

A Taxonomy of Knowledge Management Systems in the Micro-Enterprise

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Abstract: Knowledge Management Systems enhance innovation, increase operational efficiency, and improve decision-making in business organisations. The administrative and resource overheads required to implement and maintain such systems inherently exclude the smallest of firms from reaping these benefits. This research aims to identify, evaluate, and summarize the distribution of research on knowledge management and supporting systems across business size classifications with a particular focus on micro-enterprises. It also seeks to establish if existing knowledge management models, practices, and systems have invested due consideration in their design to cater for the limited resources typically found in the micro-enterprise. It contributes new insight into the applicability of knowledge management systems to micro-enterprises and it stimulates a possible re-think of how such systems can cater to the specific constraints of this prolific business type. This taxonomy is the result of a thorough analysis of 168 research papers from a total of 10511 papers published in reputable conference proceedings since 2012. It focuses on key knowledge management themes covered, including the size of the enterprise, the adoption challenges, the potential benefits, the technologies used, and the aspects of the knowledge management cycle that are being employed. Furthermore, it draws on this analysis to highlight the appropriateness of existing knowledge management systems to the distinctive risk and opportunity characteristics of the micro-enterprise.

Keywords: Knowledge management, Micro-Enterprise, Small and medium-sized business, Knowledge management cycle, Knowledge management adoption challenges, Taxonomy, Knowledge management systems

1. Introduction

Since Karl Wiig's keynote address 'Management of Knowledge' in 1986, a steady flow of milestone implementations on knowledge management (KM) in the industry have been studied and recorded. KM brings particular benefits to enterprises by registering a lowered incidence of repeated mistakes, enhanced personal knowledge base, improved organisational competence and a saving in operating costs and expenses (Cheng et al., 2015). These benefits are attained through the adoption of a cyclic approach that manages knowledge from the point of its creation, dissemination, throughout its application, and eventual destruction. The motivators for KM system (KMS) adoption are diverse, and "in an economy where the only certainty is uncertainty, the one sure source of lasting competitive advantage is knowledge" (Nonaka, 2007). Strengthening the collective expertise of staff and partners contributes to increased success in the marketplace (Fred et al., 2016). KM "continues to be a critical strategy for an organization to achieve a sustainable competitive advantage, and consequently survive in today's knowledge-based economy" (Halawi et al., 2017). A reduction in project timings, an improvement in the quality of products, and a higher level of customer satisfaction have all been attributed to effective KM, particularly when used to guide the firm's actions in these areas (Rhem, 2018).

Micro-enterprises (ME) are known to depend on the recollection of memories and experiences rather than knowledge that is explicit (Alvarez et al., 2016; Sadat, 2018). This may be the result of several factors that are unique to the micro-enterprise, such as time availability, the steep learning curves demanded by existing KMS,

human resource availability and financial limitations (Camille et al., 2017), (Michna et al., 2018). These enduring constraints that characterise the micro-enterprise present unique challenges to its adoption of KM.

This taxonomy paper aims to identify, evaluate, and summarize the distribution of research on KM and KMS across business size classifications with a particular focus on that specific to, or in its absence, relates closely to micro-enterprise. It also seeks to establish if any existing KM models, systems, and practices, have catered for the limited resources of the micro-enterprise. It contributes new insight into the applicability of KMS to micro-enterprises and it stimulates a possible re-think of how KMS can cater to the specific constraints of this prolific business type. The following sections present the methodology used, the findings and a discussion of the results to further research.

2. Literature Review

The vast amount of current literature on KM “assumes a somewhat uniform type of organisation: large, international, and dominated by Western management structures and ideals” (Lim et al., 2000). The motivation for KM research and practice to focus and cater for such large organisations is primarily due to the budgets that these corporates typically make available for such undertakings. It's of no surprise, therefore, that the adoption rate of KM in the prolific smaller business sizes is very low to non-existent. This was mainly due to the inappropriate features and excessive overheads required to realise net benefits from such implementations feasible. The vast majority of studies on KM do not consider the differences that company size and their specific characteristics have on adopting such systems. In fact, “no systematic work exists on characterising a collective set of Critical Success Factors for implementing KM in the SME sector.” (Yew et al., 2005)

In a paper that highlights the key differences between small and large businesses in Europe, (Gray et al., 2005) argue that ‘owner-managers’ of micro and to some extent Small and Medium-sized Enterprises (SME), are generally more focused on the short-term day-to-day survival of their business. They have developed a ‘proprietary’ way of informal learning and tacit abilities that cater to the specific needs of articulating and adapting to changes in market conditions very rapidly. “KM seems to have been successfully applied in large companies, but it is largely disregarded by small and medium sized enterprises” (Nunes et al., 2006), adding that this is likely due to an absence of formal processes and procedures that cater specifically to handling organisational knowledge efficiently and an underutilisation of information and communication technologies.

