# Knowledge management in SMEs in the context of the Fourth Industrial Revolution

Aderonke Olaitan Adesina

and

Prof. D.N. Ocholla

Department of Information Studies
University of Zululand

*adesinaronke186@gmail.com; OchollaD@unizulu.ac.za*

## Abstract

*Prior to the Fourth Industrial Revolution (4IR), products determined demands, leading to mass production by large-sized enterprises. It is however proposed that after the 4IR, production and consumption will become customised because it is demand that will create products, and this will be led by innovative start-ups and small and medium enterprises (SMEs). SMEs are attested to be the main drivers of export, economic growth and employment. It is theorised that the ability to gather, combine and use the knowledge embedded in people and technologies to create a range of unique products will become an increasingly important competitive advantage that SMEs can exploit in the wake of the 4IR. Also revealed is the fact that the fourth industrial revolution will primarily affect customer expectations, product enhancement, collaborative innovation, and organisational forms; all of which are traditionally enabled and supported by knowledge management. Consequent upon the highly probable intense impact of the 4IR on organisations, this paper has reviewed the literature on how knowledge management can be practised by SMEs. Owing to the industrial nature of the subject and object of focus, the paper adopted an integrative review of both industry-based and academic articles. Hence, a manual search of both purposively selected industry-based articles and academic reviews were carried out on various websites and databases, with the emphasis on the terms: knowledge management, SMEs and 4IR or Fourth Industrial Revolution. The study randomly reviewed 17 industry-based and 10 academic articles, bringing the total number of reviewed articles to 27. The study revealed that SMEs are faced with challenges, but*

*can leap into the 4IR through highlighted knowledge management strategies, grouped under people, processes and technology. The study also proposed a framework to this effect.*

## Introduction

The emergence of the fourth industrial revolution (4IR), an era of comprehensive networking and computerisation of all areas of production, is changing the methods of acquiring, processing, storing, retrieving and using knowledge. It is an era of a paradigm shift marking the transition of work from a real physical world to a virtual world. This enables companies, not only to organise their production processes more efficiently, but also, for example, to manufacture customised products within the framework of, and at the same cost as, automated manufacturing. From the foregoing, it is apparent that work processes and the approach to knowledge management will change, and entirely new business models will emerge. While there are great expectations of the possibilities that will arise from the 4th industrial era, especially in the initial phase of socio-technical change, there is, however, a high level of uncertainty about the social consequences of these new technologies (Wilkesmann and Wilkesmann, 2018:239), particularly for SMEs (OECD, 2018). SMEs contribute to more than one third of GDP in emerging and developing economies and account for 34% and 52% of formal employment respectively (OECD, 2018: 5).  In the last decade, employment in SMEs has steadily increased at the global level. Over 2003-16, across 132 countries, the number of total full-time employees in SMEs has nearly doubled, from 79 million to 156 million (International Labour Organisation (ILO), 2017:17). This is a pointer to the huge contribution of SMEs to job creation, making it essential that SMEs are intensively nurtured to operate effectively in the 4IR. However, research projects on how SMEs can explore knowledge management to implement in the 4IR era are limited.

The purpose of this study is to identify, compile, and develop a framework from reviewed knowledge management activities that SMEs can prioritise for optimum

performance and competitive advantage in the 4IR era. To achieve this, the study answered the following questions: What is the relationship between 4IR, work processes and knowledge? What factors can SMEs leverage on in the 4IR? What are the challenges SMEs face that can impede their integration into the 4IR? What knowledge management strategies can SMEs adopt to ease their integration into the 4IR? What knowledge management enabling framework can be proposed to sustain SMEs in the 4IR?

## Fourth Industrial Revolution (4IR), work processes and knowledge

It has been suggested that the 4IR will probably eliminate most human jobs (Frey and Osborne 2017:268), but the question is: if the knowledge that generates innovation, the attendant competitive edge and improved performance is tacit in nature (Pereira, Ferreira and Alves, 2012: 175; Williams, 2011:52), do robots and robotics possess the knowledge that will render humans dispensable in organisations?  This author, going by the attested submission that tacit knowledge is human embedded, argues that the 4IR is still dependent on tacit knowledge. Frey and Osborne (2017: 268) depict a scenario in which a large percentage of human work will be substituted by machines. They report that as at 2016, up to 47 per cent of workers in the United States are in occupations that will likely have some individual activities automated over the next 10 to 20 years. Bonin *et al*. (cited in Schroeder, 2016a:13) corroborating this, report that 42% of such jobs, in the German context, and 12 per cent of all jobs, are subject to a high probability of automation. Contrary to these findings, and in support of the position of this author, Schröder (2016a:14) reports that the 4IR can unfold its potential only by means of the practical knowledge, expertise and compliance of employees. The author further notes that employees' qualifications and experience have to be deployed in the 4IR for continuous improvements.

According to Schröder (2016:13), workers' practical knowledge that cannot be coded cannot be replaced by smart technologies. Schröder's standpoint was in line with that of Wilkesmann and Wilkesmann (2018: 250), who in their study assert that even if digital systems follow the idea of swarm intelligence, as shown in the case of intelligent automation, the application itself temporarily remains at the stage of

reproducing and automating routine work, and is not able to create innovations itself. Fraunhofer and Ingenics (cited in Bonekamp and Sure, 2015: 35) submit that the intelligence of technological systems is still mapped out by human beings and will not replace the ability of human beings to react flexibly and creatively to unforeseen events, and that the practical knowledge or know-how of production workers and their reflective and adaptive capacities, paired with machine precision and speed, will make the 4IR effective. As such, technologies can only take over repetitive work, activities that are controlled, and clearly defined and stable as a process (Fraunhofer in Schroeder 2016a:14). Summarily, Visser (in Koigi, 2018, para. 10) concludes that "… one thing robots cannot be, is human." The above discussion suggests that the work processes in the 4IR are highly dependent on knowledge, especially the knowledge possessed by employees.

## Success factors for SMEs in the 4IR

The above arguments present a standpoint that SMEs can leverage on; that is, the experiential, or tacit knowledge of its employees. Before the 4th industrial revolution, it is the products that determine demand, leading to mass production by large-sized enterprises. It is, however, proposed that in the 4IR, production and consumption will become customised because it is demand that will create products, and this will be led by innovative start-ups and small and medium enterprises (SMEs). Schiuma, Durst and Wilhelm (2012:638) explain that SMEs need to explore KM, particularly the management of knowledge embedded in employees, and more so in the era of the fourth industrial revolution. From the foregoing, it is safe to conclude that the ability to gather, combine and use the knowledge embedded in people and technologies, to create a range of unique products, will become an increasingly important competitive advantage that SMEs can leverage on in the wake of the 4IR. Also revealed is the fact that the fourth industrial revolution will primarily affect customer expectations, product enhancement, collaborative innovation, and organisational forms, all of which are traditionally enabled and supported by knowledge management.

