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From Technology Adoption to Organizational Resilience: A Current Research Perspective

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Abstract. Digitalization is an ever-increasing phenomenon and is being focused in all prominent research communities around the world. When it comes to businesses, the concept of digitalization can have its far-reaching impacts due to the diverseness of business and distinctiveness of their capabilities. Small and medium enterprises (SMEs) are of dire importance in this research arena, due to their immense share in global economy and organizational characteristics. The concept of digitalization needs special attention for these business specimens. Technology adoption models need to be built which can transcend the utility of digitalization and digital technologies in SMEs. We propose a hypothetical technology adoption model for increasing the digital maturity in small and medium business organizations and further proposing that matured digitalization will lead to centralized business continuity infrastructure which can boost the organizational resilience.

Keywords: Digitalization, Organizational Resilience, Technology Adoption, Small and Medium Enterprises, SMEs

1 Introduction

Technological innovation has revolutionized the ways of how business organizations operate, with the fast pace of digitalization (Remfert & Stockhinger, 2018) and 4th industrial revolution or digital transformation (Schwab, 2017). More relationships are being formed and maintained online than ever before, including supplier-purchaser relationships and even collaboration between employees of the same company (Herbsleb et al., 2000). If digitalization is considered in the perspective of digital technologies than having a digital interconnection, having access to static and dynamic information and ways of collaborative work articulation using digital technologies (or Information and Communication Technologies further ICT) can be seen within the ever spreading digitalization sphere. In the wake of digital transformation, the adoption and accumulation of different digital technologies like SMACIT (social, mobile, analytics, cloud and Internet of things) technologies (Sebastian et al., 2017) are an effective digital business strategy (Bharadwaj et al., 2013). ICT adoption seems to have a positive effect on productivity, directly as well as indirectly, depending on the sectors and have great potential to support a sustainable development (Ollo-Lopez & Aramendia-Muneta, 2012). Furthermore, the

use of electronic commerce (e-commerce) and social media have significantly cut down on the physical transportation involved in sending mail, banking, advertising and buying goods (Manochehri et al., 2012).

Within the taxonomy of organizations ranging from meso, micro, small and medium enterprises (SMEs) to big companies, SMEs have been discovered to be a key driver for a country's economic growth and crucial for a progressive economy (European Commission, 2017), thus the backbone of Europe's economy. They represent 99% of all businesses in the European Union (EU). In the past five years, they have created around 85% of new jobs and provided two-thirds of the total private sector employment in the EU. The European Commission considers SMEs and entrepreneurship as a key to ensuring economic growth, innovation, job creation, and social integration in the EU. SME is defined as an organization with less than 250 employees and less than a (or equal to) 50 million turnover (European Commission, 2017). SMEs are often global leaders within their numerous niche markets (so-called 'hidden champions' by Simon (1996)) (Ludwig et al., 2018).

The course of action adopted by many SMEs tend to keep them in their 'comfort zones' and hence hinders with the adoption of new technological advancements. This is compounded by the fact that employees make demands on technologies that they know from private use (Richter et al., 2017), which often leads to unauthorized use of private IT, also called "Shadow IT" (Steinhueser et al., 2017). The dawn of 4th industrial revolution and the vastly transforming technological paradigm poses multiple threats to the traditional ways of work routines and without taking up the correct measure, SMEs tend to lose the competitive advantage within their numerous niche markets (Remfert & Stockhinger, 2018). Sullivan-Taylor & Branicki (2011) explored the SMEs in Great Britain and found that with the ever-increasing threat of natural and man-made disasters, SMEs do not hold the resources and technical systems often equated with resilience capabilities. And despite being agile and flexible, SMEs may be need to become more strategic and driven in their approach to manage the threat and actuality of extreme events. SMEs are marginalized in the adoption of technologies and innovations in the realms of digitalization and even if they essentialize the use of digital technologies to some extent, they lack the level of maturity to reach the designated levels of digitalization, which can pave the path towards a resilient organization.

This research presents a hypothetical model for gauging the digitalization in SMEs via the usage of digital technologies. The technology adoption model lays the foundation of a benchmark roadmap for achieving the highest level of digital interconnectedness which will not only enable the SMEs to successfully transform into digital workplaces, but will also make them continuous and prepared for disasters and emergency situations. This work in progress starts off with the concise related work section for usage of digital technologies as an aspect of digital transformation, also specific to SMEs. Then, we demonstrate the usage of different digital technologies by SMEs in Germany. Later, we exploit the different categories of digitalization in SMEs for the development of the hypothetical technology adoption model for digital interconnectedness. Lastly, an ideological infrastructure for business continuity in SMEs is presented which can be realized as an epicentre of digitalization leading to a resilient organization.