Other aspects that may explain the lack of KM adoption among the smaller firms can be attributed to several arguments suggested by (Hutchinson et al., 2008) where they maintain that these firms “do not have the inherent internal knowledge sharing and communications problems of large organizations”. Suryawan et al., (2015) found that this size of firm generally has reservations toward adopting KM due to its perceived implementation and operative costs, and perceived loss of competitive advantage resulting from the inability to quickly adapt to market changes because of the tighter (more formalised) business operating procedures that KM brings about. (Tsui, 2017) also found that the need to invest in upskilling of staff and the related volatility brought about by their departure, the dominance of the proprietor in taking most decisions, the difficulty of calculating a quantifiable return on investment (ROI) all contribute to this hesitation in adopting KM. Furthermore, “the existing KM tools seems too difficult for micro-companies to use due to their lack of available time and resources” (Camille et al., 2017), a position reaffirmed by (Michna et al., 2018) who categorically state that because of their particular characteristics of “limited human, financial and material resources and a lack of time for creativity development” a different approach in terms of tools and resources to those appropriate to large organisations is necessary.

KM brings unquestionable advantages to organisations. “The most impressive benefits of good knowledge management involve money saved or earned” (Davenport et al., 1998). Texas Instruments had indicated positive returns after licensing its intellectual property and patents. Similarly, Dow Chemicals reported similar returns after it improved the management of its patents. However, the expense of KM implementations should not be underestimated. Buckman Labs estimated an investment of 2.5% of revenue, Ernst and Young a 6% of revenue, and McKinsey and Co a significant 10% investment of revenues (Davenport et al., 1998). Such is the

perceived potential of KM implementations. Despite the shortcomings inherent to accounting practices for measuring the feasibility of ‘relatively’ new strategic and wide-reaching initiatives such as KM, Turban et al., (2007) reports on findings that show a 20:1 ROI for firms engaged in the chemical industry and 4:1 for firms engaged in transportation and logistics. These figures yield a calculated average of 12:1 ROI.

“In an economy where the only certainty is uncertainty, the one sure source of lasting competitive advantage is knowledge” (Nonaka, 2007). Strengthening the collective expertise of staff and partners contributes significantly to increased competitive advantage (Fred et al., 2016). In fact, Tsui, (2017) claims that the advantages KM brings to a firm are even broader adding an increase in sales and customers, consistency in product and service offerings, customer response time, maintaining social and professional networks with less effort, providing further flexibility across delivery channels, prospecting new custom, a reduction in time required to “carry out knowledge-intensive tasks” and problem resolution. “Knowledge management continues to be a critical strategy for an organization to achieve a sustainable competitive advantage, and consequently succeed in today's knowledge-based economy” (Halawi et al., 2017). A reduction in project timings, an improvement to the quality of products, increased competitive advantage, and a higher level of customer satisfaction are attainable if knowledge is managed effectively, particularly if it is used to guide the firm’s actions in these areas (Rhem, 2018).

Despite its prolific presence, the micro-enterprise is a very small and fragile organisation which is, nonetheless, resilient in that it is highly dynamic and adapts very rapidly to change. To maintain this resilience and remain relevant to its market, it must capitalize on all the advantages it has over its larger cousins. From a KM perspective Lim et al., (2000) argue that smaller enterprises find it easier to acquire knowledge due to its less formal environment and are more adaptable to change over a shorter timescale. A low rate of staff turnover contributes positively to both adapting to change and maintaining tacit knowledge (Susanne et al., 2011). Furthermore, small firms develop particular skills and techniques aimed at avoiding the loss of knowledge (Evangelista et al., 2010).

Interest and research into the application and benefits of KM practices within the SME sized enterprises have seen a significant increase over the last five years, but substantial gaps still exist in literature that addresses challenges pertinent to the significantly prolific micro-enterprise (Mota et al., 2013) (Camille et al., 2017; Lee et al., 2015b). Mota et al., (2013) research concludes that of all the KM systems reviewed none meet the requirements of the micro-enterprise. This reinforces their suggestion that existing systems are designed for the medium and large organisations with little or no consideration for the micro-enterprise. Recent studies reaffirming the findings of an OECD, (2003) report, established that micro-enterprises largely employ personalization strategies that depend heavily on the tacit recollection of memories and experience rather than explicit knowledge (Alvarez et al., 2016) (Sadat, 2018). This is likely due to the limited resources available to the micro-enterprise that constrains this size of firm from leveraging the benefits from strategically applying knowledge management systems to their often-incongruent IT systems.

Despite their ability to rapidly adapt to market changes, the limited resources available to the micro-enterprise constrain this size of firm from leveraging the benefits and strategically applying a KMS to their often-incongruent IT systems. The “existing KM tools seem too difficult to use for micro-companies due to their lack of available time and resources” (Camille et al., 2017), a position reaffirmed by Michna et al., (2018) who state that given their particular characteristics of “limited human, financial and material resources and a lack of time for creativity development” a different approach in terms of tools and resources to those appropriate to large organisations is necessary. KM literature often assumes the micro-enterprise to be very similar to a ‘start-up’ or ‘SME-sized enterprise’. This has led to the general perception that the micro-enterprise is adequately catered for in this domain. Although a start-up may, particularly in its early existence, be classified as a micro-enterprise, its primary survival objective is to secure the largest market share in the shortest possible time. SMEs have similar goals but use significantly more resources to satisfy market demands.

