The Relevance of Technology Knowledge in SMEs for Digital Transformation

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Abstract. *The relevance of technology knowledge in digital transformation especially in small and medium-sized enterprises (SMEs) that are still largely dependent on physical human capital has become increasingly obvious. This is due to the rapid revolution in business environment coupled with increased living examples of firms disrupted by advancement in technological knowledge. Consequently, we find it progressively vital for SMEs to spot and mitigate both threats and take advantage of opportunities arising from digital transformation dynamism.*
Our study aims at exploring the relevance of technology knowledge in SMEs for digital transformation to uncover the opportunities, roadmaps, and models that SMEs can take advantage of in the digital transformation and gain a competitive edge.
We conclude that irrespective relevance of technology knowledge for digital transformation coupled with its low costs and accessibility, SMEs are yet to realize the full potential of technological knowledge. This is mainly due to technologies appearing, changing and also vanishing so rapidly in the digital age, that gaining proper understanding without dedicated resources is utterly difficult for SMEs - making them less competitive as incumbent large firms in the market.

Keywords. SME, technologies, innovation, digital, skills, learning, knowledge, disruptive, disruption, impact, influence, decision maker

1 Introduction

We are witnessing a new digital era where digital technologies and knowledge are increasingly immersed in almost all our daily schedules including our communications, work and purchasing behaviours which are being increasingly shaped by digital technology (Piccinnnini, Gregory, Hanelt and Kolbe, 2016). Consequently, the cost of technology has declined significantly leading to improved accessibility of digital technology to both large firms as well as SMEs. These, coupled with the increase in terms of ease of use as well as capabilities of digital technologies in the market environment, constitute a significant force by enabling SMEs in identifying existing or new opportunities. As noted by Toanca (2016) innovations in robotics, mobile, sensors and analytics create fast-tracking effects of digital technological headway and as a result, place much stress on new entrants in the market and the incumbents to hasten their innovation to remain competitive and sustainable and relevant to their customers in the future.

To this end, this study aims at exploring the relevance of technology knowledge in SMEs for digital transformation by answering the two research questions: (a) What is the relevance of management of technology knowledge for the digitalisation in SMEs? and (b) What is the influence of technologies and technology understanding on digital transformation among SMEs.

2 Methodology

The underlying method of literature researches shown in Figure 2 was adapted from Webster and Watson (2002). Literature was captured from (a) GoogleScholar; (b) Elsevier and (c) SpringerLink since these databases provided the most relevant results during an initial explorative search phase. Search and analysis were conducted in February 2019 using the following search keywords: SME, decision maker, knowledge, technologies, innovation, digital, skills, learning, disruptive, disruption, impact, influence. In order to avoid the findings from being too restricted, the keywords were chosen accordingly.

To set the focus on the latest findings, only literature published since 2005 was considered. Whenever possible, filter criteria restricting results to scientific papers were applied. Due to the large amount

of results, the search had to be narrowed down considering titles only. Moreover, only results relating to phenomenon and problem under investigation were considered.

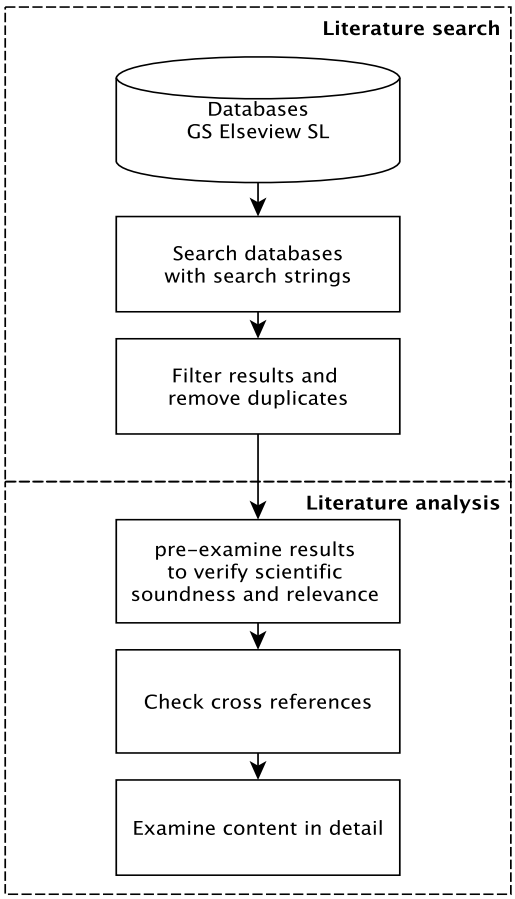

Figure 2: Process of literature research (Webster and Watson, 2002).