Kaeser (cited in Phillips 2019:para. 8) explains that the 4IR is dependent on knowledge, and according to the World Economic Forum (2017:n.p.), the fourth

industrial revolution will affect new business models and different skills and talents, all of which are enabled and supported by knowledge management. The forum highlighted some of the most prevalent aspects that knowledge management will need to support in the 4IR, such as: identifying and leveraging the skills and competencies that robots cannot "learn"; identifying and "contracting" sources of knowledge or crowd resourcing; localising global knowledge; smart organisations and continuous access to knowledge and creating employee-centric hubs; sourcing of relevant data and ensuring that data are clean prior to analysis; ascertaining the relevance and the value of capturing and sharing experience; social innovation and the sustainability of knowledge; social networks and empowering the global employee; ensuring that devices are connected to the Internet of Things and that knowledge can be created from the connectedness of devices; and ensuring the safety and privacy of employees.

Desouza and Awazu (2006:32) note that SMEs, in particular, need KM, and can compete on their know-how, which requires that they use knowledge, more than traditional resources, to their advantage. The authors suggest that while most SMEs do not have the financial means to spend on resources, such as land, labour, and capital, they can, however, do more with less, by leveraging on knowledge, which has been identified above to be critical to work processes in the 4IR.

## Knowledge management challenges of SMEs in the 4IR

This study defines knowledge management as a system of *processes, people, and technology* working together to increase the performance of organisations through learning (Seleim and Khalil 2011:588). In other words, knowledge management can be said to be a dynamic connection of structural and capital factors, organisational learning, innovation, skills, competencies, expertise and capabilities. Liebowitz (2016: 1) adds that knowledge management is 80% people and processes and 20% enabling technology. From the discussions above, it is evident that the dimension of knowledge management will change radically in the 4IR, and this poses a challenge to corporate organisations, particularly small and medium scale enterprises.

Schroeder (2016a: 5) and Schiuma, Durst and Wilhelm (2012:638) observe that KM strategy in most SMEs is not comprehensive enough. Hylton (cited in Ho, 2012: 2) notes that SMEs are as much in need of knowledge management as large enterprises. The author suggests that the world is changing rapidly, resulting in the proliferation of competitors for profit, which in turn puts enormous pressure on companies, either large or small, to innovate and develop products rapidly. It was further highlighted that innovation and rapid development require fast-tracked use of knowledge, which must be managed efficiently, effectively and securely. Today, we live in a knowledge-driven global economy, where knowledge is a commodity that provides sustainable competitive advantage. This requires that SMEs need to know their knowledge assets and how to manage and make use of them to get maximum returns (Lee *et al*. 2005: 3 - 4).

In a German study, Schroeder (2016a: 11 - 12) reports that four out of ten SMEs do not have a comprehensive 4IR strategy, compared with two out of ten large companies; and as decried by OECD (cited in Cusmano, Koreen, and Pissareva, 2018: 5), "… SMEs are lagging behind in the digital transition". The organisation further reports that a large number of SMEs have not been able to reap the benefits of the technological transition due to: limited adoption of digital technologies; a lack of investment in complementary knowledge-based assets, such as R&D, inadequate or unskilled human resources, organisational changes, process innovation and lack of cloud computing, which is the renting of computer power from an external provider so that smaller firms can use Big Data, without the barriers associated with the high fixed costs of ICT investment. The OECD Going Digital project alerts that the lag has implications for SMEs' capacity to turn technological change into innovation and productivity growth (OECD 2017b: 15). It is also suggested that SMEs in developing countries need to take optimal advantage of the 4IR, in spite of the lack of finance, lack of skilled employees, limited technological resources and key employees leaving the organisation (Seseni and Mbohwa 2019:3014). Schroeder (2016b:11) suggests that, since there is great innovation potential for SMEs, their framework conditions need to be promoted, so that they can compete in the era of comprehensive networking that the 4IR is. From the foregoing, it is safe to conclude that while SMEs

currently have challenges that can impede their full integration into the 4IR platform, they can harness knowledge management activities in order to leapfrog into the 4IR. The data gathered from the review are as presented in the methodology section.

Consequent upon the highly probable intense impact of the 4IR on organisations, it is critical to consider how knowledge management is practised by SMEs, in the context of the 4IR. For instance, given that knowledge management can be described as the deliberate and systematic coordination of an organisation's people, technology, processes, and organisational structure, in order to add value through reuse and innovation, what happens to knowledge management in SMEs in a world where employees are to be replaced by robots? How will SMEs manage knowledge in an era where tacit knowledge appears less valuable since decisions will be made rationally and scientifically?

## Methodology

The interrelationship between the subject (KM in the 4IR) and the object of interest (SMEs) in the present study have not been sufficiently explored, as revealed by online search attempts using the keywords in online databases such as Scopus and Taylors and Francis. The author explored Google search engine, and discovered that there were available industry-based articles written by SME practitioners, that could provide some insights into the required knowledge management strategies that can assist SMEs in the 4IR. Hence, this review adopted an integrative review of literature comprising both practitioner and academic articles. The integrative review method allows for the incorporation of diverse methodologies that capture the context, processes and subjective elements of a research topic. According to Whittemore and Knafl (2005:552), integrative reviews can include non-experimental research; such as case studies, observational studies, and meta-analyses, but may also include *practice applications, theories, and guidelines.* Russell (2005: 4) reports that in an integrative review, the accessible population is all published reports related to the topic of interest; hence, the data collection involves a systematic search of all the reports that are relevant to the topic. Therefore, the target population can be said to be all the relevant studies that pertain to the topic. This implies that this study set out

with no targeted population or sample. Rather, the content analysis of eligible articles was carried out to identify and extract relevant themes that pertain to knowledge management.

These terms included knowledge management, SMEs AND 4IR OR fourth industrial revolution, and must feature distinctly in the title, keywords and abstracts; as the case may be.

A manual search of both purposively selected industry-based articles from various websites, and academic reviews, using Google Scholar, was carried out with emphasis on the search terms defined above. For the extraction of themes, knowledge management is conceptualised as a system of *processes, people, and technology;* hence themes relating to people, processes and technology were picked. The study randomly reviewed 17 eligible industry-based and 10 academic articles, bringing the total number of reviewed articles to 27. The extracted data was analysed using narratives, tables and charts.

The data extracted from each article were:

- The author(s)
- Study location
- Sector of SMEs
- Themes for knowledge management strategies

## Findings and discussion

This section presents the summary of findings from the reviewed existing literature and the extracted themes.

What is the relationship between 4IR, work processes and knowledge?

The review revealed that the 4IR, though highly technology-based, is dependent on knowledge, particularly tacit knowledge, which induces innovation, and is not possessed by robots.  Literature also indicated that with the combination of people, technology and work processes, organisational participation in the 4IR will be boosted. In other words, while the 4IR will change the way work processes are done, knowledge remains a central factor that SMEs can leverage on, using people and

technologies, to perform optimally (Kaeser cited in Phillips 2019:para. 8; World Economic Forum, 2017: n.p; Fraunhofer and Ingenics cited in Bonekamp and Sure, 2015: 35).

