nature and complexity of its supply chain. The sector, therefore, could benefit from the application of environmental supply chain management (ESCM), a systematic and integrated approach towards restraining the adverse environmental impacts emanating from the supply chain. Unfortunately, uptake of ESCM in construction vis-à-vis other sectors is limited and fragmented. This formed the motivation, which using 39 interviews across 20 firms in the UAE construction sector, provide systemic insights on the various facets of ESCM namely, core and facilitating environmental practices, internal and external drivers (pressures/motives) and barriers/challenges affecting environmental practices' implementation, and relevant environmental performance measures across different firm types and stakeholders with the support of several established/emerging theories. The findings is expected to enhance the application of ESCM in construction.

Keywords: environmental supply chain management, environmental practices, construction sector, institutional theory, resource based-view, resource-dependence theory

Introduction

Ever since its introduction in the mid-1990s, environmental supply chain management (ESCM) is growing in importance in both academia and industry across a diverse range of sectors from fashion retail to nuclear power generation (Malviya and Kant, 2015), an interest that is driven by increasing environmental degradation, diminishing natural resources and rising pollution levels. Like, supply chain management, ESCM has evolved into a multidimensional concept with researchers looking at it from multiple perspectives. The central tenet of ESCM is efficient and

effective implementation and management of 'environmental practices' (Awaysheh and Klassen, 2010; Perotti et al., 2012), which include practices such as green design, green purchasing and green manufacturing at the supply chain level and practices such as implementation of EMS and ISO14001, environmental training and environmental auditing at the intra-firm level. The other related tenet of ESCM is the knowledge of the 'antecedents' of environmental practices, i.e., to understand what drives or motivates firms to implement environmental practices? (eg: regulatory pressure, firms' environmental commitment, business motives etc.) and what hinders or restricts firms from implementing environmental practices in the supply chain? (eg: high cost of implementation, lack of knowledge and awareness etc.) (Seuring and Muller, 2008; Walker et al., 2008; Walker and Jones, 2012). This understanding is important since the implementation of environmental practices would depend on the opposing pressures of drivers and barriers. The other equally important tenet of ESCM is the knowledge of the 'consequences' of environmental practices' implementation. While there is no arguing the fact that the objective of implementing environmental practices is to improve environmental performance (eg: reduction in carbon emission, material usage, energy consumption etc.), researchers have also started to associate environmental practices with the short-term and long-term financial benefits (eg: cost reduction, increase in profits, market share etc.) (Rao and Holt, 2005; Green et al., 2012). The latter is important for justifying investment in environmental practices from a business perspective. In short, the scope of ESCM includes the following four broad but interdependent themes:

- what environmental practices firms implement;
- what are the drivers for firms to implement such environmental practices;
- what are the barriers facing firms in implementing these practices; and
- what implications these practices have on firm performance.

While the underlying aspects within these themes could vary depending on the sector, the themes themselves are expected to hold good across sectors including the construction sector.

However, the progress and application of ESCM across various sectors have been uneven, with sectors such as general manufacturing, automobile and the electronic industry benefiting greatly from the application of ESCM vis-à-vis other sectors (Malviya and Kant, 2015). Among the sectors which have seen the limited application of ESCM, the construction sector is by far the single most important sector from an environmental perspective. The sector is solely responsible on a global scale for one-third of all carbon emissions, one-third of all resource consumption, 40% of total energy consumption, 25% of total water consumption and 40% of all waste generated (UNEP-SBCI, 2017). Furthermore, with 66% of the world's population expected to live in urban areas by 2050 (UN-DESA, 2014) and consequent increase in construction activities, the environmental implications can be anticipated to be even greater in the future.

Moreover, the dispersion of environmental implications across the supply chain, i.e. from design through to end-of-life, is particularly acute for the construction sector. For instance, environmental considerations made during design stage (green design) could significantly and directly reduce the environmental impacts during the operational phase of the building [responsible for 80% of the total life-cycle environmental impact according to Ng et al. (2012)], as well as eliminate the need for costly and disruptive refurbishments for reducing any environmental impacts during the post-occupancy stage (Fieldson et al., 2009; Li and Colombier, 2009). Similarly, considerations undertaken to reduce the environmental impact of all transportation-related activities (green transportation) alone could reduce roughly 6-8% of the life-cycle carbon emissions in construction projects (Ng et al., 2012). Likewise, practices aimed at minimising the adverse environmental impact during the construction phase (green

construction) on its own can contribute to more than 20% savings in a building's lifetime energy consumption (Ng et al., 2012), and practices undertaken at the end of a buildings' useful life such as environmental friendly demolition, environmental friendly disposal, and segregation of demolition waste for re-use and recycling could save up to 30% of building's lifetime energy consumption (Blengini, 2009). This clearly shows that greening the construction sector requires a supply chain wide focus, starting from design through to construction, through to their useful operational life, and finally end of life demolition and waste management.

Despite the enormous potential of ESCM in the construction sector, the present lack of application of ESCM in the sector could be attributed to the inherent nature and complexity of the sector and its supply chain. For instance, the sectors' supply chain is highly diverse, fragmented, and involves a multitude of stakeholders at different supply chain stages of a project (Edum-Fotwe et al., 1999). On a large construction project, the number of organizations involved in the supply chain can run into hundreds, if not thousands. In addition, the ESCM itself may be viewed as conceptually immature and underdeveloped by practitioners and policymakers because of the limited and fragmented theoretical basis against which it has evolved (Carter and Rogers, 2008; Touboulic and Walker, 2015). Therefore, there is a strong need for developing a reliable theoretical basis to help clarify the scope and purposes of ESCM in the construction sector as an academic and practice-based discipline.

This study, therefore, aims to develop a comprehensive understanding of the various facets of ESCM in construction with the use of established/emerging management theories, depending on where and how these theories can, individually and in combination, contribute to providing a deeper, broader and a simplified conceptualization of ESCM perspectives. Given the scientific notion that sound theoretical principles are fundamental for decision-making and managerial

actions as well as the advancement of any field (Chen and Paulraj, 2004), the theoretical underpinnings of this study are expected to enhance the practical application of ESCM in construction and in general; as well as contribute significantly towards further theoretical advancement of the field.

The specific research objectives of this study are as follows:

1. Develop a comprehensive understanding of the various facets of ESCM in the construction sector, covering all the key supply chain stages and stakeholders;

2. Underpin the findings using the lens of established/emerging management theories.

The rest of the paper is structured as follows: In the next section, first, analysis of the key stakeholders involved in the construction supply chain and their specific role is discussed, followed by a discussion on the relevant gaps in the literature pertaining to the application of ESCM in the construction sector. The qualitative research methodology used for the empirical investigation is explained in section three. The study findings and the application of management theories to underpin the findings are explained in section four. We conclude in section five with the research and practical implications, along with limitations and suggestions for future research.

Literature Review

Before the review of previous ESCM-related work in construction, it is important to first understand the key stakeholders involved in the construction supply chain and their specific role, as well as on how the information and material flow takes place in the supply chain. This knowledge on the intricacies of the construction supply chain is important in the subsequent synthesis of the limited and fragmented ESCM-related studies in the construction sector.

Construction Supply Chain

The key stakeholders in the construction supply chain are Developers, Architects/Consultants, Main Contractor, Subcontractor and Suppliers. Of the stakeholders, Developers are considered to be the most important stakeholder in the construction supply chain (Briscoe et al., 2004). This is because, they are the ones who initiate the project and therefore enjoys a hierarchical position with power in the supply chain to influence the whole project and consequently the behaviour of other downstream supply chain stakeholders (Bresnen and Haslam, 1991).

In a typical construction project, Developer appoints Architects/Consultants based on suitable selection criteria to be their client representative, to supply both building design and specialist management services. Once the building design is finalised, the Developer then finalises the tender documents with Architects/Consultants and floats the tender to select the main Contractor(s), who are then responsible for the completion of the project to a pre-determined time, cost and quality. The main Contractor is then selected by the Developer based on the technical (typically evaluated by the Architect/Consultant) and commercial proposal/bid (typically evaluated by Developer) submitted by them. This selection is important as the main Contractor play a significant role in the project's success (Hatmoko, 2008). They either carry out the construction activities themselves or hire specialist Subcontractors to carry out specific activities such as the installation of the building façade, HVAC systems, and building management systems (BMS). They typically play the role as a `facilitator' to manage demand-side from the Developers/Architects and supply side from Subcontractors and Suppliers (Cox et al., 2006). However, it is not uncommon for as much as 90% of a construction project to be subcontracted and consequently, subcontractors may contribute as much as 90% of a main contractor's turnover (Matthews et al., 2000). The complexity may further increase as

Subcontractors may possibly subcontract their works, partly or wholly, to other subcontractors. This shows, Subcontractors, too, play important roles in the construction project success. Finally, both the main Contractor and the Subcontractors will have to rely on several Suppliers to provide them with raw materials such as cement, pre-fabricated components such as glass façade and systems such as HVAC and BMS to carry out their required activities on time and at a reasonable cost, which can reach a value of as much as 50-60% of the total cost of the project (Stuckhart, 1995). Suppliers contribute to the project success through shorter cycle time, inventory level reduction and improving service level (Venkataraman, 2007). Finally, upon completion of the building, the final commission will be executed by the Consultants, and non-compliance (if any) at this stage is reverted to the main Contractor to rectify to get the building commissioned. After commissioning, the building is handed over to the Developer, who then either sell or lease partly or wholly to prospective buyers/tenants.