The micro-enterprise is different; it typically serves a niche market without necessarily warranting an increase in resources for its survival (Gherhes et al., 2016). However, the enduring resource limitations that characterise the micro-enterprise present unique challenges to adopting KM.

3. Research Methodology - Materials and Methods

To investigate whether the micro-enterprise needs a different approach to KM we seek evidence of ‘organisational size’ factors as pivotal to the realization of KM utility, i.e., it questions whether due consideration needs to be applied to the size of an organisation when designing, implementing, and operating a KM system to realise maximum benefit.

This research takes a bottom-up approach and is divided into two main phases. The first is a preliminary selection based on search criteria applied to the advanced search facilities of selected databases. It results in a set of shortlisted peer-reviewed academic papers that form the basis for this study. The second phase conducts a content analysis on the shortlisted papers, and through a series of structured queries addresses the research question and yields the taxonomic hierarchy.

A taxonomy needs to be concise, robust, comprehensive, extendible, and explanatory (Bailey, 1994). In a recent review of 33 taxonomy articles used in Information Systems Research, Lösser et al. (2020) observed that most taxonomies that took an ad hoc approach lacked these essential aspects. In search of a more structured form, Nickerson proposes an iterative seven-step method (Nickerson et al., 2013). Therefore, to ensure that this taxonomy is explicit, transferrable, and reproducible, an adaptation of the Nickerson et al. (2013) seven-stage approach is used. For this first phase, the IEEE Xplore and ACM databases have been purposefully selected to ensure that the output yields empirical primary research data about KMS that is rooted within the field of information systems and computer science. The “Full-Text Collection” of the ACM database is being used to limit results to articles that are sponsored or published by the ACM rather than the ‘ACM Guide to Computing Literature’ since this would dilute the scope through the inclusion of other third-party publishers. The data collected from this phase is intentionally constrained by date range, initially excluding papers published before the establishment of the term ‘Micro-enterprise’ by the European Union (EU) in May 2003 and further still to papers published within the last ten years. This further constrained date range allows the term to have become well understood and applied within its new EU context without excluding studies from outside of the EU.

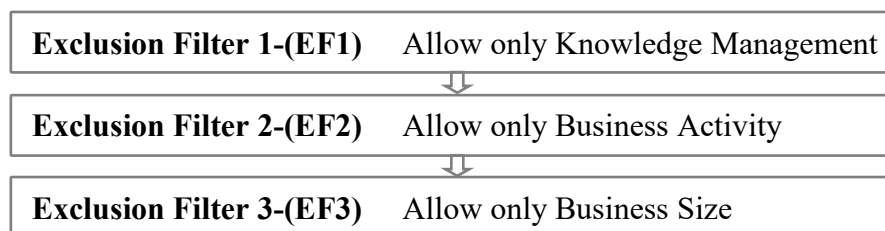


Figure 1: DB Exclusion Filters of Phase 1

A sequence of three exclusion filters, illustrated in Figure 1, are applied to the databases to ensure the relevance and intended scope of the resulting papers. This phase will produce the set of shortlisted papers on which the second phase is conducted. The first filter looks for the presence of the phrase “Knowledge Management” or any variant key phrases, such as KM, KMS, or Knowledge Acquisition, within the abstract part of the paper. This initial filter excludes papers where KM is not the main topic of discussion. The second filter searches for the presence of the word “business” or any variant key phrases or words such as Firm, Company and Organisation, within the abstract part of the paper. This second filter excludes papers that do not discuss KM within the context of business activity. The third filter searches for the presence of the word “size” or any variant key phrases such as “SME”, “Small” or “Micro”, that indicate the size of the business is a relevant point of discussion. This third filter excludes papers that disregard business size as a factor that impacts KM.

The second phase consists of three stages, a preliminary manual screening stage for establishing paper eligibility, a series of close-ended questions that address the research question, and a concluding set of open-ended questions that serve to complement the data collected from the close-ended questions toward constructing the taxonomy. This three-stage process is represented in Figure 2.

