Transactions on Engineering and Computing Sciences - Vol. 11, No. 2
Publication Date: April 25, 2023
DOI:10.14738/tecs.112.14218.
Babiker, A. E., & Elfaki, A. O. (2023). Investigating the Banking Digital Transformation Readiness. Transactions on Engineering and Computing Sciences, 11(2). 30-41.

SERVICES FOR SCIENCE AND EDUCATION

Investigating the Banking Digital Transformation Readiness

Ammar Elyas Babiker
Electronic Systems Software Engineering Department. Faculty of Engineering.
University of Science and Technology. Sudan.

Abdelrahman Osman Elfaki
Faculty of Computers and Information Technology. University of Tabuk, KSA.

Abstract

Banks and financial institutions in Sudan after ban lift are under increasing pressure to digitize services and operations so as to reduce digital gabs with its peer's institutions worldwide, and be ready for competency in the digital economy. Challenges with disruptive concepts such as IoT, physical systems, cloud computing, big data, artificial intelligence which are called Industry 4.0 with its business counterpart digital transformation face all banks in Sudan. Most banks and institutions are not ready for this digital transformation as they do not have the capabilities or digital literacy needed for digital transformation. In this paper due to the lack in such research work and the specificity of Sudan case which need specific criteria in assessing digital transformation readiness, we have proposed, implemented and testes a novel framework for assessing digital transformation readiness for banks and financial institutes in Sudan. This framework aims to assist banks and financial institutions by providing comprehensive guidance to assess their current situation and how to achieve higher digital transformation in order to maximize the benefits from digital technologies.

Keywords: Information Systems; Digital Transformation; Readiness Measurement

INTRODUCTION

Digital transformation affects all areas in company organization and management as well as the internal and external environment [1]. It is expected to have a significant impact on supply chains, business models and processes [2]. As stated in [3], fundamental changes, which are likely to be enabled by digital transformation, are as follows: Meeting personalized customer requests, flexibility, optimized decision-making, resource productivity and efficiency, creating value opportunities through new services, responding to demographic change in the workplace, and improved work-life-balance.

The benefits of digital transformation can be significant [4]. Deloitte found that 71% of digitally maturing companies say they are able to attract new talent based on their use of digital technologies [5, 6]. As well, organizations with a greater adoption of digital transformation (i.e. greater digital maturity) are seeing significantly better financial performance than similar organizations within their industry with a smaller digital footprint [5, 6].

Digital transformation is a journey companies should take towards a complete value chain transformation. At the end, successful companies will become true digital enterprises. These

digital enterprises should work together with customers and suppliers in industrial digital ecosystems [7]. One of the main challenge companies are now facing is to define their transformation roadmap. [8] Identifies five main steps for addressing the strategic planning process: status quo analysis, strategic options generation, options assessment and evaluation, articulation of a strategic roadmap, and development of strategy. More specifically for digitalization, as stated in [9], companies should undertake a comprehensive digital readiness assessment in order to have a transparent view on their current level of digital readiness. It also serves as a guidance for executives, business developers, project managers and others who work and collaborate in digital transformation journey.

Identifying and discussing research gap and shortcoming regarding already existing digital assessment models, our main research question is "How can the process of digital transformation readiness assessment be scientifically depicted and ascertained in case of the banks and financial institutions in Sudan?. Taking into account that assessment models are usually generated and tested by qualitative approaches and do furthermore contain input from experienced practitioners [10], we partially relied on an online questionnaire uploaded in specialized social banking and financial institutions groups in addition to an in-depth interview with key executives in banks as the core method of data collection.

In this paper we will describe the results of a recent research effort where we developed a readiness assessment model and a related tool to systematically assess banks and financial institutions state-of-development in relation to the digital transformation vision. Our assessment model serves both a scientific and a practical purpose. The scientific purpose aims at gaining solid data about the current state of banks and financial institutions and their digital transformation strategies to extract potential success factors. The practical purpose of this work aims at enabling banks and financial institutions to rigorously evaluate their own digital transformation readiness and give comprehensive guidance and introducing a road map for their digital transformation journey.