Overall, it clear from the review that each stakeholder (Developers, Architects/Consultants, Contractors/Subcontractors and Suppliers) has its own strategic importance in the supply chain. Addressing each stakeholders' conflicting interests in the supply chain and ensuring their commitment to implement environmental practices to the best of their abilities in a coherent manner vis-à-vis other stakeholders, therefore, becomes critical for the comprehensive greening of construction supply chains.

Next section discusses the outcome of the review of ESCM-related studies in the construction sector, including relevant gaps.

Review of ESCM Studies in Construction Sector

A synthesis of the previous ESCM-related studies in the construction sector was carried out to comprehend the current status of ESCM in the construction sector and help delineate the relevant

gaps. The main library databases such as Scopus, ProQuest, EBSCO, Science Direct, Emerald and Elsevier, Taylor and Francis, Springer and Wiley Interscience were used to ensure comprehensive coverage of the literature. Some of the indicative keywords used for the search included 'green/ sustainable construction', 'sustainability in construction supply chain', 'green/ sustainable/ environmental practices in construction', 'drivers/ enablers of green/ sustainable/ environmental practices in construction', barriers/ challenges of green/ sustainable/ environmental practices in construction', 'environmental/ sustainability/ green performance (measures) in construction', 'green building design', 'green/ environmental/ sustainable purchasing/ procurement in construction', 'green/ environmental/ sustainable transportation in construction', 'end of life management in construction', 'waste management/reduction/ re-use/ re-cycle in construction', 'environmental management systems (EMS) in construction', 'ISO 14001 in construction' and 'green/sustainable buildings'. In addition, review of leading journals that have frequently published green-related studies in construction such as 'Waste Management', 'Ecological Indicators', 'Habitat International', 'Journal of Cleaner Production', 'Journal of Environmental Management', 'Building and Environment', 'Resources, Conservation and Recycling', 'Automation in Construction', 'Construction and Building Materials', 'Engineering Sustainability' and 'Construction Management and Economics' were conducted so as to include the most relevant and up-to-date studies which could have been missed in the keyword search.

The search initially returned more than 100+ articles. However, studies which were considered either too generic or too technical such as complex computer simulation studies on heat maps of building envelopes, heat flows and thermal comfort, light reflection studies, and air quality analysis were excluded. A closer evaluation helped in further narrowing the list. Of these studies,

only three studies, namely Ofori (2000), Adetunji et al. (2008), and Carris et al. (2012) had a supply chain focus. However, despite the supply chain focus, the scope of these studies was either limited or generic. For instance, the emphasis of Ofori (2000) was mainly on green purchasing practices such as the purchase of recyclable products, purchase of products with non-toxic ingredients, providing environmental training of suppliers and conducting environmental audit of suppliers. Although multiple aspects where discussed in Adetunji et al. (2008), and Carris et al. (2012) such as green drivers, green barriers, environmental practices and performance, the aspects covered were mostly descriptive without any stakeholder focus, and also lacked depth. The other studies have sparingly looked at certain aspects of ESCM such as Shi et al. (2013), who looked at the barriers to green construction and Zutshi and Creed (2015) who looked at the importance of environmental management systems (EMS) in the construction sector. Overall, it was clear from the review that ESCM understanding in the construction sector is limited and scattered across the literature. Some of the key gaps identified are discussed in the following sections.

While reviewing the work on environmental practices first, we made a concerted effort to look at 'core environmental practices' distinctly from 'facilitating environmental practices' as the former is implemented at the supply chain level, while the latter is implemented at the intra-firm level. Specifically, core environmental practices include practices undertaken to minimize the environmental footprint across each of the distinct functional stages of the supply chain such as design, procurement, manufacturing and assembly, packaging, logistics, distribution, and reverse logistics (Hervani et al., 2005; Srivastava, 2007). Facilitating environmental practices include practices undertaken to build firms' internal resources and capabilities to achieve environmental goals such as the implementation of environmental management systems (EMS) and ISO 14001

certification, cross-functional integration, environmental auditing and environmental training (Seuring and Muller, 2008; Zhu et al., 2012).

Looking at the previous studies, it was clear that only a few studies have looked at core environmental in the construction sector, and that too was limited to specific ones such as green design (Zhang et al., 2011), green purchasing (Varnas et al., 2009), green transportation (BRE, 2003), and green construction (Jaillon et al., 2009). Getting a detailed understanding of the relevant core environmental practices, and that too for each stakeholder is important. This is because altogether, they determine the life-cycle environmental impact of a construction project (and when aggregated, for the construction sector as a whole).

Similarly, previous work on facilitating environmental practices shows that most studies have mainly focused on specific practices such as environmental management systems and ISO 14001 certification (Ofori 2000; Shen and Tam 2002; Zutshi and Creed, 2015); others such as environmental training and environmental auditing have seen limited work. Still others such as cross-functional integration (or coordination across different functions and departments) known to facilitate the realization environmental goals in other sectors (Zhu et al., 2012) appear to be missing in the construction literature. This is a major concern, given that facilitating environmental practices is important for not only improving the environmental performance (Zhu et al., 2012) but also for reaping benefits from core environmental practices (Sarkis et al., 2011; Zhu et al., 2012). Therefore, getting a detailed understanding of them, and at an individual stakeholder level, is important for improving the environmental prospects of the supply chain.

In short, a detailed understanding of both core and facilitating environmental practices at an individual stakeholder level is not sufficiently understood for the construction sector. This

understanding is expected to provide practitioners with a potential stock of core and facilitating environmental practices that they could implement in their respective firms.

Similarly, studies that have looked at the 'antecedents' of these environmental practices, i.e., drivers and barriers of environmental practices, are too limited and narrow in scope. For example, Qi et al. (2010) investigated the drivers of Contractors environmental practices whereas Varnas et al. (2010) looked at the barriers to green purchasing practices of Developers. Other studies are either descriptive or generic, i.e. without stakeholder focus (Sourani and Sohail., 2011; Zhang et al., 2011; Liu et al., 2012). Understanding the antecedents of each supply chain stakeholder are critical as they can explain why some firms implement a multitude of environmental practices and/or why the extent of implementation of these practices are different across firms. This knowledge could help practitioners and policymakers predict the sector's green behaviour and devise strategies to maximize/leverage the drivers and minimize/eliminate the barriers to enhance the environmental practices of each stakeholder. Like other sectors, the construction sector could also benefit from looking at these drivers and barriers as 'external' and 'internal' based on their source of origin as it enables more visibility and manageability for practitioners to differentiate between the pressures, motives and challenges originating from the industry (external) and from the individual organization itself (internal) (Walker et al., 2008; Walker and Jones, 2012).

Likewise, studies in construction that looked at the 'consequences' or performance improvement from environmental practices are skewed towards environmental performance (Tam et al., 2006; Gangolells et al., 2009; Chen et al., 2010; Fernández-Sánchez and Rodríguez-López, 2011). This is not surprising given that the raison d'être for implementing environmental practices is that they should improve a firm's environmental performance. However, as seen in other sectors, firms

implement environmental practices not only to achieve their environmental performance but also to achieve business goals such as improved cost/economic performance. Ideally, firms must achieve this ‘‘win-win’’ situation to rationalize their investment in environmental practices. Unfortunately, this understanding is very limited in the construction sector. The review could only identify two studies namely, Jaillon and Poon (2008) and Horsley et al. (2003) looking at the economic performance aspects of environmental practices' implementation. However, the focus of these studies was limited to pre-fabrication and green design respectively. In short, practitioners and policymakers in the construction sector are not sure on "whether it pays to be green".

