Maturity Assessment for Implementing Digital Technologies in SMEs

Li Pan
Institute of Economics and Management, National Research Tomsk State University, 36 Lenin Ave, Tomsk, Russia

Keywords: Digital Technology, Maturity Assessment, Reference Framework, Labor Productivity, Economic Profitability.

Abstract: More and more companies have been tapping into digital technologies to improve their labor productivity and economic profitability. To assess the maturity level of implementing digital technologies is paramount for SMEs to embark on the digital transformation journey. There is a lack of maturity assessment reference on implementing digital technologies in SMEs. Through defining a set of digital technology indices, this paper proposes a maturity assessment reference framework for SMEs to implement digital technologies. By using the proposed reference framework, the maturity assessment is conducted for two case study companies. The maturity assessment helps the two companies to clearly understand their current status of digital technology implementation and confidently know how to move forward on the digital transformation journey so that their labor productivity and economic profitability can be further improved and their businesses can be more competitive in the digital economy.

1 INTRODUCTION

Digital technologies have become imperative for working, learning, entertaining, socializing, shopping and accessing everything from healthcare to culture and life style. Specially, in the COVID-19 pandemic, the digital technologies have been radically changing and shaping the world and economy, which are the disruptive innovation since ever. In 2020, affected by the epidemic, the major economies in the world showed negative growth. Against this trend, the digital economy with digital technologies as an important driving force, increased by 3% year on year, becoming a key force to effectively hedge the epidemic and boost the global economy (CAICT, 2021).

The utilization of digital technologies is an effective way to improve labor productivity and economic profitability. The digital technologies such Mobile, Cloud Computing, Internet of Things (IoT), Artificial Intelligence (AI) have facilitated sharing economy, crowdsourcing, and network collaboration to reconstruct the labor and production relationships. The new transaction and consumption models redefine the business models, organizational models and working modes, which have a positive impact on productivity and profitability of enterprises. According to the research of American consulting institutions, the labor productivity of the enterprises with high information utilization rate is about 60~90% higher than that of the enterprises with low information utilization rate. In the service industry, the contribution rate of capital utilization of digital economy to the industry is 2~3 times higher than that of traditional capital utilization (The State Information Center, 2018).

Digital technologies also have a deep impact on the number and quality of employment and how work is organized. From 2006 to 2016, of the 380 million additional jobs in the OECD region, about 40% came from higher digital-intensive industries. From 2011 to 2017, for every 10 additional jobs created in Europe, four were ICT work-intensive jobs (OECD, 2019). In the digital economy, workers increasingly need to adapt their skills to new requirements, especially for generic skills such as communication, teamwork, problem solving, and creativity. Digital technologies also offer new opportunities for how they work. The increase in flexible work and employee discretion in the work model is the key to the digital development of work style (Greenan, Napolitano, 2021).

In the post-epidemic era, embracing digital technologies has been becoming essential for many

Pan, L.
Maturity Assessment for Implementing Digital Technologies in SMEs.
DOI: 10.5220/0011157300003440
In *Proceedings of the International Conference on Big Data Economy and Digital Management (BDEDM 2022)*, pages 61-66
ISBN: 978-989-758-593-7

businesses. Among them, SMEs play a central role in this shift, representing about 90% of the world and providing more than 50% of jobs. In OECD countries, SMEs account for 75 percent of jobs in the sectors most severely affected by the epidemic, and micro-enterprises with fewer than 10 employees account for about 30 percent of jobs in those industries. In emerging economies, formal SMEs account for 40% of GDP, creating 7 of the 10 jobs (OECD, 2021). Therefore, SMEs using digital technologies to innovate the production modes and management concepts, and promote sustainable development are the key to unleashing the global economic potential. In fact, there is few research on digital technologies for SMEs, and the digitalization of many companies is still in the initial stage, and most companies know little about digital technologies and have no clue about how to implement digital technologies to survive. It motivates the study of this paper to propose the maturity assessment reference framework to assist companies to embark on the digitalization journey.