After removing duplicates from the respective search results, a first content-related evaluation based on the documents' titles and abstracts was carried out to screen for inclusion. During this process, the relevance of the identified studies was determined by a review team comprising of three members using predetermined rules and procedures to enhance the objectivity of the materials and reduce researcher's biasness. Moreover, to resolve disagreements during the screening process, procedures were put in place to make the process smooth and faster.

Results without any relevance to the object of this research had to be excluded from further analysis, as well as results which lacked scientific standards. The remaining results were analysed in full detail. Finally, the bibliographies of highly relevant results were examined to determine further literature contributing to answering the raised research questions. During this process, 66 relevant results were identified.

3 Literature Review

3.1 Influences of Technologies and Technology Understanding on Digital Transformation

Digital transformation as a concept has had its meaning misused and rendering its true meaning nebulous with majority utilising it simple as a disruption in technologies such as modernization euphemism such as migrating to cloud computing, or a marketing solution by marketers. However, CIO (2019) argues that that is not always the case as the term implies to a profound transformation of both organizational and business activities, models, competencies and processes to effectively leverage the opportunities and changes of digital technologies as well as their increasing across the society in a prioritized and strategic means with both future and present shifts being taken into considerations.

On the other hand, SMEs is also another significant term used in this paper whose meaning is worth exploring to provide better direction for the readers. As used in the context of this paper, small and medium enterprises often abbreviated simply as SMEs in terms of employee capacity is used to refer to independent and non-subsidiary enterprises with few employee capacity and varies according to each nations with the acceptable upper limit often being 250 employees in European Union (OECD, 2005). However, the upper limit is always set at 200 employees in other nations while in the US SMEs is often used to refer to firms with 500 employees and below. On the other hand, financial asset is also used to describe and define SMEs especially in European Union. In terms of financial assets, OECD (2005) defines SMEs as firms with an asset turnover of less than 50 million Euros for medium sized firms and less than 10 million Euros as asset turnover for micro firms.

Firm managers are obliged to foresee the effect of technological dynamics in order to identify opportunities and threats. The paradigm shift arising from technological changes has a far-reaching effect on the scope of enterprise managers since they have to keep abreast with the transformation of business activities (Curran and Mitchell, 1982). Chalons and Dufft (2017) contend that the perception of IT has changed from being solely supportive to becoming a launching pad of novel business models. Despite the fact that digital technological revolution does not spare any business, most SMEs are yet to reap the benefits of digital transformation probably due to ignorance (Fitzgerald et al. 2013). This situation is often experienced by SMEs because functions are not much segregated and owners or few managers are left as decision makers, the reason being lack of digital experts as compared to start-ups and large corporations.

Innovation on the technological front is undoubtedly the core of competition for small and medium-sized enterprises, and it involves the process of acquisition, assimilation, dissemination, and utilization of new knowledge. Apparently, the success of technological innovation is dependent on the firm's knowledge absorptive capacity. Resource endowments greatly influence business performance, and this is well captured in the areas of entrepreneurship, human resources, and strategic management. Human capital is a crucial asset contributing to the firms' success; therefore, it has to be developed to optimize business performance. It is imperative to address issues such as managerial skills, knowledge, and experience which are components of human capital because they determine the direction of the digital transformation of SMEs (Soriano and Castrogiovanni, 2010). Haber and Reichel (2005) further assert that the knowledge possessed by CEOs assists new ventures in identifying and exploiting new opportunities besides the acquisition and transformation of new technical competence.