The paper is structured as follows: Part two gives a deep discussion of related work concerning industry 4.0, digital transformation, digital transformation readiness assessment models, digital technology in Sudanese banks and financial institutions, the effects of economic ban on sudanese banks and financial institutions and their digital transformation readiness after ban lift. The third part specifies the methodological background with regard to research design and data collection. Part four starts with a description of the process regarding the construction of the underlying digital transformation readiness assessment model and subsequently introduces the model itself. Finally, the fifth part discusses the results and limitations of our paper and identifies possible implications for further research.

RELATED WORKS

Digital technology is the current industry revolutions and its effect on business; digital transformation is one of the hot issues in business today. According to [11], 85% of organizations have plans to adopt a digital-first business strategy within the next two years with the aim to significantly transform their business, or risk falling too far behind their competitors.

Digital transformation readiness assessment models are generally originated either from academic research works or industry consulting firms. Most of those models are divided into main dimensions, each contains many items or concepts, and the readiness is usually classified in levels. [12] Identified six major dimensions or features which are: Data Storage and Compute, Service-oriented Architecture, Information Integration, Digital Twin, Advanced Analytics, and Real-time Capabilities. They divide the organizations into six levels or layers according to the assessment. Those layers start from layer zero where there is no IT integration up to layer five for self-optimizing organizations. Digital REadiness Assessment MaturitY model (DREAMY) is a model developed by [13]. In this model digital readiness is divided into four dimensions which are process, monitoring and control, technology, and organizations. Each dimension covers one or more of the five main areas identified as: 1) Design and Engineering; 2) Production Management; 3) Quality Management; 4) Maintenance Management; 5) Logistics Management. The organization readiness level is classified into five groups as initial, managed, defined, integrated and interoperable, and digital oriented. Existing literature reviews indicate that the number of available models has increased sharply in recent years [14]. At the same time, it is found that the number of model applications does not keep up with the pace of development. Against the background of the current digitization trend, the work in [14] empirically investigates which models are actually used in business practice. They found that the degree of application is very low. Moreover, they also examined user-related model requirements, reasons for employing readiness models, and the purpose of using readiness models, which can support the user-centered development of future readiness models.

As digital transformation is practical driven and not only scientific works, many models from industrial consultancy firms were developed. Table 1. summarizes some readiness models developed in the research field and table 2. summarizes some models developed by some famous consultancy firms in the industry

Table 1 Scientific digital transformation readiness models

Model/ Framework name	Author/ Publisher	Approach
Digital REadiness Assessment MaturitY	Anna De Carolis etl/ IFIP International Conference on Advances in Production Management Systems [13]	Process, Monitoring and Control, Technology and Organization
Maturity Model for Data-Driven Manufacturing (M2DDM)	Christian Webera etl/ The 50th CIRP Conference on Manufacturing Systems M2DDM 2017 [12]	Data Storage and Compute, Service-oriented Architecture, Information Integration, Digital Twin, Advanced Analytics, and Real-time Capabilities.
Digital Transformation Readiness Assessment (DTRA)	Stoianova O.V., etl/ St Petersburg University Journal of Economic Studies [16]	Management system, Business processes, Human resources, Technologies
Digital Acceleration Index	BCG [26]	Business Strategy Driven by Digital, Digitize the Core, New Digital Growth, Enabler

[15] Developed a scientific maturity model concerning the digital transformation of companies within the manufacturing industry's supply chain. It addresses fundamental components, complementary innovations and relevant terminologies in digital transformation, like smart products, Cyber-Physical Systems (CPS) and Big Data Analytics. This work focuses on supply chain for manufacturing industries. [13] Build a maturity assessment method to measure the digital readiness of manufacturing firms. Different dimensions are used to assess 5 areas in which manufacturing key processes can be grouped: design and engineering, production management, quality management, maintenance management and logistics management. They ranked firms from low to high based on maturity level.

Big data is a hot issue and main driver in digital transformation. [12] Proposed and defined maturity levels for data-driven manufacturing to guide companies in the adaption process of Industry 4.0 and digital transformation, as well as criteria for meeting these levels.

The work in [16] explores a combination of factors (prerequisites) that determine the readiness of Russian companies for digital transformation. It formulates those prerequisites for the readiness assessment system in the form of a framework. A framework includes criteria and characteristics of readiness grouped into domains. It is intended for a qualitative evaluation of readiness and for understanding obstacles to success of the digital transformation.