2 Motivation and Literature Review

Ackerman et al. (2007) argue that for users to adopt technology they must both understand its capabilities and have scaffolding mechanisms for collectively discovering, structuring, iterating, and promulgating practices that enable the technology to become a 'resource'. This also holds true for the adoption of digital technologies for achieving digitalization in

SMEs. Blatz et al. (2018) illustrated that the strategy, leadership, company culture and organization are the most weighted factors influencing the adoption of digital technologies in an organization. The extent to which an organization is digitalized is purely subjective and unstandardized.

An evident decrease in the use of communication channels like emails, pagers etc. sets a clear indication towards the adoption of easy, simple and effective digital mediums in business organizations (Muller et al., 2003). Attention should be paid to training, team working, communications and change management. Digital interconnection channels can improve internal business interconnection and social networking within an organization, hence establishing cooperative work environment in SMEs. Involvement of people from all focus areas of business, such as production, sales, suppliers, vendors, customers and customers to-be is a strategic priority for achieving business excellence. SMEs use many different technologies but fail to fully adjust themselves in the evolving digitalization & digital transformation paradigms, thus lacking the ability to achieve business excellence (Tarutė & Gatautis, 2014; Manochehri et al., 2012; Schwab, 2017). Limited funds, lack of internal and external skills, expensive technological transition and poor infrastructure are the key barriers in the adoption of digital technologies (Ongori, 2009). Acar et. al. (2005) explained that SMEs are exceptional in nature and the two main reasons for the underutilization of ICT are the lack of staff with appropriate skills and the satisfaction with existing methods.

Digitalization spans throughout an organization, it specifies the abilities of a firm including employees' collaboration, work articulation and coordination among themselves, between departments and with their suppliers and customers (Nguyen, 2009). Digital technologies are required to manage coordinated task execution, effective communication, implementation of business processes, employee-management relationship, b2b & b2c cooperation and much more. It stretches from the use of emails as the traditional way of asynchronous coordination to the more sophisticated e-commerce and digital workplace solutions for extensive cooperation and collaboration throughout a business organisation and beyond (partners, suppliers, retailers, distributers and customers). More than half of the companies (53.30%) have an internet connection and e-mailing appears to be the most common application with 47.14% using it (Nguyen, 2009). At one extreme, increased email overload, however, was associated with reduced coordination effectiveness, so it is not simply a negative psychological phenomenon, but also has negative organizational consequences (Dabbish & Kraut, 2006). Meanwhile, at the other, the e-commerce adoption literature implies that firms need to be internally and externally ready and active all the time to ensure their digital presence (Tan et al., 2007). An organization's internal readiness can be summarized as the availability of financial and technological resources, the top management's enthusiasm to adopt e-commerce, technology infrastructure, compatibility of the firm, as well as culture and values (DeBerry-Spence et al., 2008).

Digital technologies also comprise ICT groupware solutions such as messengers & chatbots like WhatsApp, Telegram, Slack etc., and elaborate communication channels such as the web-based and desktop project management solutions like Trello, Asana etc. The ASPect Project Case illustrates the benefits of ICT adoption leading to innovation in Dutch SMEs (Boekhoudt & Van der Stappen, 2004). While examining the use of group communication technologies like messengers or instant messaging (IM) platforms, Muller et. al. (2003) found that in the teams of all organizations they surveyed, getting a quick response and a better connection were the two main reasons to use instant messaging (IM) for formal and informal interconnection within an organization. Rathore and Ilavarasan (2014) provide the evidence on

the potential benefit of the applicability of mobile digital technologies such as smartphone applications and social media for internal and external business outreach in Indian SMEs. They also urge SMEs to be 'cloud ready' and use non-proprietary and commonly available technologies for gaining the competitive advantage. Young et. al. (2019) argue for the efficacy of immersive telepresence in order to ordain remote collaboration in contrast to desktop-based telepresence technologies. Cloud computing and Platform as a Service will be the future solution for Indonesian SMEs (Wiradinata, 2016). The potential benefits in the adoption of e-commerce in the SMEs of Ghana (Iddris, 2012) and Indonesia (Aidah et al., 2017) present promising transformation opportunities towards matured digitalization.