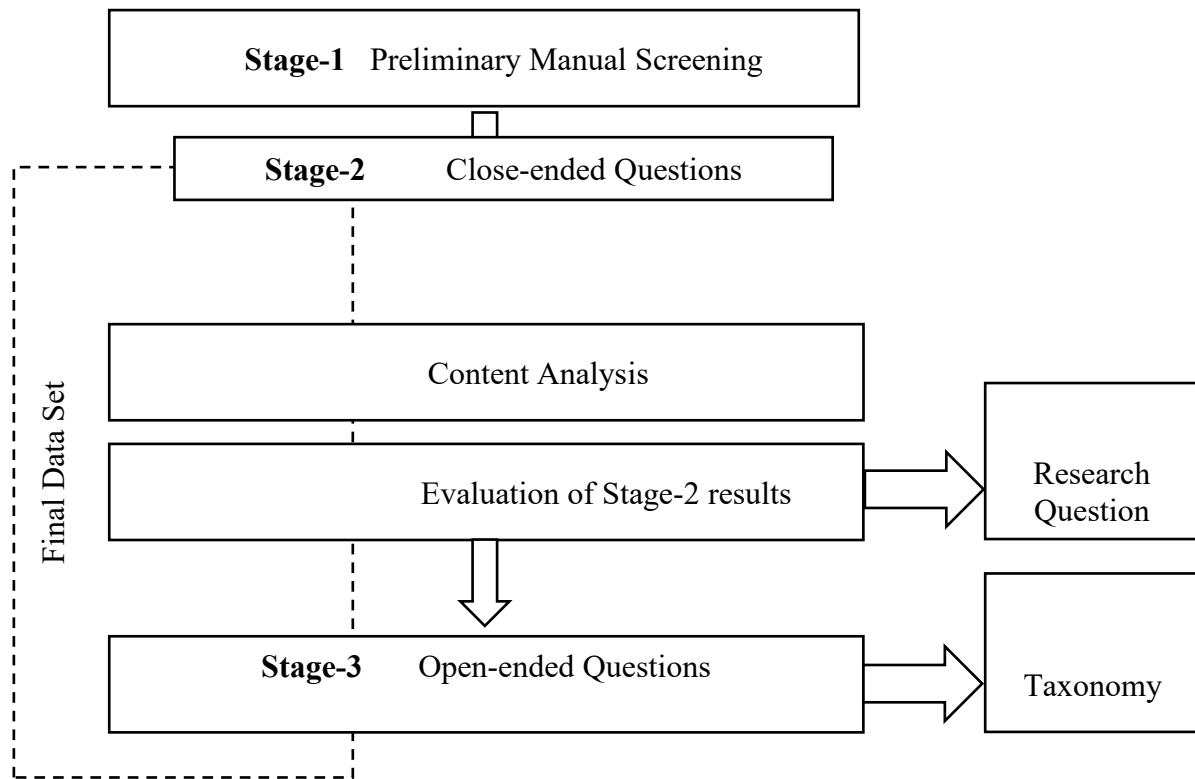


Figure 2: The three stages of Phase 2 - showing the flow of investigative analysis, addressing the research question and building the taxonomies

To enhance the inclusivity and comprehensiveness of this taxonomy several measures are taken to address the possible methodological challenges of publication and language bias. The potential for publication bias is where we recognise that studies with statistically significant results are more likely to be published, leading to an overrepresentation of specific findings. Additionally, this methodology also considers that language bias may pose a particular hurdle, as relevant literature published in languages other than English are overlooked, potentially distorting the results analysis. To mitigate these challenges, access to full-text articles is deemed mandatory, and where necessary, non-English articles were appropriately translated.

4. Empirical Results

The Phase-1 preliminary paper selection process is conducted against the ACM and IEEE Xplore databases. Table 1 details the resulting values from the application of each of the exclusion filters illustrated in Figure 1. The search criteria used, and respective variants of the principal keywords and phrases applied are also detailed for the purpose of replicability. A total of 168 papers were shortlisted for the Phase-2 analysis from an initial count of 10,511 papers.

Table 1: Phase 1– Preliminary Paper Selection as of January 2024

Search Criteria	IEEE Xplore	ACM	Total Papers
EF1- Abstract:(<i>"knowledge management" OR "Management of knowledge" OR "Knowledge transfer" OR "Knowledge acquisition" OR "Knowledge capture" OR "Knowledge distribution" OR "Knowledge dissemination" OR "Knowledge share" OR "Knowledge sharing" OR "Knowledge application" OR "Knowledge retrieval" OR "Knowledge use" OR "Knowledge creation" OR "Knowledge Usage"</i>)	9284	1227	10511
AND			
EF2- Abstract:(<i>business OR firm OR organization OR organisation OR company OR enterprise</i>)	3564	278	3931
AND			
EF3- Abstract:(<i>size OR smb OR sme OR medium OR small OR "Very small" OR micro</i>)	278	52	330
AND			
since 2003	247	52	299
AND			
since 2012	131	37	168

4.1. Stage 1 – Manual Eligibility Screening

his next phase begins with a manual screening process that assesses whether the key phrases, words, and their respective variants were filtered correctly by the databases’ advanced search facilities. Furthermore, the evaluation seeks to confirm that the context within which the key phrases and words are used is relevant to the study and to address the research question. The series of close-ended Assessment Criteria Questions (ACQs) used to manually screen the papers are detailed in Table 2.