Another gap evident from the review is that most studies have either ignored stakeholder perspectives altogether or considered only a few specific ones in isolation. For instance, Qi et al. (2010) focused on identifying the drivers of Contractors' environmental practices, while Varnas et al. (2009) focused on the green purchasing practices of Developers. Hence, the differences and commonalities between the various stakeholders (Developers, Architects, Consultants, Contractors and Material Suppliers) with respect to the different environmental aspects have not been sufficiently captured. This lack of understanding of stakeholder perspectives in greening is a major concern for the construction sector.

The other gap evident from the review is that the impact of demographic characteristics of stakeholders' such as firm size and firm ownership on ESCM is not understood sufficiently. This is also a major concern, given that a typical construction supply chain consists of hundreds, if not thousands of firms with varying size and ownership. For example, determining whether smaller organizations are adopting environmental practices at greater, lesser or even equal rates as compared to medium and larger organizations or determining whether local organizations are

adopting environmental practices at greater, lesser or even equal rates as compared to foreign organizations sets the foundation for practical and research issues. Knowledge of the differences in ESCM aspects among different firms is important to enact strategies and policy changes to support organizations (small/large/foreign/local) that are lagging behind others.

Finally, none of the studies have attempted to understand how the relationships between different stakeholders in the supply chain, such as between Developers and Architects/Consultants, and Developers and Contractors are impacting the prospects of greener supply chains. This understanding is important especially considering that construction supply chains involve a multitude of stakeholders in dyadic, short-term/temporary relationships mostly till project completion (Rezgui and Miles, 2009). Moreover, the construction sector is known for its low trust and adversarial relationships between stakeholders (Korczynski, 1996; Akintoye et al., 2000; Rezgui and Miles, 2009).

In sum, the lack of an integrated, holistic and theoretically-grounded understanding carries the risk that practitioners and policymakers could mistakenly be addressing the wrong issues and neglecting those that have more significance. In line with our research objectives, we attempt to address these gaps in the literature. The methodology used in this study is explained in the next section.

Research Setting

This investigation is set in the United Arab Emirates (UAE) because of the unique characteristics of its construction sector. Known for its high construction intensity and for housing some of the world's tallest, largest and most luxurious structures, the construction sector has played a pivotal role in the last decade in the growth and transformation of UAE from a nomadic to a modernised country. However, during this transformation, the construction sector has been responsible for

the bulk of the environmental degradation in the country (around 75% of all solid waste generated in the UAE is from the construction sector) (SCAD, 2013). In response, in line with the UAE's vision to become one of the most sustainable countries by 2021 (Vision 2021, 2017), the significant efforts undertaken by the UAE government and construction firms in recent years have resulted in marked improvements in environmental practice application, as evident from the substantial increase in the number of LEED-certified projects (from few in 2011 to close to one-thousand in 2015) (LEED, 2015). UAE is, therefore, an appropriate context for understanding the competing actions required from governments and organisations to lessen the environmental impacts associated with rapid urbanisation and economic modernization. The lessons learned from this study is therefore expected to provide significant insights for practitioners and policymakers elsewhere in the world, especially developing/emerging economies in a similar position, i.e. witnessing significant construction growth and facing associated environmental concerns.

Also, UAE provides an ideal setting to explore the importance of environmental regulatory framework in the adoption of ESCM in the construction. The following sub-section discusses the role of the regulatory framework in the UAE construction sector.

Environmental regulatory framework in the construction sector

Government regulatory framework could play an important role in the application of ESCM. This is not surprising given that government regulation leaves no option for a firm but to comply with it or exit the market. In the construction sector, this includes but not limited to green building regulations and associated non-compliance fines and penalties, landfill tax and associated fines for environmental accidents. For instance, in the UAE, any new project in the emirate of Dubai or Abu Dhabi (which covers 90% of all construction projects in the UAE) must

abide by the green building regulations in their respective emirate. This includes the municipal green building regulations in the emirate of Dubai introduced in 2011; the ESTIDAMA pearl rating system for buildings in the emirate of Abu Dhabi introduced in 2010, and the EHS Trakhees in Free Zones introduced in 2006. This is similar to the mandatory green building standards in US and UK. This implies that Developers and Architects have to meet the minimum environmental design standards mentioned in the regulations on aspects such as natural ventilation, lighting, water and energy consumption and use of renewable energy. Similarly, Contractors must achieve a minimum of at least 50% onsite waste aversion from the landfill. In addition, Contractors in both Dubai and Abu Dhabi must pay landfill charges (charged for each truckload) and fines for environmental accidents such a spilling of hazardous materials. Although Suppliers in the UAE do not face any direct regulatory requirements, they risk inclusion in the project tender if they fail to meet the minimum environmental requirements as specified in the regulations.

In short, the unique characteristics of the UAE construction sector along with regulatory framework makes UAE an appropriate context to conduct the investigation.

Methodology

A semi-structured interview approach was undertaken (Kvale, 2007). In terms of sampling, a very stringent purposive or selective sampling, a non-probability sampling technique was used. The goal of purposive sampling is to sample cases/participants strategically so that those sampled are relevant to the research objectives. In this study, it was not possible to recruit any construction industry professional at random for interviewing; instead it was necessary to be very selective in recruiting professionals so that equal representation of all key stakeholders in the supply chain (i.e. Developers, Architects/Consultants, Contractors and Suppliers) as well as

equal representation of firms based on their size and ownership is obtained. The advantage of stringent selective sampling is that it gives the ability to understand a social phenomenon better as they are gathered from two or more different or extreme situations (Bryman, 2016). In addition, in most cases, multiple respondents were carefully selected within each firm to obtain multiple perspectives. A total of 39 semi-structured interviews (one interview per person) with senior professionals (most of them had more than ten years of experience in the construction sector) were conducted across 20 firms. These were grouped into four categories: small, large, foreign and local, as shown in Table 1, based on their position in the supply chain and their size/ownership. The Organisation for

Table 1. Interview Details

Stakeholders	Interviewee Details	Developer	Architect/ Consultant	Main Contractor	Subcontractor	Supplier
Large (All key stakeholder firms involved are large)	Annual Turnover	~$ 2.5 billion	~$ 550 million	~$ 900 million	~$ 450 million	~$ 1.8 billion
	Designation of Interviewee	•Head of projects •Director-Sustainability & Commissioning	•Vice President •Senior Architect	• Senior Project Manager • Head of Procurements • Senior Coordinator - Contracts	•Site Engineer •Project Manager	•Divisional Manager •Business Development Manager-MENA •Project Engineer
Small (All key stakeholder firms involved are small)	Annual Turnover	~$ 325 million	~$ 35 million	~$ 80 million	~$ 45 million	~$ 18 million
	Designation of Interviewee	•Director-Residential Projects •Head of Operations	•Architect •Senior Architect	• Project Manager • Procurement Engineer	• Head of MEP Division	•Manager – Client Liaison
Foreign (All key stakeholder firms involved are foreign)	Annual Turnover	~$ 825 million	~$ 250 million	~$ 430 million	~$ 160 million	~$ 400 million
	Designation of Interviewee	•Head of sustainability •Senior Vice President-Operations	• Lead Architect • Senior Consultant - Sustainability	• Regional Head - Sustainability • Head of Commissioning	• Technical Manager • Manager-LEED projects •Senior Engineer-MEP & Systems	•Product Specialist •Business Development Manager
Local (All key stakeholder firms involved are local)	Annual Turnover	~$ 690 million	~$ 175 million	~$ 550 million	~$ 180 million	~$ 400 million
	Designation of Interviewee	• Chief Operations Officer • Manager – Special Projects	• Head of Design • Manager – Compliance and Tender	• Project Manager • Project Engineer	• Project Engineer	•Product Manager

Economic Co-operation and Development (OECD) classification of firms by size (small<50 and large >250 employees) was used for the categorisation of firms by size. Ownership classification of firms by local and foreign is based on majority stake (>50%) in the firm. This grouping provides an opportunity to observe 'extreme' examples of important patterns and situations (Eisenhardt and Graebner, 2007), and to stretch the explanatory power of the underlying management theories. The raison d'être of good theories is that they should be able to explain contrasting scenarios with relative ease. Each interview lasted between 45 to 60 minutes.