1) The scope of our investigation is a utopian perspective for the usage of digital technologies for digitalization in SMEs, due to three main reasons: as per the observations made in the secondary data from the ZEW Mannheim Innovation Panel, there are substantial number of SMEs using different technologies
2) The digital technologies in the scope of this investigation are basically technological genres not bounding the SMEs to adopt a specific artefact or tool for achieving a certain level in digital interconnection for example if 'informal team communication' is a genre than all the artefacts like Telegram, Slack, WhatsApp, Viber, Skype can be instances to achieve informal team communication
3) Industry has to 'turn to practise' of the digital technologies for achieving interconnectedness to accomplish digital transition leading to digital transformation (Lewkowicz & Liron, 2019).

3 Methodology: Digital Technologies in SMEs

In order to identify the current usage of digital technologies and to establish a notion of future usage of digital technologies for digitalization, we used the data from the Mannheim Innovation Panel (MIP) survey for a short descriptive analysis. The MIP data comes from the Leibniz Centre for European Economic Research (Leibniz-Zentrum für Europäische Wirtschaftsforschung - ZEW). The MIP survey is an annual survey of the innovation activities of German organizations from 21 industrial sectors (both service and manufacturing industries). The data have been collected annually since 1993 through a regular distribution of questionnaires among the German firms. The MIP dataset is structured as a panel dataset. Each annual wave of the MIP survey comprises, in addition to the basic organizational attributes of the respondent organization, questions pertaining to their innovation activities (e.g., new products, new services, improved products, improved services), innovation related expenditures (e.g., research and development investments, skilled labor) and the economic implications of innovations (e.g., revenue, productivity). Moreover, new questions are included in the annual survey to address the growing demand of researchers in relation to emerging topics.

The MIP survey of 2016 was used for the desired descriptive analysis, as it contained the information regarding the usage of digital technologies in German organizations not just at the time of survey but also the expected usage in 5 years time. More specifically, the respondents were asked the following additional question: "To what extent does your enterprise currently use the following applications of digitalisation in different business function areas, and will the usage of these application likely increase, decrease or stay the same in the next three to five years?". Each respondent was asked to respond on a categorical scale; for the current usage (high,

medium, low, no) and for the future usage in the next 3-5 years (increase, stay the same, decrease).

The questionnaire for the MIP 2016 dataset has classified 11 digital technologies (D1-D11) for an organization which were further categorized in four interrelated groups in the dataset. The dataset consists of the detailed information about the responses of 4,685 German firms. Since the focus of our research is on SMES, we have used the European Commission's definition of an SME and, in addition to discarding missing and incomplete information, we have removed large firms (with more than 250 employees), and micro firms (less than 5 employees) from the sample. After cleaning and restructuring of the dataset, we have obtained a sample of 2,266 German SMEs. The segregation of the commonly used digital technologies can be seen in Table 1.

Technologies for inter- and intra-digital interconnection of an organization
D1: Digital interconnection within production / provision of services D2: Digital interconnection between production / service provision and logistics D3: Digital interconnection with customers D4. Digital interconnection with suppliers
Technologies for internal collaboration, cooperation & communication
D5: Teleworking D6: Software-based communication (Skype etc.) D7: Intranet-based platforms (Wikis etc.)
Technologies for external digital interconnection
D8: E-Commerce D9: Social media (Facebook, Twitter etc.)
Technologies for information processing and business analytics
D10: Cloud computing / cloud applications D11: Big data analysis

Table 4. Digital technologies as per MIP survey

The descriptive analysis for the current and future usage of these digital technologies can be seen in Table 2 (p.6). An important aspect to note in the segregation of digital technologies is the aspect of generalization. The business organizations were asked about the technological genre without explicating an artefact. That gave freedom to the participants to provide open-ended information about digital technologies which fall in the categories of digital technologies. The descriptive analysis shows that the SMEs used the digital technologies from a low to a mediocre extent. The fascinating aspect supporting and motivating the development of our hypothetical technology adoption model is the future usage of digital technologies. The increase in the usage of technologies within a set of 2,266 SMEs is representative and encouraging enough to pave the path towards the standardization of technology adoption in SMEs.

4 Results: Technology Adoption Model

After the identification of technological genres through data from MIP survey and establishing the notion of the usage of digital technologies, we have developed the hypothetical technology adoption model, as shown in Figure 1. This model can also be seen as a maturity model as it intends to mature the digitalization process in SMEs by gradual technology adoption. Generic model development framework proposed by de Bruin et al. (2005) is used for the development of the hypothetical model. The agenda of the whole process is to enable comparative benchmarking for digitalization in SMEs, in order to guide the digital transformation by gradually increasing the technology adoption in SMEs. The second stage of the generic framework is to develop a design or architecture of the desired model. A common design principle is to represent maturity as a number of cumulative stages where higher stages build on the requirements of lower stages. The five stages of the hypothetical model have been proposed after rigorous brain storming sessions and review of literature mentioned in the previous sections.