The paper is organized as follows. Section II will conduct the literature review. Section III will propose the maturity assessment reference framework. Section IV will conduct the case studies for two companies by applying the proposed maturity assessment reference framework. Section V will conclude the paper with remarks.

2 LITERATURE REVIEW

This section reviews the literature on digital technologies and digital transformation maturity assessment models, and identifies the research gaps in the literature, which motivate the research works in this paper.

The essence of digital transformation is that organizations use the corresponding digital technologies to respond to changes, which is the source of disruption. In this process, digital technologies play a central role in the creation and reinforcement of disruption that occurs in the society and industry. Digital technologies create the drive that drives organizations to implement responses to gain or maintain their competitive advantages. Vial classified 282 digital transformation documents and found that most digital technologies are related to social, analysis, mobile, Internet of Things, cloud (Vial, 2019), consistent with Zhu et al. on 865 digital transformation documents from 2000 to 2020 and moreover, digital platforms are an important category (Zhu, Ge, Wang, 2021). The business competition increasingly relies on the ability to use digital technologies. In defining digital technologies, Vial observed that combinations of technologies are particularly relevant in the context of digital transformation. For example, the ability to implement algorithmic decisions may depend on the ability of companies to analyze big data collected by individuals using social media through their mobile phones. In the study of Zhu et al. on the thriving stage from 2018 to 2020 of the digital transformation literature, the research on digital technologies compared to digital business strategy, digital transformation of manufacturing (Industry 4.0), digital enterprise architecture and other fields is the least (Vial, 2019).

The findings by DeStefano et al. suggested that younger companies using cloud computing are more likely to increase jobs and sales, and that cloud computing and fiber-optic infrastructure enable younger companies to scale up without increasing their geographic footprint. In addition, cloud computing improves employee mobility between institutions within the enterprise. Cloud technology reduces fixed IT costs for enterprises, and can technically replace their own IT devices, facilitating start-ups to grow (DeStefano, Kneller & Timmis 2020). From the perspective of the strategic choice of Russian enterprises, Lezina et al. diagnosed the digital maturity preparation model of system management, company structure, business process, data management and personnel preparation through the form of questionnaires. The model created by the authors is universal and targeted at all kinds of enterprises (Lezina, *et al,* 2019). Yezhebay et al. used the SWOT analysis method to define the characteristics of advantages and disadvantages for SMEs in Kazakhstan, and developed the digital maturity model for SMEs in Kazakhstan. The model consists of six dimensions that are strategy, leadership, personnel, product, operations and technology, and the corresponding 15 sub-dimensions (Yezhebay, *et al,* 2021).

In the literature, the maturity models for SME digitalization are mostly based on the Industry 4.0 model. The most maturity models did not consider the specific requirements and challenges of SMEs and cannot reflect the actual status of digital technologies in SMEs (Mittal, *et al,* 2018). As such, SMEs are unable to use those maturity models to assess their digital technology level. Thus, it is significant to create an appropriate maturity assessment framework for SMEs to assess their maturity level for implementing digital technologies and make a right

decision while embarking on the digitalization journey.

In this paper, through defining a set of digital technology indices, a maturity assessment reference framework is proposed for SMEs to assess their maturity level for implementing digital technologies. By applying maturity assessment reference framework, SMEs are able to understand their current status of digital technology implementation and clear about how to move forward on the digital transformation journey so that their labor productivity and economic profitability can be further improved and their businesses can be more competitive in the digital economy.

3 MATURITY ASSESSEMNT REFERENCE FRAMEWORK

The research indicates that mobile technology, social media, cloud computing and data security are the first digital technologies that SMEs consider to adopt (DELL, 2021). During the outbreak of COVID-19 in China at the beginning of 2020, the Internet of Things (IoT) and Artificial Intelligent (AI) technologies are more conducive to production recovery. The research data shows that SMEs using high-level digital technologies can mobilize internal and external resources faster to promote production recovery and digital response (Renmin University of China, 2020).