Table 2: Phase 2 - Stage 1 ACQs for the manual paper screening process

<i>ACQ #</i>	<i>Manual Paper Screening Criteria</i>	<i>Yes</i>	<i>No</i>	<i>Set</i>
1.0	Is the paper unique within this dataset? (NO for Duplicate)	166	2	168
1.1	From 1.0 is EF1 met? (the phrase 'Knowledge Management' or variants)	166	0	166
1.2	From 1.1 is the paper's primary discussion on KM?	132	34	166
1.3	From 1.2 is EF2 met? (the word 'Business' or variants)	132	0	132
1.4	From 1.3 is the paper's primary discussion on Business Activity?	112	20	132
1.5	From 1.4 is EF3 met? (word 'Size' or variants)	112	0	112
1.6	From 1.5 is 'size' used within the context of business size?	81	31	112
1.7	From 1.6 does the paper present primary research? 'NO' represents literature review, systematic review, or taxonomy	72	9	81
1.8	Exclude paper from further review if the value of 1.0 to 1.7 = 'NO'	N/A	96	N/A

Of the initial 168 papers that were eligible for Phase 1, the manual screening process found 96 papers to have failed the screening criteria and were therefore excluded from further processing. Two papers were duplicated, and 34 papers did not tackle KM as the primary focus of the research (ACQ# 1.2). A further 20 papers failed to meet ACQ# 1.4 which requires the paper to discuss the application of KM within the context of business organisations. Of these, 31 papers were found to have used the term 'size' as a measure for aspects other than to describe the size of a business entity (ACQ# 1.6). A final 9 papers were excluded since they analyse secondary research (ACQ# 1.7) and would include data that is duplicated from other papers that already form part of this study. In summary, a total of 72 papers passed the manual screening process and formed the final data set.

4.2. Stage 2 – Does the Micro-Enterprise Need a Different Approach to KM?

This stage seeks to answer the research question by conducting an in-depth analysis of the 72 shortlisted papers. The first series of questions (Series 2.1) seeks evidence supporting the existence of research on KM that specifically caters for a particular size of an organisation. Each paper is assessed against the close-ended ACQs detailed in Table 3. The results are not mutually exclusive and therefore if a single paper meets the criteria for mentioning large and small enterprises it is added to each row accordingly. A percentile value of the main findings summarises the table results.

Table 3: Series 2.1 - Close-ended ACQs to determine the sizes of organisations being discussed

<i>ACQ #</i>	<i>Serithe2.1 - What research on KM exists that considers organisational size?</i>	<i>Yes</i>	<i>No</i>	<i>Set</i>
2.1.1	Does the paper mention Large Enterprises?	32	40	72
2.1.2	Does the paper mention Small or Medium-Sized Businesses?	66	6	72
2.1.3	Does the paper mention Very Small or Micro-enterprise?	9	63	72
2.1.3.1	From 2.1.3 does the paper mention Very Small or Micro-enterprise exclusively?	0	9	9
2.1.3.2	From 2.1.3 is Micro-enterprise a key focus of the paper?	7	2	9
2.1.3.3	From 2.1.3.2 does the paper suggest a different KM approach for Micro Ent.?	4	3	7
2.1.4	Does the paper mention more than one size of enterprise?	30	42	72
2.1.4.1	From 2.1.4 does the paper consider firm size to be a key factor influencing KM use?	9	21	30
2.1.5	Does the paper discuss issues that challenge SMEs or Micro Ent. when using KMS?	20	52	72
Percentile Summary				
Large Enterprise			44%	
Small and Medium-Sized Enterprise			92%	
Micro-Enterprise (none exclusively)			21%	

As a result of this series of criteria assessments (ACQ# 2.1.1 to 2.1.3), 44% of papers mention Large Enterprises, 92% mention Small or Medium-sized and 21% mention Micro-enterprise. 41% of the papers mention more than one size of organization and will be assessed further since they have the potential to discuss firm size as a key factor in KMS utility. Of these 41%, only 21% of these papers (9 in total) discuss firm size within their study. Of these 9 papers that mention micro-enterprises, none mention it exclusively, implying that all the papers in this set have some correlation to at least two firm sizes. 2 of these papers Rumanti et al., (2016) and Rahim et al., (2016) make an insignificant mention to micro-enterprise choosing to focus on the larger firm sizes, however, seven papers make a notable contribution toward organisational size being a key factor of KM utility. Torres-Blasido et al., (2019), validate a production model within a manufacturing micro-enterprise that seeks to increase productivity by encouraging its staff to share knowledge through the process of socialization. Pham et al., (2017), explore the impact of KM on business performance and provides evidence that “there is a difference in understanding and applying KM across three categories of firm size: medium, small and very small enterprises.” Hall et al., (2013), discuss the increased threat of corporate amnesia to the micro-enterprise due to its size and the dissemination of the entire organization’s tacit knowledge among the few staff members. Hartono et al., (2017), conduct a qualitative study that compares KM strategy to various organization sizes. The paper finds that a codification-based KM strategy benefits the larger firms whereas a personalization strategy benefits the smaller firms. The findings on micro-enterprise are largely inconclusive and “more follow-up studies” are required (Hartono et al., 2016) (Mahmod et al., 2013). While mostly informal, Knowledge Sharing is at its highest level in the smallest of firms and proportionately less in firms of increasing size (Riaz et al., 2019). Holistically, Hartono et al., (2016), determine that, unlike large and medium-sized firms, smaller firms