Study 1: Influence of human capital on the performance of SMEs

To show the impact of technological know-how on the transformation of organisations, Soriano and Castrogiovanni (2010) conducted an investigation to find out the effect(s) of human capital on the performance of SMEs in the EU. Using data from about 2.700 SMEs, productivity and profitability of small and medium-sized firms were measured based on the industry-specific knowledge possessed by CEOs. One of the research questions guiding their study focused on the relationship between the education of SME owners and their performance. West and Noel (2009) noted that the impact of education on business performance is aligned with the fact that acquisition of knowledge improves the managerial capacity to operate a successful enterprise generally or through an industry-specific strategy. Industry-specific knowledge is one of the elements that were explored under the education theme. The industry-specific knowledge entails the specific proficiency, skills, and insights applicable to a particular market, sector, or industry. Industry-specific skills can be developed by getting specialised education with the focus on the knowledge of products, processes, or technologies relevant to a certain sector. Institutions, specialised programs, or courses can help in getting specialised skills. Gaining these specific skills is associated with the improved managerial capacity to come up with superior technology or business plan (Haber and Reichel, 2005). Individuals amass knowledge of specific industries to get in-depth insights on particular technical aspects and characteristics of processes and products in that sector. Findings showed a positive correlation between industry-specific knowledge and SME performance, especially if owners got educated prior to the operation of a firm.

Similarly, Piccinnnini, Gregory, Hanelt, and Kolbe (2015) also conducted a study on the impacts of digital transformation on organisations but specifically focused on the automobile industry. Using an exploratory study of Delphi and in collaboration with 19 experts in the automobile industry, the researchers investigated some of the digital transformation challenges faced by managers in the industrial age. In their findings, three major digital transformation challenges were identified. These included radicalization of transformation in IT-enabled firms both within and outside the firm; industrial business transformation over digital innovation as well as the emergence of both physical and digital paradoxes. In their conclusion, the study extends the transformation literature of IT-enabled businesses by linking it to the current digital innovation topic.

In a different study, Gray (2006) explored the EU policymakers' quest to develop small entrepreneurial firms endowed with the capacity and ability to making effective use of research and development (R&D), knowledge creation and dissemination, networking, and technology transfer. Triumphant entrepreneurs ought to be considerably efficient as far as the maintenance of their knowledge base is concerned, especially in a competitive environment. Apart from time and resource constraints experienced by SMEs, they face stiff competition for necessary know-how and competencies in the labour market because of the poor supply of such skills. A policy report from one of the UK's think tanks (Learning Skills Development Agency) identified shortages on an array of critical skills among various sectors of small and medium firms. It was acknowledged that the participation of SMEs in knowledge development and training was quite poor and informal (WSC, 2012).

In conclusion, the report stated that labour force learning in a firm is vital in regard to knowledge development to guarantee its growth and survival. The level of functional knowledge in an organisation is associated with the relevance and level of formal training and experience. Small firms can scale up their technical know-how through R&D and information scanning, and these are considered as a knowledge management model. Knowledge sharing which features commonly in SMEs operating in clusters or networks is fundamental for their growth. Three key components of relevant knowledge that drive most SMEs include the technical knowledge base, the acquired new knowledge, and creation of new knowledge. Information and communication technology resources have provided significant support for the three components, considering the internal and external processes of the firm(s).

Study 2: ICT essential role in the knowledge management of SMEs

The ICT essential role in the knowledge management of SMEs is highlighted by Corso et al. (2003) who argue that ICT can transform SMEs by erasing the

usual constraints on their innovation ability by providing easy and fast access to technical know-how from external sources. This is in addition to more intense and new communication avenues developed with the help of partners. What more, SMEs leverage their responsiveness and flexibility as a result of useful networks irrespective of the spatial proximity. Generally, large SMEs driven by prospects of growth seem to capitalise more on ICT resources and applications compared to smaller SMEs. Small SMEs are characterised by resistance to training and other avenues of participating widely (Gray, 2003). Pinto and Guerreiro (2019) looks at the concept of knowledge management in a rather interesting way. Knowledge is considered as one of the critical components of business success, and firms are increasingly becoming knowledge intensive since they can leverage the value of the accumulated knowledge. Technical knowledge has been considered systematically as a tangible resource and several firms are increasingly capitalising on knowledge to improve and sustain their competitive edge.