We utilized mind mapping as a tool to analyze the digital technologies under the lens of different stages of maturity. This iterative process yielded five maturity levels of

technology adoption. Each maturity level is an augmentation of the preceding level and is well defined with respect to the domain of digitalization. In order to populate the five levels, we used the different identified sets of digital interconnection technologies examined in the aforemnetioned MIP survey. These stages not only depict the evolution of digitalization but also the actors around these technological measures. These levels further bespeak the process and organizational attributes acquired during the adoption and maturation of digitalization.

Digital Technologies	Number (N) of SMEs	Current usage of digital technologies (0(No) – 3 (High))		Future usage of digital technologies (1(decrease) – 3(increase)	
	N	Mean	SD	Mean	SD
Production / service provision					
D1: Digital interconnection within production / provision of services	2,266	1.522948	1.027074	2.436893	0.5136012
D2: Digital interconnection between production / service provision and logistics	2,266	1.284201	1.037695	2.367608	0.5133031
D3: Digital interconnection with customers	2,266	1.421889	0.9648741	2.492498	0.517411
D4: Digital interconnection with suppliers	2,266	1.244042	0.9235799	2.400265	0.5138092
Internal organization / communication					
D5: Teleworking	2,266	0.690644	0.8648499	2.15887	0.4279458
D6: Software-based communication (Skype etc.)	2,266	0.790821	0.8921658	2.248455	0.4778168
D7: Intranet-based platforms (Wikis etc.)	2,266	0.768314	0.9147709	2.237864	0.4785885
Sales / external communication					
D8: E-Commerce	2,266	0.705649	0.8634516	2.266549	0.5012146
D9: Social media (Facebook, Twitter etc.)	2,266	0.61827	0.811834	2.237864	0.5002389
Information processing					
D10: Cloud computing / cloud applications	2,266	0.602383	0.8242321	2.266108	0.4992432
D11: Big data analysis	2,266	0.413945	0.698064	2.181818	0.4618281

Table 2. Description of Digital technologies and Usage within SMEs

The ‘Ad-hoc’ level represents an enterprise with a 1-1 communication on a need-to-do basis (only if necessary without formal standard procedure) with traditional means like email etc. Digital interconnectedness is mostly proactive and decentralized and dependent on individual initiatives and skills. The SMEs at ‘Exploratory’ level becomes more procedural or procedure-oriented in the adoption of digital technologies. Teams initiate formal and informal group communication and coordination. Organization formalizes internal digital interconnectivity between management & employees, through exploratory channels and mediums. Employees are trained for better coordination and collaboration. The next maturity level is ‘Planned’, when the enterprise is mature enough after exploration of digital technologies that it starts focusing on digitalization in a planned manner to achieve ‘coordinated actions’ and knowledge flow. Internal connectivity is enhanced by spreading the digitalization to all the organizational stakeholders e.g. management, production (employees), suppliers, logistics, customers etc. Organization takes reactive measure to reach to potential customers through passive digital channels.

After a planned approach towards digitalization, the business organization starts moving towards a ‘Managed’ digitalization strategy. This strategy is centralized and an accustomed practise within an organization.

The organization takes initiatives towards secure custom software-based communication and coordination over an intranet platform. Alternatives for coordinated workspace option are adapted and the organization establishes active external digital interconnectivity channels with potential customers. Finally, the organization reaches the 'Evolved' state in digitalization. Digital connectivity is optimized and well maintained by the elaborate application of e-commerce and digital workplace practices. The evolved state demonstrates a highly interconnected and a resilient SME. Such an organization is expected to have procedures and technological infrastructures in place for emergency situations as well as a normal day in business.

5 Discussion

This exploratory paper proposes an evolutionary maturity model, starting off with low digital interconnectivity and basic level technologies which can be termed as essentials as used in organizations to some extent. Then slowly progressing towards more sophisticated technologies for higher digital interconnectedness and hence, higher maturity. It is important to note that according to the evolutionary approach, maturity in digitalization in SMEs is achieved through the gradual increase in the usage of digital technologies. The organizations at higher maturity levels have all the technologies in some form which are presented in lower maturity levels. The so called 'Evolved' level i.e. the highest level of the technology adoption model is of keen importance for further discussion and future research.