Mobile Technology is the technology that goes where the user goes. It consists of portable two-way communications devices, computing devices and the networking technology that connects them. Mobile Technology is typified by internet-enabled devices like smartphones, tablets and watches. The adoption of Mobile Technology by SMEs can improve the efficiency of mobile and collaborative working. Leveraging various forms of social media can improve product promotion, outreach and conversion, and facilitate SME business model optimization within the constraints of a company's size and financial status. Through mobile applications or by providing a digital workplace, employees can perform decentralized online tasks (crowd work) (Wood, *et al,* 2019).

Cloud Computing Technology gives users access to storage, files, software, and servers through their internet-connected devices: computers, smartphones, tablets, and wearables. Cloud computing providers store and process data in a location that's separate from end users. Cloud Computing is the ability to store and access data and programs over the internet instead of on a hard drive. This means businesses of any size can harness powerful software and IT infrastructure to become bigger, leaner, and more agile, as well as compete with much larger companies. Regardless of the size of the business, cloud computing is a major technological priority. For SMEs in particular, it is the basis for future changes in the form of work and the reshaping of business processes (CISCO, 2020). The emergence of the epidemic has accelerated the development of cloud services such as telecommuting and videoconferencing. Cloud technologies allow workers to connect from everywhere at any time, login their organization's information system, access shared documents, and exchange information about their work in an easy way. Employees become more and better informed that promote workers' discretion, autonomy and empowerment, usually entail lower direct supervision and control over employees. In return, workers are required to interact, communicate, and cooperate more (Wood, *et al,* 2019).

Internet of Things (IoT) is the network of physical objects "things" that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. The potential economic value that the Internet of Things can release is huge. The greatest potential for value creation in the factory setting will be optimizing operations in manufacturing—making the various day-to-day management of assets and people more efficient. Internet of things facilitates several advantages in day-to-day life in the business sector. For example, as devices of IoT interact and communicate with each other and do a lot of tasks, then they minimize human effort (Behura, *et al,* 2022).

Artificial Intelligence (AI) is a wide-ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence. AI is used for enterprises to drive modern decisions. Advanced AI technologies such as machine learning, deep learning, computer vision, and natural language processing while basic technologies include data management, digital assistants, and robotic process automation (ThoughtLab, 2020).

With four digital technologies Mobile, Cloud Computing, IoT and AI, the maturity assessment reference framework is proposed in Table 1. For each technology, there are three levels and six grades to describe its maturity. For each grade at every level, a set of reference indices are defined in each grade to assess the technology maturity and determine the corresponding maturity point. For example, there are

four reference indices defined for Mobile Technology in Grade 1, and two reference indices are defined in Grade 2. Grade 1 is the lowest grade where the company is in a very preliminary state for implementing the respective technology. Grade 6 is the highest grade where the company is fully mature in terms of implementing the respective technology. The four digital technologies are presented in the order of advance in the reference framework. Mobile is the primary digital technology and AI is the advanced digital technology.

Table 1. Reference framework for implementing digital technology maturity assessments in SMEs