The work of Kvale (2007) and Rabionet (2011) was used as the basis for developing ethical guidelines and interview protocols (Appendix 1). Each of the interviewees was posed with 'what', 'how', 'how much' and 'why' questions on each of the different ESCM themes. The ESCM themes posed to the respondents include external and internal drivers (1,2), external and internal barriers (3, 4), core and facilitating environmental practices (5, 6), environmental and economic performance (7, 8). The interviewees were asked to respond to each of these eight ESCM themes on both (a) their respective firm's views in general; and (b) the views of the overall sector. Similarly, interviewees were also probed on the dyadic relationships with other stakeholders such as the nature of the agreements (short-term vs long-term), and issuing arising from the low-trust and adversarial relationships impacting their greening efforts. The respondent's views were recorded and transcribed before being cross-checked with them for accuracy. In select cases, a few interviewees were re-contacted for further clarification. Supporting company documentation such as annual reports, newsletters, audit reports, training material and departmental publications were also collected (wherever possible) and analysed to complement the interview findings.

Analysis and findings

The interview transcripts and supporting company documentation enabled us to conduct three levels of analysis: (a) thematic analysis at the stakeholder level (as per the eight ESCM themes); (b) supply chain level analysis; and (c) macro analysis at the industry/country level.

Thematic Analysis at the Stakeholder Level

A comprehensive stakeholder analysis was undertaken, which involved synthesising the interviewee responses for each category (small, large, local and foreign) of stakeholder (Developer, Architect/ Consultant/ Contractor/ Supplier) across each of the ESCM themes. The findings are summarised in Appendix 2. The findings are based on consensus from the multiple participants belonging to a particular stakeholder firm (except for those few cases where only one interview was conducted per stakeholder, eg: Small-Subcontractor). The key findings across all the eight ESCM themes are explained through the lens of various established/emerging management theories as a means to organise information in a way that is internally and externally consistent, verifiable, has generality and possesses scientific parsimony (d'Amboise and Muldowney, 1988).

External drivers understood through institutional theory

Institutional theory examines how external pressures influence organisational actions (Hirsch, 1975). According to the theory, firms are under constant coercive, normative and mimetic pressure to adapt to and be consistent with their external institutional environment (in this case implementing environmental practices) (DiMaggio and Powell, 1983). Exerted by those in power, coercive pressures are powerful institutional forces that influence organisations to change their behaviour, while mimetic pressures are faced by firms to imitate/mimic the actions of their

successful competitors in the industry in order to follow their success or to avoid losing their competitive advantages. Normative pressure arises from end consumers/owners and NGOs to ensure the implementation of what constitutes appropriate and legitimate behaviour. Several studies in other sectors have used institutional theory to explain the external drivers of ESCM (Zhu and Sarkis, 2007; Wu et al., 2012).

According to the interviewees from Developer firms, coercive pressure from regulatory bodies in the form of green building regulation and associated non-compliance fines is the main driver of environmental practices. This is because any new project in the emirate of Dubai or Abu Dhabi (which covers 90% of all construction projects in the UAE) has to abide by the green building regulations in the respective emirate. The regulation has a direct impact on the various supply stages of a construction project such as design, procurement, construction, operation and end of life management. For instance, at the design stage, Developers are required to consider aspects such as natural ventilation, lighting, water and energy consumption and use of renewable energy. Similarly, during construction, the main Contractor are required to achieve as per the regulation 50% onsite waste aversion (typically achieve through re-use and recycling) from landfill.

However, apart from the Developer, and the main Contractor, none of the other stakeholders claimed to face any direct coercive governmental pressure. Instead, they (especially Architects/Consultants and Contractors) mentioned that they faced strong coercive pressure from Developers to meet their green project requirements, as any failure to do so may lead to them to not winning the project in the first case, or being expelled from the project or blacklisted from future projects. In other words, government green building requirements and Developers' own environmental requirements (if any) are passed on to Architect/Consultants and Contractors for

execution. This was easy to comprehend given that Developers are the ones who sit on the top of the supply chain hierarchy and have the power to control the downstream supply chain. However, there can be instances such as those seen with the interviewed large Developer, where the Developer has allocated the design and build responsibility to the main Contractor, wherein which the coercive pressure faced by the Architect/Consultant comes from the Contractor. Alternatively, as seen with the interviewed foreign Developer in one of their projects, the Consultant is appointed as their representative of the project, who then holds the same power as the Developer to coerce other stakeholders, including the main Contractor, in implementing environmental practices. Suppliers, on the other hand, face pressure in most cases from Consultants and Contractors to meet the green material/technology requirements as specified in the tender documentation. Foreign Consultants and Contractors also highlighted instances where they asked their Suppliers to provide green materials over and beyond what was required in the tender requirements as part of their environmental commitment. In generic terms, the coercive pressure can be seen as flowing downstream in the supply chain, with even Sub-Contractors in some cases as having the power to coerce their Suppliers.

An interesting aspect with regards to government green building regulation is that the regulation is uniform across all firms in the UAE regardless of their size and ownership, which is not the case in other countries such as China, in which larger firms and foreign firm face more stringent regulations than small firms (Qi et al., 2010; Child and Tsai, 2005). The advantage of having uniform regulation is that it ensures smaller firms (which is more than 60% of all construction firms in the UAE) to comply with regulations. Also, uniform regulation is expected to attract foreign firms to start operations in the UAE. This is because previous studies have reported unfair treatment against foreign firms in countries such as China where they face more

stringent regulation than local firms (Child and Tsai, 2005). On the downside, because of the uniform regulation, UAE cannot increase the stringency as they also must take into account the ability of small firms to adhere to these regulations since meeting regulations warrants significant financial and human resources. Also, large firms may consider these regulations less onerous to fulfil than small firms.

Overall, as expected, the findings show that large firms and foreign firms respond swiftly to these pressures by implementing environmental practices, in most cases, over and beyond what is required by regulations, whereas smaller firms and local firms were found to struggle in coping with these institutional pressures. This is an important finding because before applying coercive pressure on firms, governments should first determine whether or not small or local firms will be able to adopt these practices, otherwise there is a risk of them going out of business, as the cost of compliance would be far greater than the business benefits. This also explains why in some countries such as Malaysia, the government provides added incentives to small firms who comply with government regulations (Abidin, 2010).

As evident from the interviews, the mimetic pressure arising from competitors is also prevalent in the UAE. Developers believe "green is the new norm" because most of their competitors are pursuing LEED certification. For Architects/Consultants, this is due to the large influx of foreign consultants with a sustainability focus in the UAE. Although not to the extent as that of Architects/Consultants, Contractors also face mimetic pressure from foreign as well as from foreign-local joint venture Contractors to implement environmental practices. In contrast, Suppliers in the UAE regardless of their size and ownership, do not face much mimetic pressure due to the relatively low levels of competition in the UAE.

Normative pressure, on the other hand, was found to have limited influence on the environmental practices of firms across all stakeholders. Some of the key reasons highlighted by the interviewees include the low level of environmental awareness of the UAE investors/buyers; price consciousness of the short-term investors/buyers, especially from the Asian sub-continent (the majority of the UAE population are from the Asian sub-continent) who are not willing to spend more on environmental projects vis-à-vis conventional projects. The other concern echoed by most of the respondents is the relatively inexpensive/subsidised water and electricity in the UAE, because of which there is less incentive for customers to invest in green buildings, as the life-cycle cost savings may be less than the additional upfront cost for green buildings. In short, there is less pressure/demand from customers in the UAE for green buildings.

Moreover, unlike in other countries such as China and Malaysia where non-government organisations (NGOs) have a strong normative influence on the Developer or Contractor (Abidin, 2010; Qi et al., 2010), NGOs have limited influence in the UAE because they have no legal backing.

Internal drivers understood through institutional theory, strategic choice theory and transaction cost economics theory:

Internal drivers are pressures that arise from within the firm due to its own environmental commitment and/or for achieving clearly-identified business advantages (Varnas et al., 2009). The environmental commitment of firms, generally a voluntary obligation to society, can be viewed from a new institutional theoretic perspective (Scott, 2001), namely mimetic cultural-cognitive isomorphism (socio-cultural responsibility), a rational desire to embrace environmental practices that is consistent with the obligations and values of the society in which they function (Hsu et al., 2013). It was clearly evident from the study that the values of the owners and/or top

management was one of the main factors for Developers to implement environmental practices and achieve LEED certification. This commitment was also seen among other stakeholders, especially from foreign and large firms. In most cases, the firms' environmental commitment is clearly stated and communicated to the employees and external stakeholders, either through environmental vision or mission statements and/or the establishment of a corporate environmental policy.