Table 2 Consultancy firms digital transformation readiness models

Model/ Framework name	Firm/ Institution	Approach
Digital Maturity Model 4.0	Forrester [18]	Culture, Organization, Technology, Insight
Digital Business Aptitute	KPGM [19]	Vision and Strategy, Digital Talent, Digital First Processes, Sourcing and Infrastructure, Governance
Industry 4.0 Maturity Model	Schumacher [27]	Strategy,Leadership,Customer,Products,Operation,Culture, People, Governance, Technology
Digital Acceleration Index	BCG [26]	Business Strategy Driven by Digital, Digitize the Core, New Digital Growth, Enabler
Digital Government Readiness Assessment (DGRA)	World Bank [17]	Leadership & Governance, User-Centered Design, Public Administration and Change Management, Capabilities, Culture and Skills, Technology Infrastructure, Data Infrastructure, Strategies, and Governance, Cybersecurity, Privacy and Resilience, Legislation and Regulation, Digital Ecosystem

Digital Government Readiness Assessment ("DGRA") toolkit developed by World Bank [17], is a comprehensive diagnostic tool, aims to help governments at all levels in developing countries assess their readiness towards digital transformation. Through both qualitative and quantitative analyses, it identifies strengths and weaknesses of the current digital government status and proposes future-looking action plans to improve and/or develop a comprehensive national ICT strategy. The DGRA toolkit has been piloted in several countries (Myanmar, Vietnam, Lebanon, Kyrgyzstan, Uzbekistan, Senegal, etc.). It is comprised of a comprehensive set of 67 questions and delves into nine core foundations that build open and agile digital government's infrastructure and operations; Leadership & Governance, User-Centered Design, Public Administration and Change Management, Capabilities, Culture and Skills, Technology Infrastructure, Data Infrastructure, Strategies, and Governance, Cybersecurity, Privacy and Resilience, Legislation and Regulation, Digital Ecosystem.

Forrester Digital transformation readiness assessment model [18], is divided into four dimensions; Cultural, Organization, Technical, and Insight dimension. With digital readiness segmentations, start from skeptics, then adopters, collaborators, and ended with differentiators KPGM digital transformation model [19], measure digital business aptitude. It divides it into five domains which are: Vision and Strategy, Digital Talent, Digital Process, Sourcing and Infrastructure, Governance. Each domain is divided into many items. The readiness is categorized into five levels as: Nonexistent, Ad hoc, Defined, Repeatable, and optimized

The work in [6] Proposes a conceptual organizational readiness checklist for local government. It identified seven success factors for digital transformation as follows: Support from Senior Management, Senior Manager Assigned to Digital Transformation, Organizational Culture / Attitude Toward Change Management, Organizational Skills Assessment and Workforce Development, Strategic Planning and the Development of a Digital Strategy, Organizational Attitude Toward Use of Technologies, Commitment to Evaluation and Continuous Improvement. Based on those success factors check list from seven questions were designed.

The qualitative research in [20] generates global framework that shows the influencing factors of digital transformation in financial services using statements from domain experts. The work in [20] proves that the financial services sector is extremely affected by influences of political decisions. Political decisions have been defined as most important external factor that affect digital transformation. The work in [21] presents Disturbance Assessment Matrix (DAM) which shows the actions and behavior domains of people. Political factor is one of the DAM domains. The work in [21] shows positive impact of measuring digital transformation in banks using DAM. The last two papers are obviously demonstrated the significance and impact of political factors in digital transformation in bank sectors.

According to [22-24] The most influence factor behind the economic and financial crisis in Sudan is the American sanctions. Thus, in Sudan situation, considering American sanctions as the most important external political factor is a must. Due to Sudanese revolution in 2019, there

is speech on lifting the economic embargo and American sanctions. However, till now, there is no clear picture on this lifting.