What are the challenges SMEs face that can impede their integration into the 4IR?

From the review, the following, among others, are identified as challenges that can prevent SMEs' integration into the 4IR.

- Lack of comprehensive KM strategy
- Lack of comprehensive 4IR strategy
- Limited adoption of digital technologies
- Lack of investment in complementary knowledge-based assets
- Inadequate or unskilled human resources
- Lack of process innovation
- Lack of cloud computing
- Lack of finance
- Limited technological resources
- High employee turnover

Source: (Schroeder 2016a:5; Schiuma, Durst and Wilhelm 2012:638; Schroeder, 2016a: 11 – 12; Seseni and Mbohwa 2019:3014).

The findings in the following section apparently corroborate the fact that these are challenges that can hinder the progress into 4IR integration.

What knowledge management strategies can SMEs adopt to ease their integration into the 4IR?

This section presents the thirteen overarching themes that were extracted from the 27 articles reviewed and that illustrated some demographic details such as the geographical and sectoral distribution of the study. The tabulated and charted results are: the summary of data extraction; generation of overarching themes on KM strategies, which was done using the frequency counts of extracted themes; description of emerging themes on KM strategies; sectoral distribution of SMEs; geographical distribution of SMEs; and the themes for KM strategies and enabling frameworks. The analyses of the extracted data are presented using Tables 1-6. The summary of the extracted overarching themes is presented in Table 1.

Table 1: The summary of data extraction

| S/No. | Source | Adoption of ICTs/ knowledge-based learning | Automation | Collaboration/co-aggregating/CoP | Information/knowledge gathering and sharing/Research | Digitisation | Networking and connectivity | Cloud computing | Innovation | Hiring/Motivation of digitally skilled workforce | Flexible Organisational Structure | Training and re-skilling | Reassessment of business models | Optimisation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Chan (2019) | | | x | | | | | x | | | | | |
| 2 | Zambon, Egidi, Rinaldi and Cividino (2019, p. 1) | | x | | | x | x | | x | | | | | |
| 3 | Safar, Sopko, Bednar and Poklemba (2018, p. 634) | | x | | | x | | x | | | | | | |
| 4 | Digital Technology Council of Australia (DTCOA) (2018) | | | | x | x | x | | x | | | | | x |
| 5 | Futcher (2018, p. 69) | | | x | x | x | | x | | | | | x | |
| 6 | Yu (2018) | | | | | | | x | | | | | | |
| 7 | Koigi (2018) | | | | | | x | | | | | | | |
| 8 | Ethozgroup (2018) | | | | | x | | | | | | | | |
| 9 | Halse and Ullern (2017) | | | | x | | | | | | | | | |
| 10 | Wilkesmann and Wilkesmann (2018, p. 243) | | | x | | | | | | | | | | |
| 11 | Trento, Bannò and D'Allura (2018, p. 155) | | | | | | | | | x | | | | |
| 12 | von Reiche (2019) | | | | | | | | x | | | | | |
| 13 | Umrani and Johl (2018, p. 4) | | | | | | | | x | | | | | |
| 14 | Dassisti et. al (2017, p. 53) | | | | x | | | | | | | | | |
| 15 | OECD (2017a) | x | x | | | x | | | | | | x | | |
| 16 | Kleindienst and Ramsauer (2016, p. 114) | x | x | | | x | | | | x | | | x | |
| 17 | Orizi (2018) | | | | x | | | | x | | | | | |

| S/No. | Source | Adoption of ICTs/ knowledge-based learning | Automation | Collaboration/co-aggregating/CoP | Information/knowledge gathering and sharing/Research | Digitisation | Networking and connectivity | Cloud computing | Innovation | Hiring/Motivation of digitally skilled workforce | Flexible Organisational Structure | Training and re-skilling | Reassessment of business models | Optimisation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | Schroeder (2016a) | | | | | | | | | x | x | | x | |
| 19 | SME Magazine Asia (2019) | | x | | | x | | | | | | | | |
| 20 | Hashim (2017, pp 33-34) | x | x | | | | | | x | | | x | | |
| 21 | North Sea Region (2018, p. 14) | | | x | x | x | x | | x | | | | x | |
| 22 | *Phillips* **(2019)** | | | | x | | | | x | | | | | |
| 23 | College (2018) | | | x | x | | | | x | | x | | | x |
| 24 | Teqgroup (2018) | x | | | | | | x | | | | | | |
| 25 | Bizhub (2017) | | | | | | | x | | | | | | |
| 26 | Bolick (2019) | | | x | | | | | x | | x | | | |
| 27 | Thaw (2018) | | | x | | | | | x | | | | | |
| | **Total** | 4 | 6 | 7 | 8 | 9 | 5 | 4 | 8 | 4 | 3 | 2 | 3 | 2 |

The study extracted 13 overarching themes from the review. Table 2 presents the frequency count of each overarching theme.

**Table 2: Extracted overarching themes on KM strategies**

| S/N | Overarching theme | Frequency count |
|---|---|---|
| **1** | Digitisation | 9 |
| **2** | Information/knowledge gathering and sharing | 8 |
| **3** | Innovation | 8 |
| **4** | Collaboration/co-aggregating/CoP | 7 |
| **5** | Automation | 6 |
| **6** | Networking and connectivity | 5 |
| **7** | Adoption of ICT | 4 |
| **8** | Cloud computing | 4 |
| **9** | Hiring of digitally skilled workforce | 4 |

The study extracted 13 overarching themes from the review. Table 2 presents the frequency count of each overarching theme.

The overarching themes in Table 2 support the fact that adopting these strategies can help SMEs to overcome some of the identified challenges. The selected overarching

themes are hereby discussed in alphabetical order (Table 3), as knowledge management activities that SMEs can include in their operations to enhance their integration into the 4IR.

Table 3: Description of overarching themes as KM strategies

| S/N | Overarching theme | Description as KM strategies |
|---|---|---|
| 1 | Adoption of ICT | ICTs are essential to facilitate business processes for SMEs, as they enable improved external communication and quality of services through the use of Internet-based technologies (computers, Internet, websites, mobile phones, other wireless communications devices and computer networks). ICTs provide the channels for acquiring, storing, sharing, collaborating, categorising, dissemination and reuse of knowledge in faster and more convenient ways, both within and between organisations (Omona., van der Weide and Lubega 2010: 91). SMEs need to buy into the adoption of SMEs to survive in the 4IR |
| 2 | Automation | The concept of automation, a prominent feature in the smart industry, is described by Groover in Schumacher, Sihn and Erol (2016:3) as "the technology by which a process or procedure is accomplished without human assistance". Fernández-Macías (2018: 14) understands automation to mean the replacement of (human) labour input by (digitally-enabled) machine input for some types of tasks within production and distribution processes. The process of automation serves to make physical objects and information available at the right time, at the right place and in the right quantity. SMEs need to buy into this for effective knowledge management in the 4IR. |
| 3 | Cloud computing | Cloud describes the use of a collection of services, applications, information, and infrastructure, which comprises pools of computation, network, information, and storage resources (Dave, Dave and Shishodia 2013:619). The advent of cloud computing has opened numerous avenues that are not fully harnessed in the management of knowledge. Cloud computing involves the development of many existing technologies and approaches to computing into something different. Cloud separates application and information resources from the underlying infrastructure, and the mechanisms used to deliver them. It enhances collaboration, agility, scaling, and availability, and potentially reduces cost through optimised and efficient computing. Safar *et al*. (2018:626) emphasise software and cloud solutions as new technology that determines future business environments. |
| 4 | Collaboration/co-aggregating/CoP | This includes collaboration of all organisational components, such as smart technologies (smart mobility, logistics, buildings, products and grids), and not just humans as we have in communities of practice (Figurska and Sokóâ 2014: 237). |