suffice with a simple KM system without the need to pursue a level of KM maturity. Their study recognizes that research “often treat firms as a single monolithic group” and disregards firm size as a moderating factor in KMS’. Mahmud et al., (2013), claim that “most of the studies conducted have not considered the differences of company size as well as specific features of SME that could affect KM” and “is largely disregarded by SMEs”. Of these seven papers, Pham et al., (2017), Hall et al., (2013), Hartono et al., (2017), and Hartono et al., (2016) suggest that a different approach to KM for the micro-enterprise is necessary.

The second series of questions (Series 2.2) evaluates each paper on the KM models and cycles studied. Table 4 summarizes the findings and shows that 67 of the 72 papers (85%) discuss at least one stage of the KM cycle, and 57 of these include Knowledge Sharing amongst other stages. Despite only 20 of the 72 papers (28%) referencing an established KM model, there exists a fair distribution of papers that discuss each of the main KM cycle stages. However, the discussion on knowledge sharing has a significantly higher presence across the papers than in other stages of the KM cycle.

Table 4: Series 2.2 - KM Models and Cycles Used

<i>ACQ#</i>	<i>Series 2.2 – What KM Models and Cycles are being used or proposed</i>	<i>Yes</i>	<i>No</i>	<i>Set</i>
2.2.1	Does the paper reference an established KM model? (Wiig, Zack, Bukowitz, McElroy, Dalkir, Nonaka, SECI, ICAS, Boisot, Choo, I-Sense, von Krogh and Roos etc.)	20	52	72
2.2.2	Does the paper discuss specific KM-Cycle stages?	67	5	72
2.2.2.1	From 2.2.2 does the paper discuss K-Capture / Collection?	34	33	67
2.2.2.2	From 2.2.2 does the paper discuss K-Creation / Innovation?	45	22	67
2.2.2.3	From 2.2.2 does the paper discuss K-Dissemination / Distribution / Sharing?	57	10	67
2.2.2.4	From 2.2.2 does the paper discuss K-Application / Retrieval / Usage?	24	43	67
Percentile Summary				
Established KM Model		28%		
Discuss specific KM cycle stages		85%		
Capture		50%		
Creation		67%		
Sharing		85%		
Application		35%		

The third series of questions (Series 2.3) seeks to establish the implementation/adoption challenges of KM for Micro, Small and Medium-sized enterprises (MSME). Table 5 summarizes the findings.

This series of ACQs found 25 papers (35%) that support business size is a determining factor affecting the use of KM. Mansfield et al.'s (2021) paper identifies the “lack of resources”, the “paucity of data governance policies” and opposition toward “accepting new practices and knowledge” as the main factors in smaller enterprises that determine the use of KM. Sadler et al., (2016) support this by stating that although “KM is now easier to implement and manage”, it should “not be underestimated as ‘easy to implement’” and proceeds to explain that “it requires change from all levels of management and a shift in culture” is of potential value. This implies that the smallest of firms would find it easier to change organisational culture and have fewer strata of management to contend with. Despite Alvarez et al. (2019) focus on KM in a factory production line, their paper recognizes that a critical challenge of SMEs is “low human productivity” which they attribute to the prioritization of production numbers over a “practice of knowledge management within their production chain”.

Table 5: Series 2.3 - The state of research on KM implementation for MSME

<i>ACQ#</i>	<i>Series 2.3 - What are the implementation challenges of KM for MSME?</i>	<i>Yes</i>	<i>No</i>	<i>Set</i>
2.3.1	Does the paper argue firm size to be a key factor affecting KMS implementation?	25	47	72
2.3.2	Does the paper argue firm size to be a key factor affecting KMS's usable features and functions?	10	62	72
2.3.3	Does the paper identify implementation challenges?	21	51	72
Percentile Summary				
Firm size effects KM implementation			35%	
Firm size effects usable KM features / functions			14%	
Suggest KM implementation challenges for MSME			30%	

This is evidence that SMEs involved in a production line setting either negate the benefits of KM or may not justify its implementation. Hartono et al. (2017) found recent studies suggesting that the “size of the organization may be considered as a key moderating variable” in the implementation of KM. The paper explains that there exists “a statistically significant relationship between the level of implementation of KMS and a construction firm’s performance” and that a “codification-dominant KMS” is more attuned to the requirements of the larger firm. The paper also found that the statistics relating to the smaller firms were inconclusive and required further study. Only ten papers (14%) presented evidence that firm size determines the usable features and functions of KMS. Key amongst these was Wiratmadja et al. (2014) who identify “six areas of SME technical competence that became a crucial source of knowledge in its business processes”. Although they are specific to the firm being studied, the identification of critical technical competencies and key business activities would determine the applicable KMS features and functions that would feasibly yield the desired benefits. Implementation challenges were identified by 21 of the 72 papers reviewed i.e. 30%. Mahmud et al., (2013) argue “organizational policy, a knowledge-friendly culture, an information system culture and training” are essential prerequisites for KM implementation. Risman, (2012) consider the lack of motivation is among the key challenges, and Torres-Blasido et al., (2019) perceive cultural change as being the most significant challenge. From the Stage 2 analysis, too few papers make any substantial contribution toward KM for the micro-enterprise, indicating that the amount of research in this area from a computer science perspective is in very short supply. Although this analysis cannot be considered conclusive for addressing the research question due to the limited number of qualifying papers, there is, however, clear evidence that indicates the need for further research to determine this with certainty.