It sets a milestone on the roadmap of digitalization, in terms of absolute digital interconnectedness, abundance of skilled labor to use these technologies for cooperation and collaboration, network of enterprises, and critical communication channels. It is the best-case scenario for an organization because it has methods for unforeseen situations, a community to depend upon, labor with cooperative abilities, and a digital infrastructure for both good and inconvenient times (i.e. a crisis).

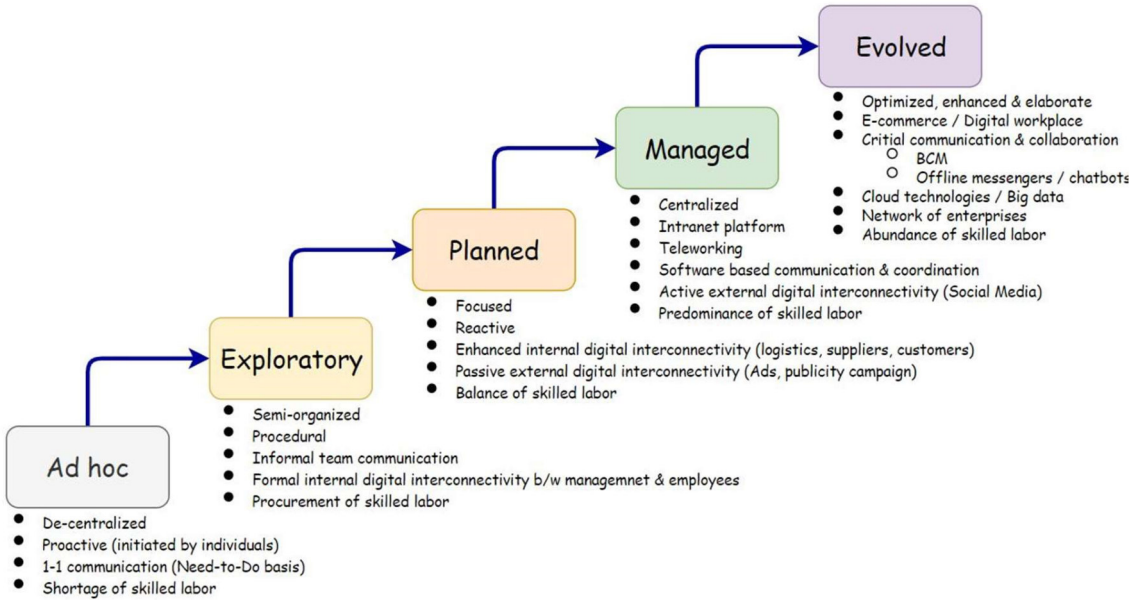

Figure 1. The technology adoption model with the staircase maturity representation

The purpose of this hypothetical model is to encourage SMEs to consider these recommendations as a path to follow and strive for a maturity which enables them to be resilient in times of crisis. It is unrealistic and impractical to expect resilient SMEs and business continuity without even considering the preconditions of digitalization. An organization without a procedural technological infrastructure for communication and coordination in normal routine is more likely to lack critical infrastructure for emergency situations.

The presented model is novel for taking the critical scenarios into consideration, as a pinnacle of digitalization. The highest level of maturity enlists some features related to critical communication infrastructures and crisis management. This model doesn't have concrete information about the technological solutions required to fulfil the criteria and this leaves a lot of flexibility for SMEs to take up the solutions as per their specific requirements. Even though we have information about cloud technologies and big data usage which somehow provide the features related to data safety and interconnectivity in crisis, there can be other, more sophisticated solutions which build on these advanced technologies targeting the specific context of an organization. The use of these solutions (like BCM, disaster preparedness apps) in the evolved maturity state is more of an optimistic proposition for an organization and an open topic of research to date. We recognize it as a limitation but not a big hurdle to affect the utility of our mode. Further limitations include the influence of different independent variables on technology adoption in SMEs which is also unexplored and can be explored in future research. This study also opens many other prospects for future considerations. We would like to investigate the impact of digitalization maturity from individual organizational perspective and also the relation between revenue and digital maturity. The concreteness of business continuity and how it evolves internally within an organization is also a factor to be investigated. The scarcity of available data for the usage of critical infrastructures and business continuity solutions form a strong foundation for surveys, interviews and qualitative and quantitative empirical studies and R&D in crisis management.

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