| 5 | Digitisation | According to Fernández-Macías (2018: 14), digitisation refers to the use of sensors and rendering of devices to translate parts of the physical production process into digital information (and vice versa) to enhance the process, storage and communication of digital information. By digitising a process, one can understand, control and manipulate it much better. It is important to point out here that the concepts of digitisation and automation are two distinct, but merging concepts (Schumacher, Sihn and Erol 2016: 5). It becomes clear that one cannot exist without the other, as any kind of automation nowadays requires digital elements to work without human interference (Fernández-Macías 2018:14) and any kind of digitisation requires elements to automatically handle and display information (Schumacher, Sihn and Erol 2016:5). Digitisation enables dematerialisation of information; limitless transfer of information between two points; transfer of information through copying; nearly no costs for reproduction of information; simultaneous utilisation of same information; convergence of transfer media for information; universality of information through conversion; additional control of information; enabling of data manipulation; existence of different levels of data; classification and indexation of information; higher degree of interaction between user and information. |
|---|---|---|
| 6 | Flexible organisational structure | It is suggested that organisational structures should be designed for flexibility (as opposed to rigidity) so that knowledge sharing and collaboration across boundaries are encouraged in organisations and across their supply chain. Gold, Malhotra and Segars (2001: 188 - 189) opine that it is the combination of the KM structural dimensions of organisational structure and incentive systems that make up an organisation's overall knowledge management structure. According to the authors, the formal organisational structures can promote or obstruct relationships among employees in an organisation. They recommend that organisational structures must be flexible to inspire sharing and collaboration across boundaries and give the firm the flexibility to adapt to the ever-changing environment |
| 7 | Hiring of digitally skilled workforce | According to Ciobanasu (2013: 50), KM is based on three important pillars: knowledge workers – individuals with thinking, learning and acting capabilities; processes, which follow an innovative approach for optimal performance of certain tasks or functions and products. systems. There needs to be a connection between people, processes, culture and technology. The balance leads to collaboration and teamwork. It is therefore essential that SMEs invest in the recruitment of a skilled workforce. |

| 8 | Information/ knowledge gathering and sharing | The exchange of information among organisational employees is a vital component of the knowledge-management process (Cabrera and Cabrera 2002: 687). Knowledge sharing has been identified as a major focus area for knowledge management. Information/ knowledge gathering and sharing connect level of the individual knowledge workers in whom knowledge resides, and the level of the organisation, where knowledge gets its economic and competitive value (Hendriks 1999: 91). |
|---|---|---|
| 9 | Innovation | Innovation is a knowledge-intensive process that has a definite knowledge culture and relevant requirements for knowledge management support (Paukert, Niederée, and Hemmje, 2004:1). An increasing amount of research on innovation and strategic management puts knowledge in the center of interest; and knowledge is discussed as the element of a recombination process to generate innovation, which helps to maintain a competitive position (Mardani *et al*., 2018: 13&  50 - 51). |
| 10 | Networking and connectivity | Networking and connectivity builds a virtual community for the sharing of knowledge (Camison 2008). The developed pool of collective knowledge exceeds individual knowledge and is fully accessible by all members. Information technology (IT) breakthrough in information processing and connectivity boost knowledge management tremendously and connectivity enables the exploitation of the knowledge potential of disconnected organisations (Davenport and Prusak, 1998). |
| 11 | Optimisation | Process optimisation can be defined as reaching an optimal form of a process, that is the best possible in given circumstances. It has to do with the process logic (what is done and why) and the individual tasks and their effectiveness (how it is done). It enables companies to increase the effectiveness of their functioning and to flexibly match the changing business environment. Process optimisation makes it possible for organisations to increase their ability to achieve their goals. As suggested by Figurska and Sokóâ (2014: 238), if a company is able to achieve its goals better and quicker than competitors, its competitiveness increases. They note that the optimisation of organisational processes supports the development of organisations and their employees, as both can function as a better integrated system (Figurska  and Sokóâ 2014: 245). |

| 12 | Reassessment of business models | The World Economic Forum (2019, para. 6) reports that fewer than 10% of companies' business models are economically viable in order to compete effectively in a hyper-connected world; implying the *4IR,* in terms of customer value, revenue growth rates and market valuation. The forum suggests that the most successful business model today is the digital platform business model, which is predicted to mediate up to 30% of global economic activity by the year 2030. Corroborating this assertion, Kim (2016:22) reveals that platform business models are efficient and innovative. A platform is a business model that creates value by facilitating exchanges between two or more interdependent groups, usually consumers and producers. In order to make these exchanges happen, platforms harness and create large, scalable networks of users and resources that can be accessed on demand. Safar *et al*. (2018: 626) notes that SMEs presently have the challenge of implementing new technologies, and in modifying and adapting their business models. Hence, some business models have been proposed for the 4IR environment, which can also be explored by SMEs (Glova, Sabol and Vajda, 2014:1125). These include value and process/structural models. |
| 13 | Training and re-skilling | In a survey performed on a group of 909 employees working in the creative sector of SMEs, in 2013, the development of employee competence was reported to determine the successful development of the growth and innovation of companies (Figurska and Sokóâ 2014: 243). |

All the above strategies are opined to be supportive of knowledge management in the era of the fourth industrial revolution, and as reported by the sources cited in the discussion, they can also induce optimum performance and competitiveness for SMEs. The study reviewed literature on SMEs from different sectors as presented in Table 4.