DEVELOPMENT OF A DIGITAL TRANSFORMATION READINESS ASSESSMENT MODEL FOR BANKING AND FINANCIAL INSTITUTIONS

Even though digital transformation is a new subject in academic field. There is increasingly number of researches regarding factors for successful digital transformation and their readiness in many areas. However, assessing firms' readiness for digital transformation in some fields and environments is not sufficent or even not exist. This paper proposes a framework for assessing digital transformation in banking and financial institutions in Sudan. There are some factors for general success factors for digital transformation and some specific factors for the case of banking and financial institutions in Sudan. The framework tries to answer questions regarding both kind of factors, and be real and accurate assessment tools for this sector and similar ones in other countries. As maturity and readiness models share the common property of defining a number of dimensions or process areas at several discrete stages or levels of readiness [10, 15], similar factors in this framework are grouped into dimensions, and each dimension contains many items or concepts. This grouping try to make the framework as general as possible.

Framework Dimensions

It is clear that technology is not only the main factor in digital transformation readiness. Without clear vision, structured processes and defined organization structures, firms will not be able to exploit the opportunities these technologies offer. This consideration along with what is in literature regarding digital transformation and banking and financial processes and transactions; the analysis is based on seven main dimensions containing all the concepts and items related to digital transformation, and additional local factor. Those dimensions are: management and leadership, workforce development, processes and transactions, change management and regulations, technology infrastructure, data infrastructure, external political factors which characterized in the American sanctions.

Digital transformation will affect all functional areas of the organization, and transform existing business models and administrative structures. Strong leadership with clear vision and strategy is an important factor in successful digital transformation journey. Dimension one cover this in three main items: Leadership, vision and strategy. Regarding workforce development, [25] states that number one operational and cultural challenge that organizations face is finding, training and retaining the right talent. In this work, we divide this dimension into three items to assess and to find the gap to be filled by firms; digital talent development, acquisition, and optimization. For processes and transactions, we grouped firms' readiness into four items. Processes and transaction standardization, processes and transaction integration, automation of processes and transactions, and control of processes and transactions. Change management and regulations are classified into: culture and resistance, strategies to grow new culture, organization aligned with change.

The seventh factor is external political factor which is the American sanctions, where the American technologies is forbidden to be used in Sudan. Table 3 shows the proposed framework dimension and sub-dimensions that have been adopted in this work.

Table 3: The proposed framework dimension and sub-dimensions

#	Dimensions	Sub-dimensions
1	Management and Leadership Domain	Leadership, vision, culture and strategy
2	Workforce Development Domain	Digital talent development, Acquisition, and Optimization
3	Processes and Transactions Domain	Experience, Development, and Measurement and Analytics Process
4	Governance Domain	Governance Body, and Privacy and Security Risk Management
5	Technology infrastructure Domain	Strategic Partner Relationship, Enterprise and Applications system, Mobile engagement, Cloud, and Industry Revolution 4.0
6	Data infrastructure Domain	Data Management Strategy, Big Data Analysis, and Legislation and Regulation
7	External political factors Domain (Economic Sanctions)	Digital Banking, Transactions- SWIFT BAN Payment and Credit Cards

Readiness Levels

Readiness level in this work is classified based on the gab to be filled. Gabs are based on the current status or level of the firms and the target level to be achieved. Table 4 shows how each sub-domain from our proposed model and its associated measuring factors (management and leadership domain as instance).

Table 4: sub-domain from our proposed model and its associated measuring factors

#	Sub-domain	Measuring Factors
1	Vision	No Vision regarding the role of digital technologies in business
		General vision but without specific goals
		General gools for the vision regarding the role of digital technologies in business
		Specific vision with gools regarding the role of digital technologies in business
2	**Strategy**	There is no digital strategy for addressing customer outreach opportunities
		There is a general strategy without specific gools
		There is a general strategy with general gools
		There is a general strategy with Specific gools
3	**Leadership**	Senior leaders do not appreciate the opportunities and threats
		Senior leaders do appreciate the opportunities
		Senior leaders do appreciate the threats
		Senior leaders do appreciate the opportunities and threats
4	**Culture**	The work environment is not depends on specific policies
		The work environment is open to sources of information
		The work environment is partially open to different sources of information and insights
		The work environment is completely open to different sources of information and insights

RESULTS AND DISCUSSION

In this section, the results have been presented, highlighted, and discussed. The survey has been digitally posted at https://forms.gle/Ky3aZGkMzfaDiETq9. Table 5 shows the results regarding management and leadership domain.