4.3. Stage 3 – The Taxonomy

Through a series of open-ended questions, this third stage builds on the data gathered from the previous two stages, and through a reflective analysis of the findings forms the structure of the taxonomy detailed in Figure 3.

The ‘Adoption Challenges’ category highlights Staffing challenges, Costs assumptions, Technology availability and Business alignment as the most notable challenges of KMS implementation. The ‘Perceived Benefits’ category highlights Knowledge application, Customer mapping, Business growth and Innovation capacity as the leading advantages of KMS use. The ‘Suggested Technologies’ category identifies three main perspectives of KMS solution types, specifically Proprietary systems, Generic (non-KMS-specific) solutions, and Entire platforms. Each focus area is further detailed by several subclassifications that represent the entirety of the qualifying data for the MSMEs.

ADOPTION CHALLENGES		PERCIEVED BENEFITS	
STAFF Staff incentive Staff Indispensability Tech skills Staff Motivation Communication difficulties	BUSINESS Lack of Policies Lack of Management Sturcture Culture Change Organizational Learning Poor Informatization Complex KM Theory Unaware of KM Benefits	KNOWLEDGE Knowledge Reusability Timely access to Knowledge Accurate Knowledge Retrieval	BUSINESS Business Performance Vectors Competitive Advantage Enhanced Business Strategy Increased Productivity Wealth Generation
COSTS Cost Overhead Time Shortage	TECHNOLOGY KMS Availability	CUSTOMER Target Customer Needs Costing Accuracy Superior Information Quality	INNOVATION Improved Innovation Capability Readiness to Innovate
SUGGESTED TECHNOLOGIES			
PROPRIETARY Confluence R2RML Ontology SPARQL Text2Onto Framework Social Engagement Tools	Graspeo SharePoint Intranet Yammer	PLATFORMS Mobile Web Platform Cloud Platform Web 2.0 site Social Media Platform	GENERIC CRM System Database System Generic ICT Tools

Figure 3: The Taxonomy for MSME

It reflects the areas of KM research that were found to have been conducted across the MSMEs. Three specific main classifications are extracted from the set of 72 papers. These classifications are Adoption Challenges, Perceived Benefits, and Suggested Technologies.

ADOPTION CHALLENGES		PERCIEVED BENEFITS	
STAFF Staff incentive Staff Indispensability Tech skills Staff Motivation Communication difficulties	BUSINESS Lack of Policies Lack of Management Sturcture Culture Change Organizational Learning Poor Informatization Complex KM Theory Unaware of KM Benefits	KNOWLEDGE Knowledge Reusability Timely access to Knowledge Accurate Knowledge Retrieval	BUSINESS Business Performance Vectors Competitive Advantage Enhanced Business Strategy Increased Productivity Wealth Generation
COSTS Cost Overhead Time Shortage	TECHNOLOGY KMS Availability	CUSTOMER Target Customer Needs Costing Accuracy Superior Information Quality	INNOVATION Improved Innovation Capability Readiness to Innovate
SUGGESTED TECHNOLOGIES			
PROPRIETARY Confluence R2RML Ontology SPARQL Text2Onto Framework Social Engagement Tools	Graspeo SharePoint Intranet Yammer	PLATFORMS Mobile Web Platform Cloud Platform Web 2.0 site Social Media Platform	GENERIC CRM System Database System Generic ICT Tools

Figure 4: A Taxonomy of KMS in the ME

A further step to augment the final taxonomy that is specific and exclusive to the ME applies the subset of the seven papers from ACQ# 2.1.3.2 as a filter to the existing dataset. In contrast to the over-arching taxonomy covering the MSMEs in Figure 3, this final step results in the taxonomy of KMS for ME detailed in Figure 4.