Study 3: Innovation as drivers of SMEs

A quantitative analysis was also carried out by Parilli and Elola (2012) to determine innovation drivers of SMEs in Spain. Using questionnaires, a survey was conducted on firms in the following sectors: (1) machine tools; (2) engineering, consulting, and IT; (3) Metal products; and (4) Paper and graphic arts — the authors present two innovation modes in their study. The first one is innovation pegged on science and technology (STI) factors, for instance, human capital, R&D, and infrastructure while the second mode of innovation uses the Doing, Using, and Interacting (DUI) mode of learning. Some countries emphasise on the essence of science and technology-based catalysts in driving innovations. In relation to this, investments in the human capital and R&D are considered as vital inputs of innovation. The U.S., Sweden, and Japan use this approach in structuring their innovation strategies. Concisely, the human capital consists of science and technology graduates while the infrastructure consists of technology parks and science centres.

Conversely, other countries like Norway and Denmark incur low investments in formal R&D programmes but are still able to produce innovations continually based on a knowledge flow that is more implicit. Particularly, the second approach refers to innovation drivers that rely on experience and tacit knowledge flow and obtained from practice, observation, and exchange. Learning is actualised by doing, using, and interacting (DUI).

To complement on the concept of innovation modes, organisational behaviours is identified and grouped into four; the low learning, the STI, the DUI, and a blend of DUI/STI. It was observed that a combination of STI and DUI is more effective in terms of the learning process and knowledge process hence a higher innovation output. Individually, each of the modes made a pertinent contribution as stated below.

"The STI mode alone contributes to the generation of advanced scientific and technologic knowledge, mainly associated with analytical processes driven to identify natural principles and the mechanism that can be applied to all industries with a preference for chemicals, pharmaceuticals, biotechnology, software, and nano-materials. The DUI approach alone adds the possibility of learning by doing, by using and by interacting, which promotes translation of scientific, analytical knowledge inputs into synthetic knowledge that more easily deliver outputs that are widely used in engineering based industries such as machine tools and automotive, shipbuilding, as well as many traditional manufacturing sectors. It also helps workers in absorbing knowledge more efficiently, productively and participating actively in the innovation process of their firms (Parilli and Elola, 2012).

Results from the quantitative analysis showed a significant correlation between the STI innovation model and innovation outputs of small enterprises. About 49% of the firms (59 out of 118) did not report about any innovation output, and these had poor STI innovation profiles while 30% of the firms said to have substantial innovations showed a high STI innovation profile. The data collected indicated that enterprises with an impressive record in terms of STI innovation profile yielded more in terms of innovation. The same results were replicated in the case of DUI analysis, that is, enterprises with a superior record of the DUI innovation mode yielded better innovation results. Notably, organisations that reported low levels of STI innovation mode also scored poorly on the DUI mode of innovation as proved by approximately 55% of the firms (95 out 174). In their conclusive statement, Parilli and Elola point out that the study aspects show a significant novelty in the SMEs innovation process. Similar to the initiatives undertaken by large corporations, SMEs ought to structure their science and technology-based activities and procedures considering that they are major drivers to attain high-level competitiveness. The landscape has currently shifted from incremental innovations, implicit knowledge flows, and DUI practices to STI drivers including the science and technology infrastructure, human capital, and research and development. Audretsch (2003) and Rammer et al. (2009) attest to this by indicating that promotion of SMEs innovation should be hinged on high-tech and knowledge-based entrepreneurship. The latter also postulates that progressive R&D undertakings lead to successful SMEs innovations especially where external knowledge sourcing is concerned.

Study 4: Impacts of Knowledge on competitive advantage of SMEs

Alvarez et al. (2014) affirm that know-how or knowledge (an intangible resource) influences the competitive advantage of SMEs. Survey findings by

Azevedo, N, Ofonso, L and Vasconcelos, B (2019) affirm that knowledge and experience are some of the most important resources of an innovative firm given that they influence implementation of projects such as technologies and innovative products. In the post-industrial era, the development of IT has made it possible for people to access and manage large quantities of information. Knowledge sharing or transmission of knowledge improves the asset value of SMEs because there is a flow of knowledge between firms and clients which is more crucial than the flow of money and goods (Deshpande, 2018). Management of technical knowledge is a dynamic process that entails development, identification, capturing, storage and transmission of knowledge for it to be transformed to value. It is widely viewed that the firm's intellectual capital is crucial for enhancing its performance and attaining competitive advantage (Subramaniam and Youndt, 2005). Intellectual capital is an aggregate of three forms of capital, that is, the organisational, human, and social capital. Effective management of the intellectual capital guarantees superior performance and a sustained competitive edge. Presently, the concept of off-shoring has turned out to be popular in the era of firm innovation, and it is manifest through tasks such as customer relationship management, software development, and R&D. Accordingly, it is imperative for SMEs that want to venture in such a line of business to portray high-levels of technological know-how (Mihalache et al. 2012; Nieto and Rodrıguez 2016; Peeters et al. 2014).