Table 5: Results regarding management and leadership domain

	Digital Vision	Strategy	Leadership	Culture
Mean	2.97	2.73	2.47	2.47
Std. Deviation	.999	.785	.681	.776
N	110	110	110	110

The tabulation above shows that 110 respondents answering questions regarding management and leadership domain. Table 6 shows the results regarding Workforce Development domain.

Table 6: Results regarding workforce development domain

	Digital Talent - Digital Talent Acquisition	Digital Talent - Digital Talent Development	Digital Talent - Skills Optimization and talent pools
Mean	2.27	1.97	1.93
N	110	110	110
Std. Deviation	.691	.556	.740

Table 7: Results regarding processes and transactions domain

	Process Domain - User Digital Experience Design Process	Process Domain - Digital Process Development	Process Domain - Digital Platforms Measurement and Analytics Process
Mean	2.13	2.73	2.70
N	110	110	110
Std. Deviation	.571	.785	.651

Table 8: Results regarding governance domain

	Governance Domain -Digital Transformation Governance Body	Governance Domain – Privacy and Security Risk Management
Mean	2.73	3.23
N	110	110
Std. Deviation	.907	.898

Table 9 shows the results regarding technology infrastructure domain.

Table 9: Results regarding technology infrastructure domain

	Technology Infrastructure - Strategic Partner Relationship	Technology Infrastructure – Enterprise and Applications system	Technology Infrastructure - Mobile and Mobile engagement	Technology Infrastructure – Cloud	Technology Infrastructure – Industry Revolution 4.0 (IR 4.0)
Mean	2.63	2.80	2.23	2.70	2.57
N	110	110	110	110	110
Std. Deviation	.718	.664	.679	.952	.774

Table 10 shows the results regarding data infrastructure domain.

Table 10: Results regarding data infrastructure domain

	Data Domain – Data Management Strategy	Data Domain – Big Data Analysis	Data Domain - Legislation and Regulation
Mean	2.37	2.47	2.30
N	110	110	110
Std. Deviation	.850	.776	.750

Table 11 shows the results regarding external political factors domain.

Table 11 shows the results regarding external political factors domain

	Economic Sanctions – Digital Banking	Economic Sanctions – Financial Transactions- SWIFT BAN	Economic Sanctions – Payment and Credit Cards (Visa and Master Card)
Mean	2.30	2.00	1.97
N	110	110	30
Std. Deviation	.794	.643	.669

Table 12 summarized the survey results regarding banking digital transformation readiness measurement domains.

Table 12 summarized the survey results

#	Total Means	Domain
1	**2.66**	Management and leadership domain
2	**2.06**	Workforce development domain
3	**2.52**	Processes and transactions domain
4	**2.98**	Governance domain
5	**2.59**	Technology infrastructure domain
6	**2.38**	Data infrastructure domain
7	**2.09**	External political factors domain

The results illustrate and show that the Sudanese banks readiness towards digital transformation is below the average. There are plenty of efforts to be made for preparing Sudanese banks for digital transformation. Our future work is developing a road map for enhancing banks readiness towards digital transformation.

Reference

[1] Khan S. (2016) Leadership in the Digital Age: a Study on the Effects of Digitalization on Top Management Leadership. Digitala Vetenskapliga Arkivet. September, 16. URL: https://su.diva-portal.org/smash/get/diva2: 971518/FULLTEXT02.pdf (accessed: 29.11.2019).

[2] The Economist Intelligence Unit: The Internet of Things Business Index: A Quiet Revolution Gathers Pace, (2013).

[3] Kagermann, H.; Wahlster. W; Held, J; Deutsche P.A. Recommendations for implementing the strategic initiative INDUSTRIE 4.0. Final Rep. Ind. 4.0 WG. 82 (2013).

[4] Provost, F., and Fawcett, T. 2013. Data science and its relationship to big data and data-drive decision making. Big Data 1 (1): 51-59.

[5] Gurumurthy, Ragu and Schatskey, David. 2019. Pivoting to digital maturity: seven capabilities central to digital transformation. In Deloitte Insights. Retrieved July 17, 2019 from https://www2.deloitte.com/content/ dam/insights/us/articles/4955_Pivoting-to-digital-maturity/DI_Pivoting-to-digital-maturity.pdf

[6] Morgan Calvert, Western University, "ASSESSING ORGANIZATIONAL READINESS FOR DIGITAL TRANSFORMATION — Developing a readiness checklist for municipalities' — January 2021

[7] P. GMIS, "Industry 4.0: Building the Digital Industrial Enterprise," 2016.