Digital Tochnoligies		Mobile	Cloud Computing	IoT	AI
Level 1	Grade 1	• Internet/wireless connection • Paperless documents • Networked computers/machines • Product Platform (Social media)	• Data storage in the cloud • Files shared in the cloud	• Single node/device • Low cost and low complexity	• Developing plans for AI
	Grade 2	• Product Platform (Website) • Product digital specifications	• Public cloud • Community cloud	• Single node/device • Low volume • Local data	• Building internal support for AI (working closely with business teams to identify use cases) • Simple rule based decision
Level 2	Grade 3	• CRM • Order management System • Public cloud environment • Mobile workplace	• Community cloud	• Single node/device • Big volume of data • Intensive computng	• Machine learning • Computer vision
	Grade 4	• ERP • Financial management system • Hybrid cloud environment • Collaborative office	• Expanding on the cloud • Data cybersecurity	• Multiple end nodes/devices • Big volume of data • Intensive computng • Multiple Local data • Local analysis	• Bring in a richer set of data to drives higher AI performance (psychographic, geospatial and real-time) • ML based decision
Level 3	Grade 5	• Multi-screen office • Product branding and Digital marketing • Digital business process	• Hybrid cloud • Data cybersecurity • IaaS	• Multiple end nodes/devices • Coordinator node/device • Multiple Infinite sensing network	• Natural language processing • Deep learning • Using AI for parts of business
	Grade 6	• 5G connection • Secure cloud environment	• Cloud Optimisation • Services Secure cloud • SaaS • PaaS	• Multiple independent end nodes/devices • Visualized applications	• Widely using AI to generate to transform business • Training and hiring people

4 CASE STUDIES

In this section, we use the maturity assessment reference framework proposed in Section III to assess the maturity for implementing the digital technologies in two case study companies, Company A and Company B. Company A is a manufacturing company which produces dried fruits, bread, sea-buckthorn juice and other foods with 30 employees including 10 administrative personnel and 20 workshop workers. Since the pandemic in 2020, the company has used various social media such as WeChat, Mini Programs, Douyin to sell its products. The sales of sea buckthorn juice is now number one in China on the Douyin platform. Company B is a new media company whose main business is video shooting, promoting and branding through new media. It also helps other companies to advertise their products in the new media space and develop their live streaming businesses. The company currently has 6 people.

According to the maturity assessment reference framework proposed in Section III, by interviewing the technical heads of the two companies, we obtained the points in Table II, where 1 represents all the indices defined in the corresponding grade are met, 2/3 represents two of three indices are met, and 0 represents none of indices are met. The maturity score S is calculated by (1).

$$S = \sum_{i=1}^{6} w_i p_i \quad (1)$$

where $w_i = \frac{i}{21}$ is the weight assigned to Grade i, and p_i is the point obtained in the corresponding grade for the respective technology, $i = 1, 2, \ldots, 6$.

Table 2. Assessment Results.

	Level 1		Level 2		Level 3		Maturity Score
Mobile	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	
A	1	1/2	1	3/4	2/3	1/2	**0.68**
B	1	1/2	1/4	0	1/3	1/2	**0.35**
Cloud Computing							
A	1	1/2	0	1/2	0	0	**0.19**
B	2	1/2	1/2	0	0	0	**0.17**

Based on the maturity scores in Table 2, we are able to know which digital technology the company has been implementing at which maturity level. From Table 2, in Company A, Mobile and Cloud Computing technologies have been implemented with maturity levels 0.68 (i.e., 68%) and 0.19 (i.e., 19%), respectively. In Company B, and Cloud Computing technologies have been implemented with maturity levels 0.35 (i.e., 35%) and 0.17 (i.e., 17%), respectively. From our interviews with these two companies, Company A indicated that IoT technology has been considered but not yet implemented, and AI technology is not very relevant for its business. Company B does not consider to implement IoT and AI technologies at this moment. We noted a lack of understanding of IoT and AI in both companies, which led to missing strategic considerations. This may be also due to the current scale of their businesses. Although these two companies in our case studies are not involved in IoT and AI technologies, it's valid for us to keep these two technologies in the reference framework. Those companies with larger sizes or more advanced development may engage in IoT and AI, where the reference framework will be applicable.

For SMEs under great pressure to survive, from the perspective of saving operational costs, we recommend to share technologies, data, human resources, marketing channels, infrastructure and other resources by using a shared platform.

5 CONCLUSIONS

The use of digital technologies has become a critical turning point for all businesses. SMEs have not fully embraced digital technologies due to their constraints on survival, costs and sizes. This paper created the maturity assessment reference framework for SMEs to assess the maturity level of digital technology implementation. By conducting the case studies for the two companies, the proposed reference framework is applied to provide an opportunity for the companies to understand their current states of digital technology adoption and subsequent development. In the near future, we shall be conducting more case studies for companies from various industries and apply the proposed maturity assessment reference framework to assess their maturity of digital technology implementation and provide them decision support for their embarking on the digital transformation journey so as to further improve their labor productivity and economic profitability and maintain their competitiveness in the digital economy.