5. Discussion

The absence of ‘Suggested Technologies’ from the final taxonomy’s main classification indicates the lack of KMS availability that is specific to the needs of the ME. This lack of availability, combined with the overhead costs resulting from licensing, skills training and administrative time required is also evident from this taxonomy. This raises important questions about why and how existing systems can be adapted to the unique operational constraints of the ME. Firstly, there may not be a significant enough market demand for tailor-made KMSs designed specifically for MEs. Since MEs have limited resources to invest in technology, they may not represent a sufficiently attractive market segment for KMS providers. This lack of demand could further discourage KMS developers from investing time and effort into creating such specialized systems. Secondly, resource limitations are a significant obstacle that MEs face. With restricted budgets and personnel, it may be

overly challenging to adopt complex KMSs designed for the larger organizations. MEs often lack the necessary technical expertise, financial means, or time required to implement and maintain a KMS. Lastly, there is a general lack of understanding about why MEs should invest in a KMS in the first place. In fact, the only perceived benefits recorded were Business Performance Vectors, Increased Productivity and Readiness to Innovate, which although significant and important, portrays a very narrow perspective on the broadness of advantages that a KMS has the potential to provide. Many ME business owners appear to be unaware of advantages such as improved decision making, increased employee productivity, or better communication among team members. Without recognizing these advantages, it would be difficult for MEs to realise the potential value of adopting a KMS.

The phenomenon of Staff Indispensability is accentuated in MEs over other sizes of enterprise. Staff members feel that they personally own certain knowledge and refuse to share it with others out of fear of losing the value that they personally contribute toward the firm. Staff indispensability can be attributed to several reasons including resource constraints and a lack of formalized management systems. In MEs, this may stem from the very small workforce and the limited skills and capabilities available to them. Staff in these settings often perform multiple roles and tasks compared to larger enterprises where significantly higher levels of specializations are more common. Therefore, the loss or absence of even one key employee can severely impact the functioning of the entire organization, as their multiple roles are not easily substituted by other members of staff. Furthermore, MEs typically lack formalized management systems and hierarchies that can help with transitions resulting from staff absences or turnover. The informal nature of these organizations makes them more reliant on their core employees, who often play a crucial role in their day-to-day operations. This is further compounded by the fact that in such small setups, employees might not have access to adequate training and development opportunities, leading to limited skills and competencies across the workforce. Additionally, the close-knit nature of these organizations can contribute to an environment where staff indispensability is more accentuated. Staff may develop a sense of ownership in their roles, and as a result, are less likely to delegate their tasks or share responsibilities with other team members. In such cases, the absence or departure of an indispensable employee can have significant implications on the firm's operations, productivity, and even threaten its very existence.

A constant need to keep staff motivated to capture and share knowledge is also noted together with a lack of organisational policies in the MEs. This allows for processes to be applied out of convenience rather than out of need. The lack of staff motivation to capture and share knowledge can stem from several factors, including limited resources, tight schedules, and a perceived disconnection between an individual's contributions and organisational success. Staff may not prioritize knowledge sharing if they are preoccupied with immediate tasks or if they feel that their efforts will not be recognized. Additionally, the absence of well-defined organisational policies can lead to confusion about how information should be stored, accessed, and used, further discouraging staff from engaging in these practices.

The study also finds "Organisational policy, a knowledge-friendly information system culture, and training" are amongst the essential prerequisites for KM implementation within MEs. Developing and implementing organisational policies may prove overly challenging due to the limited human resources, leading to ineffective implementation or neglect. Additionally, the lack of a clear hierarchy often results in unstructured approaches to KMS adoption. Creating a culture that values knowledge-friendly information systems can also be challenging for MEs since they may have limited IT infrastructure and technical staff. Consequently, creating an environment that promotes the collection, sharing, and utilisation of knowledge through technology is not necessarily seen as a priority. Training staff to use the KMS effectively is another prerequisite that presents difficulties. The underlying lack of human resources hinders the development and provision of adequate training programs for staff. Moreover, the small size of these organisations means that most staff members are involved in various core tasks, limiting time availability to KMS-related training.

The lack of staff motivation, and cultural change was noted as being the largest challenges hindering the implementation of such a system. Low staff morale may lead to resisting the adoption and utilisation of new

systems and related processes, while a lack of appetite for bringing about a change in culture could manifest into an unsupportive work environment for innovative practices such as KMS. The main causes may include poor working conditions, inadequate remuneration, resistance to innovation, and a general disconnect from industry trends. These factors often stem from an unwillingness or inability to invest resources in staff engagement, training, and infrastructure, which can ultimately lead to stifled growth and limited success in the competitive business environment. These challenges, if left unaddressed, would hinder the implementation of KMSs and deter the realization of its benefits within MEs.

6. Conclusion

This research summarizes the distribution of recent studies on KM and KMS for organisations that fit within the classifications of the European Union's MSME business size. This endeavour is supported by a rigorously structured and formal approach within the research area and outlines the analysis of the literature represented. It exposes the existence of a gross imbalance in KM research through a resounding emphasis on knowledge sharing and dissemination over other KM stages. The resulting taxonomy contributes new insight into the applicability of current KM research to MSMEs. More importantly, it establishes that there is insufficient consideration for micro-enterprise in existing KM models, designs, systems, and practices and provokes a re-think on how KMSs can specifically cater for this business size. In conclusion, while this study has focussed on the relationship between KM practices and the MSMEs, further research is warranted to delve deeper into the nuances of this dynamic interaction to enhance the competitiveness and sustainability of this size of organisation in today's knowledge-driven economy.

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