However, as evidenced by the interviews, the environmental commitment was not the only internal motive for firms to implement environmental practices. Firms tend to view environmental practices as a way of achieving clearly stated business advantages, and their decisions can, therefore, be viewed through the lens of strategic choice theory. The strategic choice theory emphasises the role of a manager's decisions in organisational outcomes (Child, 1972). In the realm of ESCM, implementing environmental practices was seen as a strategic choice by respondents to improve brand image, attract investors with a sustainability focus, achieve a high valuation of stock price, increase profitability, enter foreign markets and counter any environment-related reputational risks. For instance, one of the interviewed Developer highlighted that it is a strategic decision to pursue LEED certification, because, in any case, they still have to meet the government's green building regulations based on a similar framework to that of LEED. Similarly, other stakeholders also highlighted that it was a strategic choice to be involved with prestigious environmental projects, as they would be good references for winning future projects.

The other internal driver identified from the interviews was cost savings, which can be achieved either during the construction phase (relevant to Contractors/Sub-Contractors) and/or during the use/operational phase (in the form of energy, water and other savings that accrue for

owners/tenants). For Developers (in the foreign and local categories), operational cost saving was a significant driver for implementing environmental practices. This was because the Developer was the owner/end user of the building and therefore could significantly benefit from the lifecycle cost savings. However, for the other two interviewed Developers (in the large and small categories), implementation of environmental practices to achieve cost reduction was less rigorous, since they were not the potential beneficiaries of lifecycle savings. To generalise, projects started with the intent to be sold off are less concerned with cost reduction efforts compared to Developers who intend to own and use the building for themselves. This can be explained from the premise of both internal and external transaction cost economics theory (Williamson, 1981). Investment in green buildings can be seen as an internal transaction for Developers who intend to own the buildings, and transaction cost benefits are the operational cost savings achieved while managing the building, including personnel costs, maintenance costs and utility bill costs. According to the interviewed foreign Developer, 'Even small aspects such as reducing the flow rate of the shower head or tape, or using light sensors in corridors, can bring significant cost savings, much higher than what you can imagine.' Similarly, cost savings was also found to be a significant driver for all the Contractors interviewed. Investment in green construction equipment technology can be seen as an internal transaction for Contractors, and the potential cost savings achieved from reduced labour hours, waste minimization and resource recycling can be seen as internal transaction cost benefits. For instance, one of the Contractors was able to reduce US$0.2 million from a single project through green construction practices. In a respondent's words, 'Any capital expenditure has to have a good return on investment, i.e., it must pay for itself within few years.'

In the case of external transactions, such as those between a Developer and a buyer/end-user, transaction cost economics focuses on how much effort and cost is required for the two entities, the buyer and the seller, to engage in a relationship that will allow for effective completion of a transaction (Williamson, 1981). Interestingly, buyers/end-users in the UAE are not fully convinced to invest in green buildings, largely due to their lack of awareness on the benefits of green buildings. The echoes the findings of Pinkse and Dommisse (2009), who found that the major challenge facing the Dutch construction sector is communicating the advantages of environmental technologies to potential home buyers. Similarly, the transaction costs among supply chain partners are critical. This means that Architects/Consultants, Contractors and Suppliers must all realise cost benefits (high profits) for engaging in environmental projects. Given that the UAE is relatively a new market for environmental projects, the high-profit potential of environmental projects is a significant driver since there is a plenty of scope for stakeholders to charge a premium from the Developer for environmental projects. On the contrary, for Architects/Consultants to sell the green design/concept to the Developer, they are required to convince the Developer of the potential benefits from the project. Overall, it was seen that transaction cost requirements are less stringent or relaxed when both parties involved in the transaction demonstrate an environmental commitment.

External barriers understood through stakeholder theory and resource-dependence theory

A stakeholder is 'any group or individual who can affect or is affected by the achievement of an organisation's objectives' (Freeman, 1984). Stakeholder theory suggests that firms produce externalities that affect many parties (stakeholders) which are both internal and external to the respective firm (Freeman, 1984). The three externalities affecting stakeholders generated by Developers as evident from the interviews include: (1) the tight deadline set by the Developer;

(2) design variation after the start of the project; and (3) lack of upfront stakeholder engagement. Given that implementing environmental practices is a time-consuming process, a tight deadline set by the Developer is a significant barrier for other stakeholders to achieve the desired environmental outcomes. Similarly, variations after project initiation were found to adversely affect the Contractor's environmental practices, as they led to waste and re-work. Also, the lack of early stakeholder engagement is a concern as it leads to project variation, project delay due to logistical issues, role conflict from ambiguity in the tender specifications and compatibility issues with environmental systems and other systems in the buildings. In fact, previous studies such as Albino and Berardi (2012) and Rodriguez□Melo and Mansouri (2011) have highlighted the need for high-level stakeholder integration and engagement for incorporating environmental practices in construction. In other sectors too, stakeholder collaboration in the supply chain is identified as an important factor for environmental practices (Vachon and Klassen, 2008). The importance of early stakeholder engagement can be summarised in the words of one of the Contractors, who said 'we should be involved, in fact, from the pre-design stage' because an 'Architect's dream is an engineer's [Contractor's] nightmare.'

The other major external challenge faced by the interviewed Developers was the lack of available local Contractors and Suppliers with a reputation in handling environmental projects. This can also be explained through the lens of resource-dependence theory (Salancik and Pfeffer 1978), where organisations are dependent upon resources provided by outside parties in order to compete (in this case the implementation of environmental practices). The theory also warrants the need for establishing inter-organizational collaboration and the establishment of formal and semi-formal linkages with other firms (Ulrich and Barney, 1984) to ensure that strategically critical resources are available. However, it was evidenced that this barrier was less critical for

foreign firms as they have formal ties with Suppliers from their home country. These global linkages have provided them with strong bargaining power and to earn favourable credit terms and supply arrangements so that they are less impacted by the lack of local green Suppliers.

Internal barriers understood through resource-based and knowledge-based views

According to the resource-based-view (RBV), an organisation's resources can be defined as all assets, capabilities, organisational processes, firm attributes, information and knowledge possessed by a respective firm (Barney, 1991). Similarly, according to the knowledge-based view (KBV) (an extension of RBV), knowledge is the most strategically significant resource of a firm. The proponents of KBV argue that the knowledge-based resources of a firm are socially complex and difficult to copy, and therefore the heterogeneous knowledge bases and capabilities of firms are the major determinants of sustained competitive advantage and superior corporate performance (Grant, 2002).

The internal barriers of stakeholders identified (refer Appendix 2) can be explained from the premises of both resource-based and knowledge-based views. For instance, architectural and consulting fees, as well as tender costs, are much higher for environmental projects than conventional projects, and hence this is the main deterrent for Developers to work on environmental projects. According to the interviewed Architects/Consultant and Contractors, the staff allocation required for environmental projects is much higher than that of conventional projects. Also, the lack of required knowledge and skills of staff for managing green systems and technology effectively is a major challenge during the operational phase (post-occupancy) from a Developer's perspective. For instance, one of the respondents highlighted an instance in which a LEED gold certified building performed worse than a normal building because it was poorly maintained and operated. For Contractors, the lack of knowledge and skills of onsite construction

workers was their major challenge. In terms of firm size, the internal barriers were found to be higher among small firms as they lack the human, technological, and financial resources required for implementing environmental practices vis-à-vis large firms. In terms of firm ownership, local firms were found to lack the managerial and technical know-how to implement environmental practices than their foreign counterparts.

Core environmental practices and facilitating environmental practices understood through strategic choice theory, resource and knowledge-based views, resource-dependence theory, implementation theory and complexity theory

The various core and facilitating environmental practices implemented by stakeholders across supply chains are summarised in Appendix 2. Three important aspects identified from the interviews with respect to the implementation of various core and facilitating environmental practices across stakeholders are as follows:

- *The difference in breadth in the consideration of environmental practices*. For instance, in the case of a foreign Developer, the aspects covered under green design was comprehensive, whereas, in the case of a small Developer, these were minimal, designed to meet the minimum requirements of the green building regulations.
- *The varying extent of implementation*: For instance, both foreign and local Developers were found to incorporate solar panels into their projects. However, for local Developers, the solar panel accounted for no more than 5% of the total energy requirements of a given building, whereas for the foreign Developers, the electricity from solar energy accounted for up to 25% of the total energy requirements.
- *The varying effectiveness of implementation*: As evidenced from the study, implementation of environmental practices does not necessarily mean that environmental or

economic performance will be boosted. Only successful and effective implementation leads to the desired level of performance. For instance, in one of the projects of a large Developer, despite the building being LEED pre-gold certified for design, the implementation was a failure to the extent that the performance of the building was worse than that of a normal building.