Table 4: Sectorial distribution of SMEs

| S/N | SME Sector | Number | % | Source |
|-----|-----------|--------|------|--------|
| 1 | ICT Sector | 2 | 7.4 | Chan (2019; Thaw( 2018) |
| 2 | Industrial SMEs | 2 | 7.4 | Zambon, Egidi, Rinaldi and Cividino (2019); Safar, Sopko, Bednar and Poklemba (2018) |
| 3 | Manufacturing | 5 | 18.5 | DTCOA (2018); Futcher (2018); Yu (2018); Koigi (2018); Ethozgroup (2018) |

| | | | | | |
|---|---|---|---|---|---|
| 4 | Generic | 18 | 66.7 | | Halse and Ullern (2017); Wilkesmann and Wilkesmann (2018); Trento, Bannò, and D'Allura (2018); von Reiche (2019); Umrani, and Johl (2018); Dassisti et al. (2017); OECD (2017a); Kleindienst and Ramsauer (2016); Orizi (2018); Schroeder (2016a); SME Magazine Asia (2019); Hashim (2016); Northsea region (2018); *Phillips (2019);* College (2018); Teqgroup (2018); Bizhub (2017) Vetnam Investment review (2017); Bolick (2019) |
| | Total | 27 | 100 | | |

The study reviewed literature on knowledge management strategies applicable to both SMEs in different sectors (66.7%) and specific in ICT, manufacturing and Industrial sectors. It can be implied that the findings from this study can be applied by all SMEs, irrespective of the sector. The geographical location of the source of the review on knowledge management in SMEs is illustrated in Table 5.

Table 5: Geographical distribution of SMES

| S/N | Location | No. | % | | Sources |
|---|---|---|---|---|---|
| 1 | AFRICA (South Africa) | 4 | 14.8 | | Futcher (2018); Koigi (2018); Phillips (2019); College (2018) |
| 2 | ASIA (Malaysia, Vietnam and Singapore) | 6 | 22.2 | | SME Magazine Asia (2019); Hashim (2016); Bizhub (2017) Vetnam Investment review (2017); Chan (2019); Yu (2018); Ethozgroup (2018) |
| 3 | OCEANIA Australia | 1 | 3.7 | | DTCOA (2018) |
| 4 | EUROPE (Germany, Northsea Area and UK) | 4 | 14.8 | Orizi (2018); Schroeder (2016a); Northsea region (2018); Teqgroup (2018) | |

| 5 | Non-specific | 12 | 44.4 | Zambon, Egidi, Rinaldi and Cividino (2019); Safar, Sopko, Bednar and Poklemba (2018); Halse and Ullern (2017); Wilkesmann and Wilkesmann (2018); Trento, Bannò and D'Allura (2018); von Reiche, (2019); Umrani and Johl (2018); Dassisti *et al*. (2017); OECD (2017a); Kleindienst and Ramsauer (2016); Thaw (2018) | |
| | TOTAL | 27 | 99.99 | | |

Of the location-specific reviews, the largest percentage came from Asia, followed equally by Africa and Europe. SMEs in Africa, represented by South Africa, are faced with many challenges that can inhibit their growth, but are encouraged to buy into the

adoption of the following knowledge management strategies for inclusivity in the 4IR: connectivity, data collection for social change, mobility and traffic congestion, innovation, optimisation, inter-organisational value chain innovativeness and supportive partner knowledge, collaboration, abolishment of bureaucratic practices and structures, adoption of knowledge-based learning paradigms and designs, knowledge of systemic programme management, incorporation of collaborative virtual networks of partners, cloud computing, collaboration, digitisation, reassessed business models, proactive goals about change, and increased knowledge gathering (Futcher 2018; Koigi 2018; Phillips 2019; College 2018).

In order to overcome the challenges discussed in this section, studies have shown that certain enablers must be in place for the successful implementation of knowledge management, especially in the context of the 4IR.  Eze *et al*. (2013:229 - 230) proposed a framework for sharing knowledge. The authors mention that for knowledge to take place, employees in SMEs must trust each other, the organisation must formalise their operations, appropriate knowledge technology must be in place, and there should be empowering leadership, motivation, and an effective reward system. Seseni and Mbohwa (2016: 3) also developed a framework that proposes: organisational culture, sufficient time, management support, teamwork, effective communication, employee motivation and trust. Farooq (2018:255), in an Indian study, highlighted the following: organisational structure: rewards systems, motivation, interpersonal trust, management support, information and communication technology, knowledge sharing and business performance relationship. Seseni and Mbohwa (2019:3014, 3020) brought to the fore the following: trust, teamwork, motivation, management support and sharing knowledge; Schroeder (2016a: 5) suggests that SMEs should create flexible organisational structures and boost their employees' interdisciplinary thinking. The above-mentioned frameworks have the following in common: trust, motivation, reward system, organisational structure, management support, and knowledge sharing.

| Table 6: KM strategies enabling frameworks |
|---|
| •Effective communication |
| •Empowering leadership |
| •Flexible organisational structures |
| •Information and communication technology |
| •Trust |
| •Knowledge sharing and business performance relationship |
| •Management support |
| •Employee motivation |
| •Organisational culture |
| •Rewards systems |
| •Teamwork |

What knowledge management enabling framework can be proposed to sustain SMEs in the 4IR?

## Proposed KM model for SMEs in the 4IR

The proposed model will be based on the summation of Liebowitz (2016:1), who noted that knowledge management is 80% people and processes and 20% enabling technology. The study, therefore, grouped the extracted overarching themes (in the order of highest to lowest frequency count), under the three KM components of people, processes and technology as illustrated in Table 7.

| Table 7: Extracted Themes as KM Components | |
|---|---|
| People-oriented | Pro |
| •Collaboration/co-aggregating/CoP<br>•Hiring of digitally skilled workforce | |