[8] Capgemini Consulting, "Digitizing Manufacturing : Ready , Set , Go !," 2014.

[9] T. De Bruin, R. Freeze, U. Kaulkarni, and M. Rosemann, "Understanding the Main Phases of Developing a Maturity Assessment Model," in Australasian Conference on Information Systems (ACIS), 2005, pp. 8–19

[10] Fraser, P., Moultrie, J. and Gregory, M., "The use of maturity models / grids as a tool assessing product development capability", 2002 IEEE International Engineering Management Conference, Cambridge, 2002, pp. 244-249

[11] Morgan, B. May 13, 2019. "40 Stats on Digital Transformation and Customer Experience." F o r b e s . c o m . Retrieved July 24, 2019, from https://www.forbes.com/sites/blakemorgan/2019/05/13/40-stats-ondigital- transformation-and-customer-experience/#666d100a6475

[12] Christian Webera,∗, Jan Konigsberger ¨ a , Laura Kassnera , Bernhard Mitschanga " A Maturity Model for Data-Driven Manufacturing " , The 50th CIRP Conference on Manufacturing Systems M2DDM 2017, Available online at www.sciencedirect.com 2212-8271 © 2017 The Authors. Procedia CIRP 63 (2017) 173 – 178

[13] Anna De Carolis1 , Marco Macchi1 , Elisa Negri1 and Sergio Terzi1, "A maturity model for assessing the digital readiness of manufacturing companies", August 2017, : https://www.researchgate.net/publication/319377653

[14] Vanessa Felch, Björn Asdecker, Eric Sucky, "Maturity Models in the Age of Industry 4.0 – Do the Available Models Correspond to the Needs of Business Practice?", Proceedings of the 52nd Hawaii International Conference on System Sciences | 2019

[15] Christoph Klötzer, Alexander Pflaum, "Toward the Development of a Maturity Model for Digitalization within the Manufacturing Industry's Supply Chain", Proceedings of the 50th Hawaii International Conference on System Sciences | 2017

[16] Stoianova O.V., Lezina T.A., Ivanova V.V. (2020). "The framework for assessing company's digital transformation readiness". St Petersburg University Journal of Economic Studies, vol. 36, iss. 2, pp. 243–265. https://doi.org/10.21638/spbu05.2020.204

[17] Digital Government Readiness Assessment ("DGRA") toolkit developed by World Bank

[18] Forrester Digital transformation readiness assessment model

[19] KPGM digital transformation model

[20] Werth, O., Schwarzbach, C., Cardona, D. R., Breitner, M. H., & von der Schulenburg, J. M. G. (2020). Influencing factors for the digital transformation in the financial services sector. *Zeitschrift für die gesamte Versicherungswissenschaft*, *109*(2), 155-179.

[21] Mărăcine, V., Voican, O., & Scarlat, E. (2020). The digital transformation and disruption in business models of the banks under the impact of FinTech and BigTech. In Proceedings of the International Conference on Business Excellence (Vol. 14, No. 1, pp. 294-305).

[22] Malik, M., & Malik, M. (2015). The Efficacy of United States Sanctions on the Republic of Sudan. Journal of Georgetown University-Qatar Middle Eastern Studies Student Association, 2015(1), 7.

[23] De Ruyt, J. (2019). American sanctions and European sovereignty. Egmont European Policy Brief No. 54.

[24] Ibrahim, A. H., & SI, D. M. M. (2020). The Major Factors behind the Economic and Financial Crisis in Sudan.

[25] Palmer, Doug. June 5, 2018. "Coming of age digitally: Learning and leading in new ways." Deloitte Digital.

[26] Digital Acceleration Index. BCG (2016). https://www.bcg.com/ru-ru/capabilities/technology-digital/digital-acceleration-index.aspx19.

[27] Schumacher, A., Erol, S., Sihn, W.: A maturity model for assessing industry 4.0 readinessand maturity of manufacturing enterprises. Procedia CIRP 52, 161–166 (2016). https://doi.org/10.1016/j.procir.2016.07.04020.