These differences among firms can be understood using various theories. For instance, the difference in the breadth in the consideration of environmental practices and varying extent of implementation can be explained using strategic choice theory, resource and knowledge-based views and resource-dependence theory. As mentioned earlier, the features that a Developer decides to incorporate within an environmental practice (say green design) may very well depend on the strategic choices and internal motives of the Developer. Having said that, the strategic choice depends on several other factors, such as the resource and knowledge-based view given that environmental projects require considerable investment upfront, specifically to implement systems such as solar water heaters, energy efficient HVAC, building management systems and so on, as well as the knowledge to understand the implementation benefits of these practices. Similarly, the strategic choice is also contingent upon the resource-dependence of the Developer on other stakeholders. For example, as highlighted by the large Developer, in one of their projects, the entire design and build responsibility was given to the Contractor, which implies that the Developer, in this case, was 100% resource dependent on the Contractor. Similarly, in the case of the foreign Developer, in one of their projects, the Consultant was hired to be their representative. The behaviour of other stakeholders can be also explained by the resource and knowledge-based views and resource-dependence theory. For example, main Contractors are often too resource-dependent on Sub-Contractors and have to establish stringent selection criteria (e.g., green purchasing) to select the best, which itself proves to be a resource-rich task.

The actual effectiveness of implementing core environmental practices and facilitating environmental practices can be explained through the lens of implementation theory (Goggin, 1990) and complexity theory (Anderson, 1999). According to implementation theory, the success or failure of new implementation (in this case environmental practices) depends on the implementation climate, absorptive capacity of new technology and processes and organisational readiness. With regards to core environmental practices in the respondents' view, the effectiveness of implementation depends on the implementation climate (EMS and ISO 14001), the absorptive capacity of new technology and processes (environmental training, R&D) and organizational readiness (cross-functional integration, environmental auditing), which re-affirms the importance of facilitating practices for successful implementation. Previously, Pinkse and Dommisse (2009) also found that contractors that actively gather information and build internal technical capacity are keener on adopting environmental technologies. With regards to facilitating environmental practices, respondents highlighted that different departments within the same firm may not share information with other departments, leading to reduced efficiency in the implementation of facilitating environmental practices.

According to complexity theory (Anderson, 1999), firms operate within a system (in this case a supply chain), and therefore the successful implementation of environmental practices depends upon how firms manage the complex interactions with the multiple parties involved. As this complexity increases, firms find it more difficult to implement environmental practices (Sarkis et al., 2011). For instance, according to one of the respondents, the success of an environmental project from a Developer's perspective will depend on how well it manages the complex interactions with Architects/Consultants, Contractors and Suppliers (if applicable). In addition, complexity theory can also explain the difficulty in managing the complex systems

within the buildings. For example, the large Developer emphasised that the operational performance of one of their buildings was much lower than expected because of the difficulty involved in integrating the different complex systems and optimising their performance. In other words, the complexity of managing the premises post-occupancy increases when the systems used are complex in terms of both operation and compatibility with other systems.

Performance measures understood through legitimacy theory

The majority of the interviewees acknowledged the importance of environmental and economic performance measures in evaluating the benefits of environmental practices. For instance, one respondent stated, 'We cannot manage what we don't measure.' The use of certain performance measures is especially high for Developers, given that the operational phase of a building is of paramount importance given the potential to improve its lifecycle environmental performance and cost saving/economic performance. However, the accuracy of reporting among UAE Developers varied from a high level of transparent reporting (externally audited) to limited self-reporting, in addition to a general lack of consistency in the reported measures. For instance, some of the environmental measures reported by Developers included energy and water consumption during the operational phase, which in any case is mandated by the regulation to capture the last five years of data for a respective building. However, those Developers who owned and used the building for themselves were also capturing other measures such as air quality and levels of solar electricity generated. With respect to the Contractors, the main environmental performance measure was waste statistics, with the exception of the foreign Contractor, where onsite usage of water, electricity and fuel consumption were reported. For Suppliers, product documentation regarding embodied energy content is produced in the case of material supplies, whereas HVAC suppliers, for example, uses performance results during

commissioning to benchmark with their theoretical performance. Also, Suppliers was found to check their system performance with the Developers during the operational phase of the building. Still, the overall use of performance measures in the UAE is few and far between. This lack of accurate and consistent reporting measures can be explained based on the premises of legitimacy theory (O'Donovan, 2002).

Legitimacy is a generalised perception or assumption that the actions of an entity are desirable, proper or appropriate within some socially constructed system of norms, values, beliefs and definitions. Based on this understanding, companies seek to gain, maintain or repair their legitimacy by using environmental reporting measures. This is because environmental disclosure is often requested by a number of parties, such as governments and stakeholders. Also, legitimacy makes firms standardise their reporting measures due to particular demands, especially from the government in which they are operating (Geijer and Sturesson, 2013). However, at present in the UAE, there is no legitimacy requirement from the government on firms to report these practices, except for water and energy consumption of buildings in the operational phase. Nevertheless, as evident from the interviews, voluntary reporting was found to significantly increase the legitimacy of the firms among stakeholders, investors and buyers, while also allowing firms to successfully secure new projects.

In terms of actual performance improvements, environmental performance (during construction and the operational phase) was found to be much higher for large firms vis-à-vis small firms. However, no such generalisation can be made between foreign firms and local firms, as both of them performed equally well in terms of environmental standards. Although it could be argued from a KBV perspective that foreign firms have much better knowledge and experience in executing environmental projects, the findings show that for local firms, even

without years of experience and knowledge, if the Developer and other stakeholders are willing to embrace the concept of ESCM and work diligently, it is still possible to achieve both environmental and cost/economic performance at par with foreign firms.

Supply Chain Level Analysis

Supply chain contract agreements and agency theory

Agency theory focuses on scenarios in which one entity, the principal, authorise a second, the agent, to act on the principal's behalf (Eisenhardt, 1989). An important concept in agency theory is the 'self-interested behaviour' or the behaviour of the agent to operate in their own self-interest rather than in the best interests of the principal firm. Hence, it could be argued that agency theory naturally fits with supply chain management research (Ketchen and Hult, 2007).

From the interviews, the study identified three different contract models between the Developer and other supply chain stakeholders. The first, as seen among large Developer in one of the projects, is the 'design and build' scenario, where the Developer has given the entire responsibility of the project to the Contractor. In this case, it was the Contractor's responsibility to manage the entire supply chain of the project, from design to commissioning and finally LEED gold certification. However, because the entire project was agreed upon by the Contractor for a certain amount, the tendency of the Contractor, in this case, was to maximise their profits at the expense of several environmental goals. This was fuelled by the fact that the Contractors underestimated the budget for the project, and hence they were forced to work on tight margins. Given that Consultants are hired by the Contractor in this scenario, there was a general tendency for the Consultant to favour the Contractor in approval of many aspects of the project, such as the use of cheaper materials, systems and sub-contracts. The rigour in the technical evaluation of environmental aspects was therefore clearly compromised. However, the most interesting and

serious conflicts of interest occurred in the final commissioning of the project. Instead of the Developer hiring an independent commissioning agent, the Contractor, in this case, was able to hire the commissioning agent. This meant that the operational performance of the building was clearly lower than what was expected, and thus LEED gold certificate was unattainable as a result. Based on these findings in conjunction with the agency theory, we can, therefore, say that the 'design and build' model was not best suited for ESCM; according to one Developer, 'We've learned from this project about what has gone wrong and are working very hard to prevent this from happening in future.'

The second scenario, as seen among foreign Developer in one of the projects, can be referred to as the 'client representative' scenario, where the Consultant was hired by the Developer to be their representative, with the Consultant given the entire responsibility to manage the project, including the hiring of the main Contractor. Given that in most cases the main Consultant is the most knowledgeable entity among all stakeholders, this model worked well for the Developer, especially considering the fact that this particular project achieved LEED platinum status. One of the reasons for this achievement is that the major issue in agency theory, which is self-interested behaviour, was not at play, as the client representative (Consultant) was not responsible for any financial-related matters. The various financial aspects, such as negotiations, were carried out by the Developer. In the words of one of the Consultants, 'Technical evaluation is done by us [Consultant], while the financial evaluation is done by the Developer, and the final decision, of course, will rest with the client [Developer], but we ensure [this process] is fully compliant, and we don't even know who is the cheapest.'

The third and most common scenario was found to be the 'client managed' scenario, where the Developer used their in-house resources to make the selection of

Architects/Consultants and the main Contractor, and in some cases the Sub-Contractors too. In this case, the Developer has tighter control over the project. Though it works better than the first scenario, the resources and knowledge of the Developer in making the selections is limited than in the second scenario. Also, some of the negative aspects of agency theory could occur in this case because the various environmental and financial goals within the Developer firm may potentially conflict. For example, there could be situations where top management often behaves in ways that benefit them financially, and not the project team. For example, a CEO may exploit his/her role as an agent by compromising a particular management practice (in this case ESCM) in order to improve his/her own compensation/profit targets regardless of the actual benefit of the management practice for the company. This issue could potentially arise in situations where the Consultant is trying to convince the Developers of the benefits of implementing environmental practices. In the words of one Consultant (Small), 'We will try to convince the Client/Developer about the possibilities of implementing environmental practices; however, there is a limit to which we can push.'

