


Tining Haryanti

A Comparative Analysis Review of Digital Transformation Stage in Developing Countries

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A Comparative Analysis Review of Digital Transformation Stage in Developing Countries

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Abstract:

Purpose: Digital Transformation (DX) is a phenomenon that must be addressed properly so that its benefits can be optimized. Slow adaptation to DT leads to the destruction of the industry and threatens its sustainability. This article reveals significant insights in describing the trend of DX stages, especially in developing countries.

Design/methodology/approach: Based on a comparative analysis of research related to DX in developing countries in reputable journals, more than 900 articles that reviewed DX. By conducting a strict and thorough screening of DX stages in developing countries, especially on the topic of Information Systems, 60 relevant articles were obtained.

Findings: DX barriers in phase 1 comprise the fact that access and infrastructure are starting to be bridged, but not completely. DX barriers in developed countries have shifted predominantly from stage 1 to stage 2. More than 80 of the revealed indicators contribute to the success of DX in developing countries. In addition, this article also discusses various future research opportunities and essential indicators that intersect in stages 1, 2, and 3.

Originality/value: DX barriers in developed countries have shifted predominantly from stage 1 to stage 2. More than 80 of the revealed indicators contribute to the success of DX in developing countries.

Keywords: digital transformation, stage, developing countries, digital barrier, digital indicator

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1. Introduction

Although Digital Transformation has been introduced for quite a long time since the dawn of the 3rd industrial revolution, it is evident that digital transformation cannot be carried out concurrently throughout the world (van Dijk, 2020). There are differences in DX stages that occur in various countries. Those differences can be observed in developed and developing countries. Current discussions on DX in developing countries focus on digital skills

(Dobrolyubova, Alexandrov & Yefremov, 2017; van Deursen & van Dijk, 2019). Although access and infrastructure constraints have not been completely addressed, revolutions taking place in many countries in the wake of the industrial revolution 4.0 are suspected of contributing to bridging access problems (van Dijk, 2005). Digital Transformation continues to evolve, various academic literature and practitioners discuss aspects of DT with the dominance of DT discussions in developed countries. Meanwhile, digital transformation in developing countries faces complex problems that cannot be generalized with developed countries. To fill the research gap, this study proposes an in-depth discussion of DT trends, especially in developing countries. This research adds to the contribution of the literature on DX in general, and specifically for developing countries. In practical terms, this research adds a reference for management in determining the right strategy based on the development trends of DT specifically faced by developing countries. To respond optimally to the development of DX, identification of factors at each stage of DX is needed. Data collection in this study was carried out based on the classification of DX topics in developing countries. To maintain the quality of research results, the data sources selected were reputable journals indexed by Scopus. There were over 900 selected articles. The next step of data selection was selecting sources in the form of journals, eliminating sources in the form of book and conference, narrowing down the data to 186 articles. The data sources should focus on the topic of Information Systems. The next step was screening the title and abstract of the articles, further bringing down the number to 98 articles. Finally, after selecting and screening the full text of the articles, 60 relevant articles were obtained. This paper aims to identify the stages and key factors of DX in developing countries. In addition, it intends to contribute to overcoming or bridging DX problems through the implementation of appropriate strategies for the success of DX. This paper seeks to answer two main research questions, namely: finding out how is the trend of DX stages in developing countries and identifying the main factors at each stage of DX in developing countries. The paper is divided into three main parts. The initial chapter discusses the stages of DX. The next chapter discusses a comparative analysis of DX trends in developing countries through reputable journals until 2021. Furthermore, it reveals the DX factor identified through comparative studies. Finally, the brief conclusion section closes the article and presents various future research prospects.

2. Theoretical Context

Based on the stages, there are several terms about digital transformation, namely: Digitization, Digitalization, Digital transformation (Bumann & Peter, 2019; Reis, Amorim, Melão, Cohen & Rodrigues, 2020; Verhoef et al., 2021). Digitization is the conversion from analog to digital (Bumann & Peter, 2019), or the encoding of analog information into a digital format (that is, into zeros and ones) so that computers can store, process, and transmit that information. Digitalization describes how the use of digital technology and its impact in transforming existing business processes (Li, Nucciarelli, Roden & Graham, 2016; Verhoef et al., 2021). An example of digitalization is the creation of artefact as a means of online communication that allows customers to easily connect with companies, or to transform customer interactions that were previously carried out traditionally transformed into customer interactions using technology (Ramaswamy & Ozcan, 2016; Verhoef et al., 2021). Meanwhile, digital transformation illustrates company-wide changes leading to the development of new business models (Pagani & Pardo, 2017). This change involves the use of computer technology and the internet for a more efficient and effective process of economic value creation (Reddy & Reinartz, 2017). Digital Transformation is the main focus of this research. The success of digital transformation is related to the bridged digital barriers that exist. The digital divide is becoming a phenomenon that covers various aspects. The ever-changing digital problems have resulted in a dynamic digital divide. For a large number of people, lack of access becomes the main problem for connecting to technology, especially the Internet. Nevertheless, access to digital media or computer ownership starts from motivation and a positive attitude towards using it. Internet penetration is increasing rapidly and significantly reducing the gap between those who access it and those who fall behind in the digital world (Calderón-Gómez, 2021; Ragnedda & Kreitem, 2018). Although they have been reduced, access gaps persist, and inequalities in accessing the Internet can be observed both between countries (the global digital divide) and within countries (social digital divides between regions in those countries). Internet penetration is a part of broader digital inequality. Thus, it cannot reduce the multidimensionality of the digital divide (Ragnedda, 2018; Ragnedda & Muschert, 2017). For example, Indonesia has the highest internet penetration among developing countries in Southeast Asia (Das, Gryseels, Sudhir & Tan, 2016; Nikkei Asian Review, 2018; Tjiptono, Arli & Viviea, 2016). Nevertheless, Indonesia