Contrary to most of the studies that indicated the involvement of large corporations in off-shoring activities, recent research has shown that SMEs are also engaging in the off-shoring business (Lewin et al., 2009; Di Gregorio et al., 2009). Actually, SMEs are increasingly continuing to tap on the offshore talent so as to innovate and grow. Kasemsap (2018) add that the latest evidence indicates that research and development services and products off-shored by SMEs contribute to their increased innovation and growth.

3.2 Management of Technology Knowledge

As a concept, technological knowledge is currently being defined clearly from the general technological philosophy literatures. Thus, defining the term technology knowledge in this paper offers a standing point on discussion of the phenomenon under investigation within management of technological knowledge in SMEs. According to Compton (2004) technological knowledge is a term that is used to describe knowledge that can be specifically identified as technological and relies on epistemological criteria and draws from materials that emphasises not on notions of truth but functions.

The purpose of this paper is to reflect on the current basis for technological knowledge in general. In so doing, the paper begins with a discussion of the nature of knowledge and technological knowledge from a range of perspectives both within and outside of technology education.

At one point during their life cycle, SMEs have to deal with processing of masses of data (Big Data is a key component of digital transformation). Modern IT provides means to build a knowledge base in order to address internal and external information, sometimes it is manifested in huge amounts of data (Mbassegue et al. 2016). Big data emanates from exponential volumes of data originating from connected components, individuals, networks, organisations, and groups, but it is important to find ways to access it (Kashyap, R and Piersson, 2018). Apart from the size, Howkins (2002) clarifies that data variety and the possible relationship between data and the tools for analysis also matter. Functions such as decision making in a firm are greatly influenced by the volume, value, veracity, velocity, and variety of the produced data (Koutroumpis and Leiponer, 2013). The presence of Big Data creates potential opportunities and challenges to enterprises because processing has to be done before decisions are made. Following from that, SMEs require adequate infrastructure and capacity to exploit such kind of data optimally. SMEs' external environment generates loads of data on many fronts such as social, economic, political, demographic, and technological. George et al. (2014) postulate that the survival and competence of SMEs are related to the collection, processing, and integration of external data in the decision-making process.

Ideally, adequate technical knowledge is paramount when dealing with large amounts of data. Technical and material structures and managerial practices are some of the organisational aspects that facilitate the handling of Big Data by way of identification, processing, and knowledge dissemination. Entrepreneurs have a mandate to improve the firms' capacity to sustain competitive advantage, and in relation to that, knowledge turns out to be a matter of strategic interest. Value creation and addition in organisations are realised through meaningful mobilisation of resources, and as such, managers have to devise various ways to promote the creation of value. In view of that, individual and collective acumen needs to be mastered and applied effectively. According to Mbassegue et al. (2016), capitalisation of knowledge ensures optimisation of resources deployed to manufacture products and provide services. They add that "based on the capitalization and enhancement of knowledge it is possible to find innovative solutions to improve quality and productivity". Blending knowledge management and Big Data is vital for the management and transformation of SMEs; basically, they are crucial inputs for value creation. Concisely, knowledge management features three major elements: Data, information, and knowledge. Data that has been generated need to be contextualised to become information, which is in turn processed to become

knowledge. Transformational knowledge platforms like artificial intelligence and algorithms are applied to data to arrive at different kinds of knowledge with the help of IT (Minelli et al., 2013; Sathi, 2012). Figure 1 shows the integration of Big Data and knowledge management.