In summary, there is no one particular scenario that works better than the others. Depending on the specific circumstances, each Developer has to decide on the type of supply chain contract agreement they want to pursue.

Macro analysis at industry/country level through diffusion of innovation theory

The influx of foreign firms to the UAE has had a significant impact in promoting ESCM in construction projects in the UAE. This is because they not only have a more positive attitude towards sustainability but are also making a concerted effort to educate the market on the benefits of environmental practices. Also, with increasing foreign-local joint venture firms, the knowledge and culture of sustainability are passed on to the local partner by the western partner.

This could explain some of the significant increase in the number of LEED-registered projects from few in 2011 to nearly 1,000 in 2015 (LEED, 2015). The other significant reason for this increasing sustainability focus of UAE firms is the influence of government regulation.

This influence of foreign firms and government regulation on the overall sustainability prospects of the UAE can be explained based on the premise of diffusion in innovation theory (Rogers, 1962). According to the theory, diffusion of an innovation (in this case ESCM) can be viewed as a process of initiation, persuasion, planning, adoption and confirmation (Sarkis et al., 2011). Diffusion happens naturally if it is communicated through particular channels, over time, among the members of a social system (Rogers, 1962). In the UAE construction sector, the communication to implement environmental practices from the government side is mainly through green building regulation channels. However, according to respondents, they need to more stringent. In the words of an interviewee: 'they (the government) should conduct operational energy performance audits of buildings.' Also, there is no federal-level green building regulation, and firms have highlighted these concerns as they work on related but different green building guidelines in Dubai and Abu Dhabi. Given that government agencies are examples of powerful groups that may influence the actions of individual organisations (Rivera 2004), for widespread diffusion of ESCM, it is important that governments also use multiple communication channels to promote ESCM. Some of the feedback received from the interviewees concerned the more active role that can be taken by the government, such as incentives/subsidies for firms to implement environmental practices and preferential treatment for government projects or awards. Also, the government could empower NGOs to take a more active role in promoting environmental practices in addition to hosting conferences, workshops and seminars to spread awareness. In addition, the government could make the green material,

product, and system certification mandatory, which would not only ensure the effective performance of the Suppliers but also bring more green Suppliers to the country, which would eventually reduce the costs.

Conclusion

Previous studies in the construction sector have primarily focused on related but more specific aspects of ESCM, despite several calls in the literature to adopt a more holistic and integrated approach (Ferretti et al., 2007). One of the significant contributions of this study is that it addresses these gaps in the literature by conducting a holistic, grounded investigation into the various facets of ESCM in the construction sector. The three-level analysis of the findings (thematic analysis at the stakeholder level, supply chain level analysis and macro analysis at industry/country level) provides superior and systemic insights for practitioners and policymakers, not just in the UAE, but also elsewhere for greening the construction supply chain and the sector.

For instance, the study provides understanding on the key internal and external drivers (pressures/motives) and key internal and external barriers/challenges facing different firm types (large, small, foreign and local) and across different stakeholders (Client/Developer, Architects/Consultants, Main-Contractors, Sub-Contractor and Suppliers). Since the extent of environmental practices implementation would depend on the net force field impact of opposing pressures of drivers and barriers, the findings are useful for policymakers and industry leaders to predict the sector's environmental behaviour and to devise strategies for each stakeholder so that they can maximise/leverage the drivers and minimise/eliminate the barriers to promote sector-wide efficient and effective environmental practices' implementation.

Similarly, the findings provide practitioners in the UAE and elsewhere with a potential stock of core and facilitating environmental practices that can be adopted by each stakeholder in greening the construction supply chain. This includes simple environmental practices such as the use of video conferencing instead of face to face meeting to complex environmental practices such as the use of energy efficient machinery in onsite construction. This implies that firms with limited knowledge and resource constraints can start by implementing simple environmental practices and then gradually move towards more complex environmental practices. The findings are also useful for policymakers to prioritise their actions, strategies and policy interventions to create support/pressure mechanisms to improve those environmental practices that are lagging others.

Also, the study provides insights on the important and relevant performance measures for stakeholders to capture their environmental performance such as reduction in environmental accidents, greenhouse gas emissions, water consumption, energy consumption, material use, and waste generated. Since firms cannot effectively manage what they do not measure, this understanding provides practitioners with simple, standardised, easy to operationalise performance measures to capture the environmental performance of their projects.

The study demonstrates the relevance of each supply chain stakeholder in the application of ESCM in the construction sector as well as the importance of managing their conflicting interests and challenges in engaging them to environmental practices in a coherent manner vis-à-vis other supply chain stakeholders. The supply chain level analysis provides the pros and cons of different contract models between the Developer and other supply chain stakeholders on the environmental outcome of the projects namely the 'design and build' scenario, 'client representative' scenario, and 'client managed' scenario. Practitioners looking to enhance the

environmental performance of their projects therefore must ensure there are no contractual flaws in the model.

Since the study identified heterogeneity in the various ESCM aspects across different firm types, at a country level, policymakers and industry groups should encourage diffusion of environmental knowledge through supportive programs such as collaborative partnerships and mentoring opportunities such as between large firms and small firms, and between foreign and local firms to ensure all firms regardless of their size and ownership are fully involved and commitment to protecting the environment.

However, practitioners or policymakers faced with the reality of addressing complex sustainability challenges, the accumulation of the above empirical evidence is of limited value unless accompanied by general principles which might inform wider application. The study therefore identifies several theories including several emerging theories such as strategic choice and implementation theory in an attempt to offer multiple theoretical perspectives in the conceptualization of the multifaceted reality of ESCM. The explanatory and predictive capability of the proposed theories provides practitioners with a deeper, broader and a simplified conceptualization of ESCM perspectives beyond the individual issues in the supply chain, thus enabling them to structure and manage environmental supply chains more easily in their particular context. Thus, the study makes a significant and novel contribution to the theoretical advancement of the field, not only in construction but also in general.

The other methodological contribution of this study to ESCM is that it addresses the lack of theoretically grounded research in ESCM (Carter and Easton, 2011; Carter and Rogers, 2008). In this study, it is the practical issues facing the sector used as input for theorising. It is widely

recognised that it is the engagement with practical problems that opens up avenues for good theories to emerge (Van Maanen et al., 2007).

However, the study has some limitations. One of the limitations of the study is that the theories presented here are by no means exhaustive, and could be biased based on the author's own particular familiarity and disposition. Moreover, the findings were only based on 39 interviews and therefore future investigation on a much larger scale as well as in different country contexts is required for further validation of the findings. Also, policymakers were not interviewed in this study, instead, available secondary data on policy aspects are considered. Further, future studies could also include policymakers, end-users/buyers and real-estate agents to obtain a more comprehensive picture.

Future researchers could utilise this theoretical understanding either directly in their research contexts or as a basis for cumulative theory building and testing. This is important, as theory building and testing is an on-going process, and can only be strengthened through a series of further refinement and tests across different populations and settings (Hensley, 1999). Thus, this study could be considered as a first comprehensive step towards the precise identification of a coherent conceptual base for the field to grow as a legitimate management discipline.

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Appendix 1 - Interview Protocol

Main questions

- What are the environmental practices implemented by your firm?
- What are the main external drivers for implementing environmental practices in your firm?
- What are the main internal drivers for implementing environmental practices in your firm?
- What are the main external barriers/challenges faced for implementing environmental practices in your firm?
- What are the main internal barriers/challenges faced for implementing environmental practices in your firm?
- What are the performance measures used to measure the impact of environmental practice implementation in your firm?
- What is the extent performance improvements from these environmental practice implementations in your firm?

  **(Similar questions were asked with respect to the sector also. For eg. What are the main external drivers for implementing environmental practices in the sector?)

Probing questions – Samples

- How was your experience working with other stakeholders in the supply chain in implementing green practices?
- To what extent was your direct involvement in the supply chain?
- Do you sub-contract your assigned job?

- Where you able to meet all the environmental related requirements in the tender specifications?