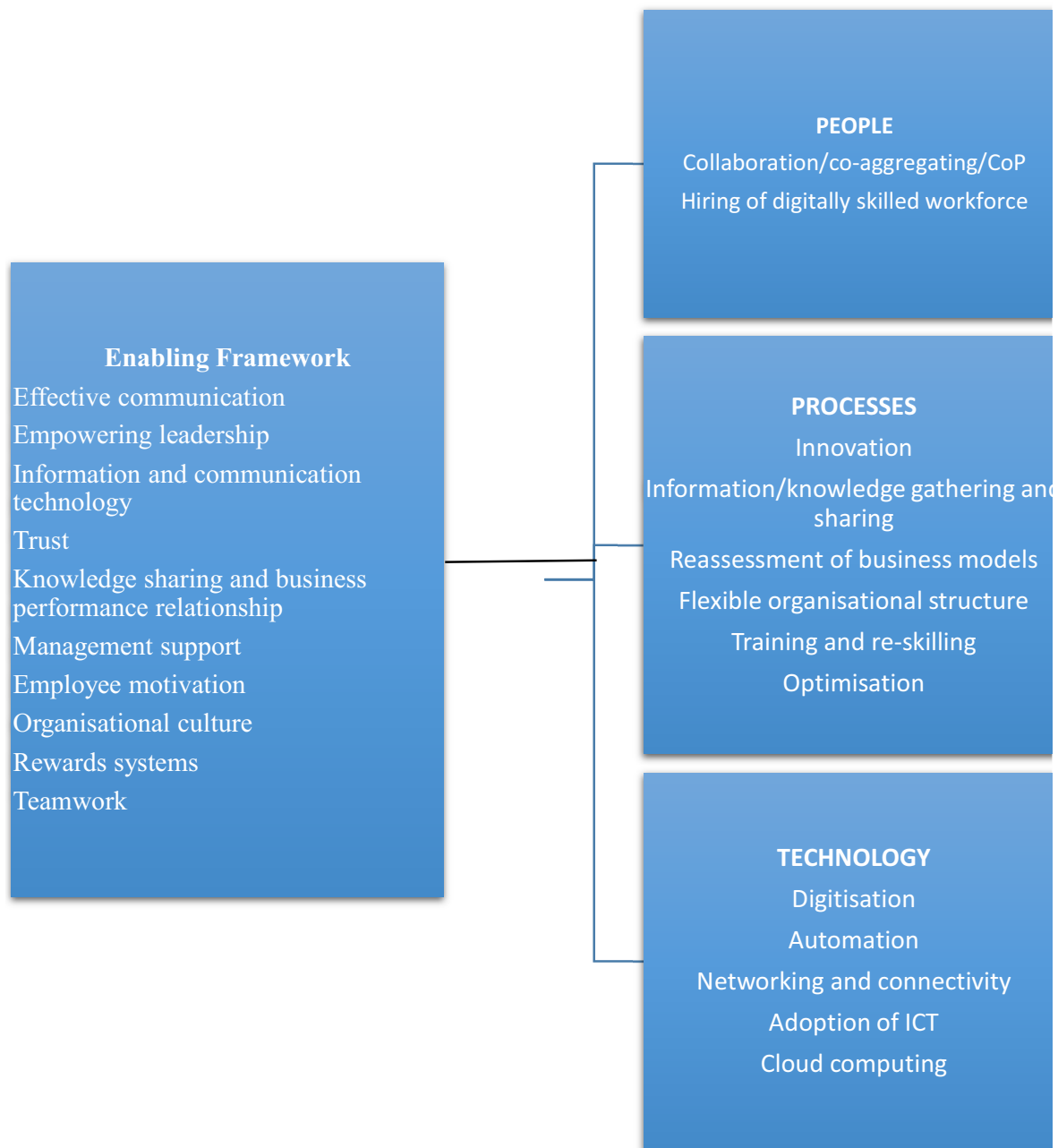Hence, the proposed framework is as presented below:

**PEOPLE**

Collaboration/co-aggregating/CoP

Hiring of digitally skilled workforce

**Enabling Framework**

Effective communication

Empowering leadership

Information and communication technology

Trust

Knowledge sharing and business performance relationship

Management support

Employee motivation

Organisational culture

Rewards systems

Teamwork

**PROCESSES**

Innovation

Information/knowledge gathering and sharing

Reassessment of business models

Flexible organisational structure

Training and re-skilling

Optimisation

**TECHNOLOGY**

Digitisation

Automation

Networking and connectivity

Adoption of ICT

Cloud computing

Figure 1: Proposed KM model for SMEs in the 4IR

## Conclusion

The 4IR is an era of a shift from a real physical world to a virtual world: organisations not only need to systematise their production process more efficiently, but also create customised products. This has its attendant effect on knowledge management and

business models. In the 4IR, driven by demand, production and consumption will become customised and small and medium enterprises (SMEs) will be key contributors (OECD 2018: 5). SMEs contribute to more than one third of GDP in emerging and developing economies, making it essential to give SMEs due attention for improved performance. In the knowledge-driven global economy, knowledge is a commodity that provides a sustainable competitive advantage. This requires that SMEs need to know how to manage and make use of their knowledge assets, in order to get maximum return, particularly given the expected impact of the 4IR on organisations, which makes it critical to consider how knowledge management is practised by SMEs. There is a plethora of knowledge management tools and solutions in the market; however, they are targeted at very large multinational organisations, with little aimed at SMEs. In addition, specific studies on the required KM strategies that SMEs can employ for successful operations in the 4IR are not easily available or accessible. Therefore, this study sought to reduce these gaps and the dearth of literature on the practice of knowledge management by SMEs in the context of the 4IR.

The reviewed literature revealed that merging knowledge management strategies with SMEs' work processes will enhance their performance in the 4IR environment. The study also highlighted that currently SMEs are faced with challenges, such as limited adoption of digital technologies; a lack of investment in complementary knowledge-based assets, such as R&D, inadequate or unskilled human resources, organisational changes, process innovation and lack of cloud computing; all of which can deter their integration into the 4IR. Furthermore, the study identified knowledge management strategies that SMEs can explore to blend into the 4IR. The study also noted that, people, processes and technology are the three knowledge management structures required for organisational performance and improved competitiveness, which SMEs can include in their operations in the 4IR environment. Therefore, this study differs from existing literature on the subject of knowledge management in SMEs in the 4IR, by blending the people, processes and technology structures, and using this to propose a KM framework for SMEs in the 4IR. From the review, as presented in the framework, digitisation and automation appear to be the first step on

the ladder under the technology cluster, while collaboration, followed by the hiring of a skilled workforce, leads the people segment; and under processes, both innovation and information/knowledge gathering and sharing are most essential.

The study integrated both industry-based articles (via organisational websites) and academic articles (via databases), and submits that SMEs, in spite of the challenges, can adopt the proposed 4IR knowledge management framework, to leapfrog into the 4IR.

Findings from the study imply that the concept of the 4IR does not mean complete automatic job loss by humans to robots. That is, organisations, such as SMEs, do not have to fold up in the 4IR era. Literature findings imply that while routine tasks can be automated for performance by robots, innovative jobs are highly dependent on human-embodied knowledge, and as such, the management of knowledge, both tacit and explicit, will continue to be required. Furthermore, findings suggest that SMEs have the people advantage and can leverage on this, in addition to technologies, to perform optimally in the 4IR. SMEs would only need to adopt appropriate knowledge management strategies, as identified by this study, to achieve this task.

The following are the recommendations from this study:

SMEs should leverage on the tripod stand of people, processes and technology by:

- Employing a workforce with digital skills; encourage collaboration and the formulation of communities of practice.
- Ensuring technology-enabled and driven work processes through the adoption of relevant technologies, networking and cloud computing.
- Adopting a more flexible and innovative organisational structures, making training and re-skilling a consistent practice, and reassessing their business models to favour the comprehensive networking nature of the 4IR.

Policy-makers and stakeholders in the SME sector should provide enabling environment and infrastructures, such as improved national bandwidth, affordable networking tools, and stable power, especially in the developing country context, for SMEs to operate in the 4IR era.

The study suggests that future studies investigate the method(s) of implementation of each strategy by SMEs, in order to stay relevant and competitive in the 4IR.

## Acknowledgement

## References

Bizhub. (2017). Fourth industrial revolution challenges SMEs. Retrieved from *http://bizhub.vn/news/fourth-industrial-revolution-challenges-smes_289668.html*

Bolick, Christopher. (2019). *How Can Project Managers Prepare for The Fourth Industrial Revolution?* Retrieved from *https://www.northeastern.edu/graduate/blog/project-management-fourth-industrial-revolution/*

Bonekamp, L., & Sure, M. (2015). Consequences of Industry 4.0 on human labour and work organisation. *Journal of Business and Media Psychology*, *6*(1), 33-40.