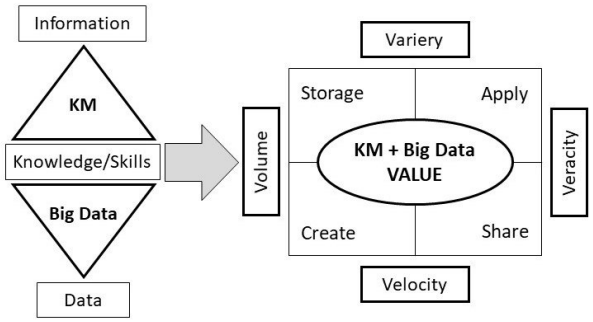

Figure 1: Integrating Big Data and KM (Mbassegue et al. 2016)

4 Conclusions

Even though the relevance of technology knowledge in digital transformation especially in small and medium-sized enterprises that are still largely dependent on physical human capital has become increasingly obvious, the uptake of digital knowledge to mitigate threats and take advantage of opportunities by SMEs remain relatively low.

Utilizing quantitative literature methods, this study sought to answer two posed research questions regarding (a) the relevance of management of technology knowledge in SMEs for digitalisation and (b) the influence of technologies and technology understanding on the digital transformation of SMEs.

The conclusion derived from the literature research for the first research question is that the impact of technology knowledge management on digitalization of SMEs is attested to be high. Particularly, this study concludes that technology knowledge in terms of human capital such as managerial capacity and industry-specific knowledge (skills, proficiency, and insights) are very fundamental components of digital transformation in SMEs which in turn influence performance of SMEs.

In terms of the influence of technologies and technology knowledge on the digital transformation of SMEs, this study concludes that both are essential components of digital transformation in SMEs. Technology management including management and proper understanding of ICT and innovation helps in effective management of SMEs and increases the competitiveness of SMEs in the market or industry.

Nevertheless, the study was also susceptible to some limitations which might have affected the validity and reliability of its findings with the major ones being its over-reliance on secondary data collection methods which does not provide the first-hand information. Consequently, this study recommends incorporation of primary data collection methods such as surveys in future researches so as to get more valid, reliable, and up-to-date results. Further, these methods should also include questions specifically assessing SMEs managers understanding on technological knowledge at different levels. By so doing, these future studies would be in a position to offer clear findings and guidance as to what technology knowledge might imply at different levels of SMEs.

References

Audretsch, D. B. (2003). Standing on the shoulders of old midgets: The US small business innovation program. *Small Business Economics*, 20, 129–135.

Alvarez, I., Cilleruelo, E., Zamanillo, I., &Zarrabeitia, E. (2014). Knowledge Management Practices in SME: Case Study in Basque Country SME.

Azevedo, N., Ofonso, L. and Vasconcelos, B. (2019) The Role of the ICT IN Knowledge Transfer. 18h Edition.

OECD (2005) SME and Entrepreneurship Outlook. *OECD Paris*, page 17.

Châlons, C., and Dufft, N. (2017). The Role of IT as an Enabler of Digital Transformation. *The Drivers of Digital Transformation*, F. Abolhassan (ed.), Springer International Publishing, pp. 13–22.

CIO. (2019). What is digital transformation? A necessary disruption. Retrieved from: https://www.cio.com/article/3211428/what-is-digital-transformation-a-necessary-disruption.html

Compton, V. (2004). Technological Knowledge: A developing framework for technology education in New Zealand. *New Zealand Ministry of Education Curriculum Project*, pp. 1-20

Corso, M., Martini, A., Pellegrini, L. and Paoluci, E. (2003). Technological and organizational tools for knowledge management: in search of configurations. *Small Business Economics*, 21, pp. 397-408.

Curran, S., and Mitchell, H. (1982). New Technology: Understanding the Impact. *Office Automation*, London: Palgrave Macmillan UK, pp. 20–39. (https://doi.org/10.1007/978-1-349-05975-1_3).

Deshpande, M. (2018). Policy Perspectives for SMEs Knowledge Management. 6th Edition.

Fitzgerald, M., Kruschwitz, N., Bonnet, D., and Welch, M. (2013). Embracing Digital Technology:

A New Strategic Imperative. *MITSloan Management Review*, pp. 1–12. (https://doi.org/10.1057/palgrave.ejis.3000650).

George, G., Haas, M. R., &Pentland, A. (2014). Big Data and management. *Academy of Management Journal*, 57, 2, 321-326.