Appendix 2: Summary of findings by stakeholders and sub-themes (Large firms)

Large	Client/Developer	Architects/Consultants	Main Contractor	Sub-Contractor	Supplier
External drivers	Mandatory green building requirement (ESTIDAMA)	Client requirements; competitive pressure	Client tender specifications, ESTIDAMA requirement on onsite green practices	Meet main contractor requirements; ESTIDAMA requirement on onsite green practices	Meet ESTIDAMA material specifications
Internal drivers	Environmental vision and mission; improve brand image, attract sustainability investors, high valuation of stock price; enter foreign markets	Prestigious project to be involved with and a good reference for future projects, opportunity to learn from the project experience, high profit potential, in line with their future vision and mission of the firm		Prestigious project to be involved with and a good reference for future project	Environmental vision and mission; Prestigious project to be involved with and a good reference for future projects
External barriers/challenges	Design variation; project delay; commissioning issues; tender specification ambiguity; issues related to design and build contract model in general.	Reporting to the contractor (with little previous project experience) instead of the client, as the main contractor was awarded the design and build responsibility	Later design variation, lack of previous green project experience of this scale, lack of efficient and capable subcontractors, and lack of regional suppliers.	Tight margin to work with	Tight margin, logistics of transport
Internal barriers/challenges faced	High project cost, operational performance of the building lower than expected, complex to operate and maintain the green building systems	Shortage of resources lack of knowledge	Under costing of the whole tender pricing, shortage of resources	Lack of knowledge and experience in complex technology	-
Core green practices implemented	Innovative glass façade passive design technology; Intelligent building management systems, energy efficient HVAC systems, photovoltaic roof, automated sun shades, insulating air cavities, water recycling systems and energy efficient heating and lighting systems (green design)		Comprehensive onsite waste management (green construction); stringent selection of sub-contractors who has previous experience with ESTIDAMA (green purchasing)	Stringent selection of green material suppliers, preferably the ones listed in the ESTIDAMA database	-
Facilitating green practices implemented	Frequent multiple stakeholder project team meeting	Auditing of suppliers including factory visit, training for suppliers	Cross-functional teams, training/workshops for sub-contractors	-	
Performance measures and improvements	Energy consumption and water consumption measures are used. Improvements not as expected	-	Onsite waste recycle statistics; Pre-occupancy building and water energy efficiency measures during commissioning		Mentioned in the product sheet such as embodied energy, recycle content.

Appendix 2: Summary of findings by stakeholders and sub-themes (Small firms)

Small	Client/Developer	Architects/Consultants	Main Contractor	Sub-Contractor	Supplier
External drivers	Mandatory green building requirement (Dubai municipality green building regulation)	Client requirements	Client tender specifications	Meet main contractor requirements	Meet the minimum green building regulation standards
Internal drivers	Cost reduction through energy and water reduction in common areas (which is still owned by the Client) though the apartments are sold to end users	Part of corporate strategy to educate clients on the benefits of green buildings and push green design	Achieve cost saving through waste minimization and waste recycling measures	-	Own corporate environmental commitment policy
External barriers/challenges	Tight internal deadline, lack of green supplier network, lack of customer demand	Convincing client on the green building benefits, tight overall project budget	Tight client deadline, lack of network of green sub-contractors and suppliers		Low profit margin
Internal barriers/challenges	Lack of corporate environmental policy, high cost, lack of knowledge and awareness, lack of in-house skilled professionals	-	Lack of corporate environmental policy, lack of dedicated environmental project team, lack of knowledge, skills and experience on green construction techniques, no perceived incentives	Lack of knowledge and experience.	
Core green practices implemented	Design to meet the minimum requirement of Dubai municipality green building regulation (green design), 50% weightage for technical compliance that meet Dubai Municipality green building regulation (green purchasing)		Onsite waste management and achieve target as mentioned in the tender specifications		
Facilitating green practices implemented	Monthly stakeholder progress meeting	Audit of Contractors and Suppliers on meeting green building regulation, training programs for Contractors and Suppliers	-	-	
Performance measures and improvements	Energy consumption and water consumption measures are used. Marginal improvements	-	-	-	Mentioned in the product sheet such as embodied energy, recycle content.

Appendix 2: Summary of findings by stakeholders and sub-themes (Foreign firms)

Foreign	Client/Developer	Architects/Consultants	Main Contractor	Sub-Contractor	Supplier
External drivers	Head quarter policy of the foreign partner in the local-foreign joint venture project, ESTIDAMA green building regulation	Client requirements, Competitor pressure	Meeting stakeholder requirements, achieve ESTIDAMA waste management targets for Pearl rating 2 and LEED platinum standards.	Meeting main contractor requirements	Meeting main-sub contractor requirements
Internal drivers	Environmental commitment stated in the vision and mission, significant cost reduction opportunities, brand image, high share value, reputational risk	High profit margin, prestigious client to work with, in line with their sustainability vision and mission		Good reference for future projects, good learning experience and profit margin	Good reference and profit margin
External barriers/challenges faced	Getting qualified local contractors and suppliers, and hiring qualified professionals from within the UAE; project delay and project variations		Project variation, project delay	Getting the task completion sign-off due to stringent commissioning tests, complex integration with other systems	Logistics, compatibility with other systems
Internal barriers/challenges faced	High cost	More organizational resource allocation than traditional projects	High cost to train employees on the aspects required to be LEED platinum certified and ESTIDAMA pearl rating 2	Allocation of dedicated resources for the project	
Core green practices implemented	Design is based on LEED platinum and ESTIDAM Pearl rating 2. Stringent selection process for hiring the main contractor		Stringent selection in hiring sub-contractors based on their previous LEED and ESTIDAMA experience and quality of the proposal (green purchasing); transportation planning for materials and personals to and fro from the site to ensure the distance is minimized (green transportation); use of waste management plan and use of automation and energy efficient equipment's	Stringent selection of material suppliers, energy efficient onsite installations, waste minimization techniques.	Recyclable and minimal material packaging (green design), energy efficient transportation planning for onsite delivery of materials (green transportation), material specification above the requirements for LEED platinum and ESTIDAMA 2.
Facilitating green practices implemented	Frequent auditing of progress, regular workshop on the best practices and lessons learned, strong project team comprising of representatives from all stakeholders		Frequent audit and training programs for sub-contractors	Audit of suppliers and training/awareness sessions for suppliers	Material/product optimal performance training for consultants, contractors and post-occupancy building management team
Performance measures and improvements	Reduction in emission, energy, water, air quality during operational phase and cost savings during operational phase		Onsite water, energy and fuel consumption	Relevant water/energy/fuel savings report	Transportation emission, commissioning test results of the product

Appendix 2: Summary of findings by stakeholders and sub-themes (Local firms)

Local	Client/Developer	Architects/Consultants	Main Contractor	Sub-Contractor	Supplier
External drivers	Dubai municipality green building regulation	Client requirements, Competitor pressure		Meeting contractor requirements	Meeting contractor requirements
Internal drivers	Environmental commitment of the client to go for LEED gold certification, to attract investors	Good reference for future projects and higher profit margin	Cost savings from waste minimization, high-profit margin	High-profit margin	High profit margin
External barriers/challenges faced	Finding cost effective local contractors and suppliers	Both client, contractor and consultant themselves are relatively new to the green building concept which led to lot of uncertainty	Design variation and re-works	Ambiguity in the tender specification with regards to scope which led to conflicts with the main contractor. Finding cost effective green suppliers	Tight margin to work
Internal barriers/challenges faced	High cost, lack of knowledge on many aspects	Allocation of dedicated resources for the project	Lack of incentives for doing more than required	Lack of incentives for achieving above the requirement	-
Core green practices implemented	Site selection near to public transport, energy efficient lighting system, solar water heaters at roof, energy efficient HVAC systems, glazed façade, insulated roof, waste water recycling, landscaping, materials with re-cycled content, use of regional materials with local ownership, minimization of hazardous material and indoor air quality		Comprehensive onsite waste management plan with dedicated onsite areas for waste recycling, stringent selection of sub-contractors based on their previous experience of green projects	Selection of green material suppliers	-
Facilitating green practices implemented	Monthly stakeholder progress meeting	Environmental training programs for contractors and suppliers, audit of suppliers	Establishment of cross-functional teams within the firm	-	-
Performance measures and improvements	Energy meters installed to provide automatic meter reading and to monitor and measure energy use at the system and equipment level to the whole building (electricity, air conditioning, and water). Energy consumption and water consumption during operational phase, operational cost savings, 40% use of regional materials, 20% is the average recycled content in materials, 15% reduction in water, and 75% waste water recycling, annual solar energy generation of more than 100 MWh	-	80% of waste diverted from landfill	-	Performance measure of equipment's/ systems available from the Client meter readings