Cabrera, A., & Cabrera, E. F. (2002). Knowledge-sharing dilemmas. *Organization studies*, *23*(5), 687-710.

Camison, C. ed. (2008). *Connectivity and Knowledge Management in Virtual Organisations: Networking and Developing Interactive Communications: Networking and Developing Interactive Communications*. IGI Global.

Camison, C., Palacios, D., Garrigos, F., & Devece, C. (2009). *Connectivity and knowledge management in virtual organisations*. Hershey, New York: Information Science Reference.

Chan, C.. (2019) *SMEs need open innovation for Fourth Industrial Revolution.* Retrieved from *https://www.sgsme.sg/news/smes-need-open-innovation-fourth-industrial-revolution.*

College, C. (2018). *Industry 4.0 Impact on Organisations, Leadership and Management. http://www.businessessentials.co.za/2018/06/07/industry-4-0-impact-on-organisations-leadership-and-management/.*

Cusmano, L., Koreen, M., & Pissareva, L. (2018). 2018 *OECD Ministerial Conference on SMEs*. Retrieved November 24, 2019 from from *https://doi.org/10.1787/90c8823c-en.*

Dassisti, M., Panetto, H., Lezoche, M., Merla, P., Semeraro, C., Giovannini, A., & Chimienti, M. (2017). Industry 4.0 paradigm: The viewpoint of the small and medium enterprises. 7th International Conference on Information Society and Technology, ICIST 2017, Mar 2017, Kopaonik, Serbia. Retrieved from *https://hal.archives-ouvertes.fr › hal-01526397 › document .*

Dave, M., Dave, M. and Shishodia, Y.S. (2013). Cloud Computing and Knowledge Management as a service: A collaborative approach to harness and manage the plethora of knowledge. *BIJIT-BVICAM's International Journal of Information Technology.*, *5*(2).

Digital Technology Council of Australia (DTCOA) (2018). What is Industry 4.0 anyway? Retrieved from *https://www.dtcoa.com.au/dailynews/2018/5/17/what-is-industry-40-anyway*

Ethozgroup. (2018). *Industry 4.0: Implications for SMEs in Singapore. Retrieved from* https://www.ethozgroup.com/blog/industry-4-0-implications-smes-singapore/

Eze, U. C., Goh, G. G. G., Goh, C. Y. and Tan, T. L., (2013). Perspective of SMEs on knowledge sharing. *Vine: The journal of information and knowledge management systems, 43*(2), 210-236.

Farooq, R. (2018). A conceptual model of knowledge sharing. *International Journal of Innovation Science*, *10*(2), 238-260.

Fernández-Macías, E. (2018). *Automation, digitalisation and platforms: Implications for work and employment European Foundation.* Luxembourg: Publications Office of the European Union. Retrieved from *https:// digitalcommons.ilr.cornell.edu/intl/636/*

Figurska, I., & Sokó³, A. (2014). Optimization of Knowledge Management Processes through Benchmarking in Organizations. *Mediterranean Journal of Social Sciences*, *5*(27 P1), 235.

Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological forecasting and social change*, *114*, 254-280.

Futcher, M. (2018). *Competitive advantage during industry 4.0: the case for South African manufacturing SMEs* (Doctoral dissertation). University of the Witwatersrand. South Africa.

Glova, J., Sabol, T., & Vajda, V. (2014). Business models for the internet of things environment. *Procedia Economics and Finance*, *15*, 1122-1129.

Gold, A.H., Malhotra, A. and Segars, A.H., 2001. Knowledge management: An organisational capabilities perspective. *Journal of management information systems*, *18*(1), pp.185-214.

Halse, L.L. and Ullern, E.F. (2017). *Getting Ready for the Fourth Industrial Revolution: Innovation in Small and Medium Sized Companies*. Conference paper. 31 August 2017. Retrieved from *https://link.springer.com/chapter/ 10.1007/978-3-319-66923-6_29*

Hashim, H (2017). Industry 4.0 - SMEs are the Vanguards in Catalysing Change. *Insight.* Retrieved  from *http://www.smecorp.gov.my/index.php/en/component/ content/article/189-malaysia-weekly-economics-news-article/2359-viewpoint-by-datuk-dr-hafsah-hashim?highlight=WyJoYWZzYWgiLCJoYXNoaW0iLCJoYXNoaW0ncyIsImhh ZnNhaCBoYXNoaW0iXQ==&Itemid=437*

Hendriks, P. (1999). Why share knowledge? The influence of ICT on the motivation for knowledge sharing. *Knowledge and process management*, *6*(2), 91-100.

Ho, E. S. P. (2012). *Implementation of Knowledge Management in Small and Medium Enterprises (SMEs), Kuching* (Doctoral dissertation, Universiti Malaysia Sarawak). Retrieved from *https://ir.unimas.my/id/eprint/11251/1/ Implementation%20of%20Knowledge%20Management%20in%20Small%20a*

nd%20Medium%20Enterprises%20(SMEs),%20Kuching%20(24%20pages).p
df

International Labour Office (ILO). (2017). *World employment and social outlook 2017: Sustainable Enterprises and Jobs, Formal... Enterprises and Decent Work*. International Labour Office. Geneva. Retrieved from *https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_579893.pdf.*

Kim, J., 2016. *The platform business model and strategy: A dynamic analysis of the value chain and platform business* (Doctoral dissertation, The University of Manchester (United Kingdom)). Retrieved from *https://www.research.manchester.ac.uk/portal/files/54581969/FULL_TEXT.PDF*

Kleindienst, M. and Ramsauer, C. (2016). SMEs and Industry 4.0 – Introducing a KPI based Procedure Model to identify Focus Areas in Manufacturing Industry. *Athens Journal of Business and Economics,* 2(2), 109-122. *https://doi.org/10.30958/ajbe.2-2-1*

Koigi, Bob. (2018). *South Africa SMEs critical to fourth industrial revolution, experts.* Retrieved from https://africabusinesscommunities.com/tech/tech-news/south-africa-smes-critical-to-fourth-industrial-revolution-experts/

Lee, C.C., Egbu, C.O., Boyd, D., Xiao, H. and Chinyo, E., (2005). Knowledge management for small medium enterprises: capturing and communicating learning and experiences. CIB W99 Working Commission 4th Triennial International Conference Rethinking and Revitalizing Construction Safety, Health, Environment and Quality, Port Elizabeth – South Africa, 17-20 May 2005, 808-20. Retrieved from http://usir.salford.ac.uk/2847/

Liebowitz, J. (2016). *Beyond knowledge management: What every leader should know*. Auerbach Publications. New York. Retrieved from *https://doi.org/10.1201/b11511*

Nonaka, I., and Takeuchi, H. 1995. *The Knowledge Creating Company: How Japanese Companies Create the Dynamics of Innovation*. New York: Oxford University Press

North Sea Region (2018). *Industry 4.0 – opportunities and challenges for SMEs in the North Sea Region*. Retrieved from *https://northsearegion.eu/media/7320/growin-40-desk-study.pdf*