Gray, C. (2006). Absorptive capacity, knowledge management and innovation in entrepreneurial small firms. *International Journal of Entrepreneurial Behaviour and Research*, 12, 6, 345-360.

Haber, S., & Reichel, A. (2005). Identifying performance measures of small ventures - the case of the tourism industry. *Journal of Small Business Management*, 43, 257–286.

Howkins, J. (2002). The Creative Economy: How People Make Money from Ideas. Penguin, United Kingdom.

Kasemsap, K. (2018). Facilitating Entrepreneurship, Internationalization, and Innovation in Global Business. 6th Edition.

Kashyap, R. and Piersson, A.D. (2018). Big Data Challenges and Solutions in the Medical Industries. In Vivek Tiwari, Ramjeevan Singh Thakur, Basant Tiwari and Shailendra Gupta (Eds.), *Handbook of Research on Pattern Engineering System Development for Big Data Analytics*. IGI Global.

Koutroumpis, P., Leiponen, A. (2013). Understanding the value of big data. *IEEE Conference on Big Data, Sillicon Valley, CA*.

Mbassegue, P., Escandon-Quintanilla, M.-L., Gardoni, M. (2016). Knowledge management and big data: Opportunities and challenges for small and medium enterprises (SME). *13th IFIP WG 5.1 international conference on product lifecycle management for digital transformation of industries, PLM 2016*, 492, 22-31.

Mihalache, O. R., Jansen, J. J., Van Den Bosch, F. A., &Volberda, H. W. (2012). Offshoring and firm innovation: The moderating role of top management team attributes. *Strategic Management Journal*, 33(13), 1480–1498.

Minelli, M., Chambers, M., Dhiraj, A. (2013). Big Data, Big Analytics: emerging business intelligence and analytic trends for today's businesses. Wiley, New Jersey

Nieto, M. J., & Rodrıguez, A. (2011). Offshoring of R&D: Looking abroad to improve innovation performance. *Journal of International Business Studies*, 42(3), 345–361

Parrilli, M. D. and Elola, A. (2012). The strength of science and technology drivers for SME innovation. *Small Business Economics*, 39, pp.897-907.

Peeters, C., Dehon, C., & Garcia-Prieto, P. (2015). The attention stimulus of cultural differences in global services sourcing. *Journal of International Business Studies*, 46(2), 241–251.

Piccinnnini, E., Gregory, R., Hanelt, A. & Kolbe, L. (2015). Transforming Industrial Business: The Impact of Digital Transformation on Automotive Organizations. *Thirty Sixth International Conference on Information Systems, Fort Worth*. pp. 2-20.

Pinto, Hugo; Guerreiro, André (2019), Resilience, Innovation, and Knowledge Transfer. Conceptual Considerations and Future Research Directions. In Helena Almeida; Bernardete Sequeira (Eds.), *Advances in Knowledge Acquisition, Transfer, and Management. The Role of Knowledge Transfer in Open Innovation*. IGI Global, 281-299

Rammer, C., Czarnitzky, C., &Spielkamp, A. (2009). Innovation success of non-R&D performers: Substituting technology by management in SMEs. *Small Business Economics*, 33, 35–58.

Soriano, D. R., & Castrogiovanni, G. J. (2012). The impact of education, experience and inner circle advisors on SME performance: insights from a study of public development centres. *Small Business Economics*, 38, 3, 333-349.

Subramaniam, M., &Youndt, M. A. (2005). The influence of intellectual capital on the types of innovative capabilities. *Academy of Management Journa*l, 48(3), 450–463.

Toanca, L. (2016). Empirical Research Regarding the Importance of Digital Transformation for Romanian SMEs. *Management and Economic Review*, 1(2), pp. 93-108

Webster, J., and Watson, R. (2002). Analyzing the Past to Prepare for the Future: Writing a Review, *Management Information Systems Quarterly* (26:2), pp. 13–23.

West, G. P., I. I. I., & Noel, T. W. (2009). The impact of knowledge resources on new venture performance. *Journal of Small Business Management*, 47, 1–22.

WSC2012. (2012). *Proceedings of the Winter Simulation Conference. Winter Simulation Conference.* Program. 1-176.