ACKNOWLEDGMENT

The author would like to thank the two case study companies for their valuable information and feedback.

REFERENCES

Behura A, Satpathy S, Mohanty S N, et al. (2022) Internet of Things: Basic Concepts and Decorum of Smart Services. In: Nandan Mohanty S., Chatterjee J.M., Satpathy S. (Eds), Internet of Things and Its Applications. Springer, Cham, Switzerland. pp. 3-36.

CAICT (2021). White Paper on the Global Digital Economy.http://www.caict.ac.cn/kxyj/qwfb/bps/20210 8/P020210913403798893557.pdf. Accessed 20 Dec 2021

CISCO (2020). Asia Pacific SME Digital Maturity Report. https://www.cisco.com/c/dam/global/zh_cn/solutions/ small-business/digitalmaturity/cisco-smb-digital-maturity-ebook.pdf. Accessed 23 Dec 2021

DELL (2021). White Paper of the Digital Initialization Index in SMEs. https://i.dell.com/sites/csdocuments/App-Merchandizing_Documents/zh/cn/DELLDigitalization WP%202.0_Lite.pdf?ref=cptl_white-paper2tiles1rows1_cta_primary_. Accessed 23 Dec 2021

DeStefano T., Kneller R. & Timmis J. (2020). Cloud computing and firm growth. J. Munich Society for the Promotion of Economic Research, CESifo Working Paper No. 8306

Greenan N. & Napolitano S. (2021). Why Do Employees Participe in Innovation? Skills and Organisational Design Issues and the Ongoing Technological Transformation. J. halshs-03270141v

Lezina T., Stoianova O, Ivanova V, et al. (2019). Assessment the company's readiness for digital transformation: Clarifying the issue. In: International Conference on Digital Economy. Beirut. pp. 3-14.

Mittal S, Khan M A, Romero D, et al. (2018). A critical review of smart manufacturing & Industry 4.0 maturity models: Implications for small and medium-sized

enterprises (SMEs). J. Journal of manufacturing systems, 49: 194-214.
OECD (2019). Measuring the Digital Transformation: A Roadmap for the Future. OECD Publishing, Paris.
OECD (2021). OECD SME and Entrepreneurship Outlook 2021. OECD Publishing, Paris.
Renmin University of China. (2020) COVID-19 and Digital Transformation of Chinese Small and Medium Enterprises.https://www.rmbs.ruc.edu.cn/uploadfile/ed/upload/file/20200311/1583923008453554.pdf.Accessed 25 Dec 2021
The State Information Center. (2018). A profound impact of the digital economy on social and economic development.http://www.sic.gov.cn/News/611/9743.htm. Accessed 22 Dec 2021
ThoughtLab. (2020). AI: From Data to ROI. https://thoughtlabgroup.com/ wp-content/ uploads/ 2020/09/ai-from-data-to-roi-codex5984.pdf. Accessed 21 Dec 2021
Vial, G. (2019). Understanding digital transformation: A review and a research agenda. J. The journal of strategic information systems, 28(2): 118-144.
Wood, A. J., Graham M, Lehdonvirta V, et al. (2019). Good gig, bad gig: autonomy and algorithmic control in the global gig economy. J. Work, Employment and Society, 33(1): 56-75.
Yezhebay A, Sengirova V, Igali D, et al. (2021). Digital Maturity and Readiness Model for Kazakhstan SMEs. In *International Conference on Smart Information Systems and Technologies*. Nur-Sultan.
Zhu X., Ge S. & Wang N. (2021). Digital transformation: A systematic literature review. J. Computers & Industrial Engineering, 162, 107774.