North Sea Region. (2016). *Industry 4.0 – opportunities and challenges for SMEs in the North Sea Region*. Retrieved from *https://northsearegion.eu/media/7320/growin-40-desk-study.pdf*

OECD (2017a). *Enhancing Productivity in SMEs, OECD Working Party on SMEs and Entrepreneurship*. Paris, October 2017. Retrieved from *www.oecd.org/mcm/documents/C-MIN-2017-8-EN.pdf*

OECD (2017b). *Going Digital: Making the Transformation Work for Growth and Well-Being.* Meeting of the OECD Council at Ministerial Level, Paris 7-8 June 2017. Retrieved from *https://www.oecd.org/mcm/documents/C-MIN-2017-4%20EN.pdf*

OECD (2018). *Financing SMEs and Entrepreneurs 2018*: An OECD Scoreboard, OECD Publishing, Paris. Retrieved from *http://www.oecd.org/cfe/smes/ Highlights-Financing-SMEs-and-Entrepreneurs-2018.pdf*

Omona, W., van der Weide, T., & Lubega, J. (2010). Using ICT to enhance knowledge management in higher education: A conceptual framework and research agenda. *International Journal of Education and Development using ICT*, *6*(4), 83-101.

Orizi, S. (2018). *Work of the future – Industry 4.0. Stuttgart*. Retrieved from *https:// www.produktionsarbeit.de/content/dam/produktionsarbeit/de/documents/ Management_Summary.pdf*

Paukert, M., Niederée, C., & Hemmje, M. (2004). Adapting organizational knowledge management cultures to the knowledge life cycle in innovation processes. *KM Chronicles: Cultures of Knowledge*. Retrieved from *https://www.brainguide.de/ upload/publication/d7/kxxe/ 19b9edcb0a03ff8abf207d1b11a5f784_1311535265.pdf*

*Phillips, M. (*2019). *Harnessing the power of the 4th Industrial Revolution*. Retrieved from *https://www.usb.ac.za/usb_news/harnessing-the-power-of-the-4th-industrial-revolution/*

Russell, C. L. (2005). An overview of the integrative research review. *Progress in transplantation*, *15*(1), 8-13.

Safar, L., Sopko, J., Bednar, S., & Poklemba, R. (2018). Concept of SME business model for industry 4.0 environment. *TEM Journal*, *7*(3), 626.

Salesforce. 2019. *Meet the Three Industrial Revolutions Learning Objectives.* Retrieved from *https://trailhead.salesforce.com/en/content/learn/modules/ learn-about-the-fourth-industrial-revolution/meet-the-three-industrial-revolutions*

Schröder, C. (2016a). The challenges of industry 4.0 for small and medium-sized enterprises. *Friedrich-Ebert-Stiftung: Bonn, Germany*. Retrieved July 30 2019 from https://www.researchgate.net/publication/ 305789672_The_Challenges_of_Industry_40_for_Small_and_Medium-sized_Enterprises.

Schroeder, W. (2016b). '*Germany's Industry 4.0 strategy: Rhine capitalism in the age of digitalisation*'. Friedrich Ebert Stiftung. Retrieved July August 31 2019 *https:/ /www.uni-kassel.de/fb05/fileadmin/datas/fb05/FG_Politikwissenschaften/ PSBRD/FES-London_Schroeder_Germanys_Industrie_4.0_Strategy.pdf*

Schumacher, A., Sihn, W. and Erol, S., 2016. Automation, digitization and digitalization and their implications for manufacturing processes. In *International scientific conference on Innovation and Sustainibility* (pp. 1 - 6). Retrieved from *https://www.researchgate.net/publication/ 318877006_Automation_digitization_and_digitalization_and_their_implication s_for_manufacturing_processes/citation/download*

Seleim, A. A., & Khalil, O. E. (2011). Understanding the knowledge management-intellectual capital relationship: a two-way analysis. *Journal of Intellectual Capital*, *12*(4), 586-614.

Seseni, L. and Mbohwa, C., 2019. SMEs Managing Organisational Knowledge in The 4IR Era: A Case Study of Developing Countries. Proceedings of the International Conference on Industrial Engineering and Operations Management Bangkok, Thailand, March 5-7, 2019.

SME Magazine Asia. 2019. *Accelerating Malaysian Business and the Workforce into Industrial Revolution 4.0.* Retrieved from *https://smemagazine.asia/ accelerating-malaysian-business-and-the-workforce-into-industrial-revolution-4-0/*

Teqgroup 2018. Industry 4.0 – are SME's being left behind? Retrieved August 29, 2019 from *https://teqgroup.co.uk/industry-4-0-are-smes-being-left-behind/*

Trento, S., Bannò, M., & D'Allura, G. M. (2018). The Impact of the 4th Industrial Revolution on the High-Tech Industry. *Symphonya. Emerging Issues in Management*, (2), 145-157.

Umrani, A. I., & Johl, S. K. (2018). How Different Ownership Structures Perform in Industry 4.0: A Case of Malaysian Manufacturing SMEs. In *SHS Web of Conferences* (Vol. 56, p. 04003). EDP Sciences.

Vietnam Investment review. 2017. Fouth industrial revolution challenges SMEs Retrieved August 31, 2019 from *https://www.vir.com.vn/apicenter@/ print_articleandi=53211*

von Reiche, Victor. 2019. The Fourth Industrial Revolution. Retrieved July 30, 2019 from *https://www.citadel.co.za/insights/articles/the-fourth-industrial-revolution/*

Whittemore, R., & Knafl, K. (2005). The integrative review: updated methodology. *Journal of advanced nursing*, *52*(5), 546-553

Wilkesmann, M., & Wilkesmann, U. (2018). Industry 4.0–organizing routines or innovations? *VINE Journal of Information and Knowledge Management Systems*, *48*(2), 238-254.

World Economic Forum. (2019). *Is your business model fit for the Fourth Industrial Revolution?* Retrieved from https://www.weforum.org/agenda/2019/01/is-your-business-model-fit-for-the-fourth-industrial-revolution/

World Economic Forum. (2017). *The-fourth-industrial-revolution-is-about-people-not-just-machines.* Retrieved from *https://www.weforum.org/agenda/2017/06/the-fourth-industrial-revolution-is-about-people-not-just-machines/* Retrieved August 30, 2019

Yang, Y. T. (2018). *The 4th Industrial Revolution and what does the future look like for SMEs?* Retrieved July 30, 2019 from *https://2ibpartners.com/the-4th-industrial-revolution-and-what-does-the-future-look-like-for-smes/*

Yu, Z. (2018). Industry 4.0 – *How does it benefit the SMEs?* Retrieved July 30, 2019 from *https://invoiceinterchange.com/industry-4-0-what-is-it-and-how-does-it-benefit-the-smes/.*

Zambon, I., Egidi, G., Rinaldi, F., & Cividino, S. (2019). Applied Research Towards Industry 4.0: Opportunities for SMEs. *Processes* 2019, 7, 344.