still has a low rating on the DX readiness index (Dutta & Lanvin, 2021). From time to time, the use of internet access has increased. The internet access of developed countries reaches around 70% to 98%, while the average internet access in developing countries is 40% (van Dijk, 2020). This access problem is generally categorized as the first stage of DX problem. Previous research has revealed that digital literacy or skills and usage are more important in the digital divide (Correa, 2016; Ragnedda, 2017). This divide is known as the second stage digital divide. The issue of DX divide further develops to the benefits of the Internet usage. In this case, not only the positive impacts are observed, but also the negative impacts such as cybercrime, illegal hacking, hate speech, disinformation on social media, smartphones, or the internet, and addiction to games (Calderón-Gómez, 2021; Ragnedda & Kreitem, 2018). The benefits of DX is known as the third stage digital divide. In summary, the definition of the stages of the DX issue is presented in Table 1.

DX Stages	Definition	References
First Stage	The use of internet access and infrastructure distribution	(van Dijk, 2005, 2020; Newhagen & Bucy, 2003; Ragnedda & Kreitem, 2018; Ragnedda & Muschert, 2017)
Second Stage	Technological proficiency	(Dobrolyubova et al., 2017; van Deursen & van Dijk, 2019)
Third Stage	The use of technology to improve the quality of life	(Ragnedda & Kreitem, 2018; van Dijk, 2005)

Table 1. Digital Transformation Stages

3. Methods

3.1. Data Sources and Search Strategy

The stages of this study are presented in Figure 1.

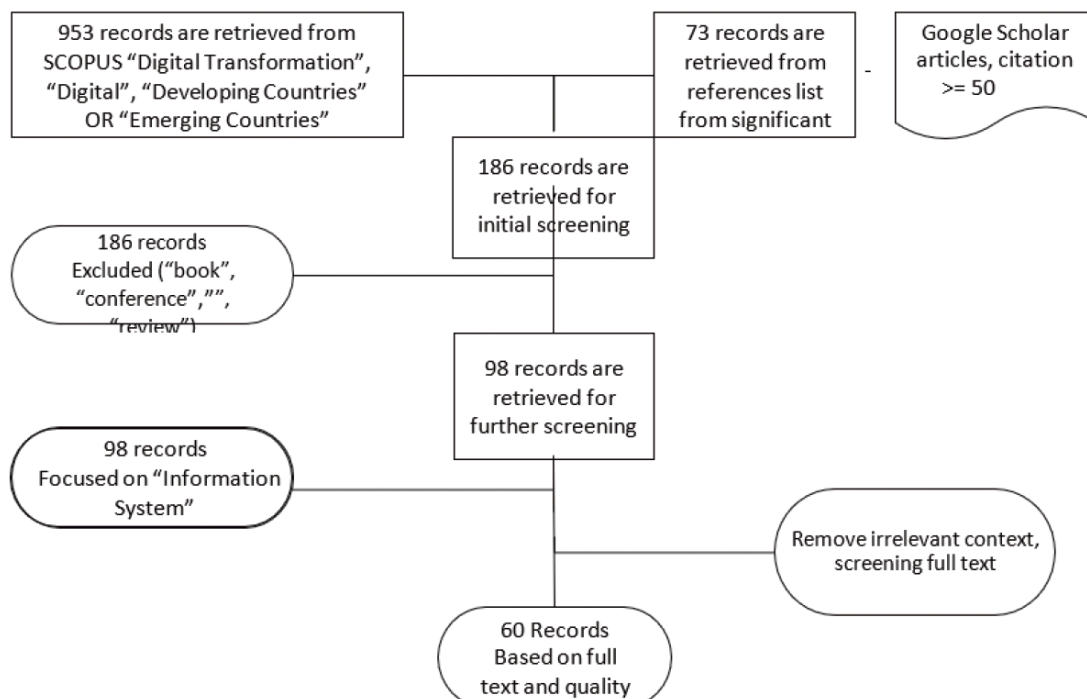


Figure 1. Stages of Research

The first stage of this study is to search for massive and thorough references about Digital Transformation. Second, focus the search results on the Information Systems field. Third, this study applies a strategy of presenting materials that represent most of the work on Digital Transformation. In this study, the source data

were taken from a reputable journal of Scopus. The selection of the scopus database is because for citation analysis, Scopus offers about 20% coverage (Falagas, Pitsouni, Malietzis & Pappas, 2008) more than other databases such as Web of Science and Google Scholar. In addition, Scopus covers a wider range of journals, which helps both in keyword search and citation analysis (Falagas et al., 2008; Harzing & Alakangas, 2016). The keywords of Digital Transformation, Digital, Developing Countries, or Emerging Countries are applied as an initial screening for data search. As a result, 953 articles were obtained from Scopus and 73 articles with more than 50 citations of the predetermined keywords are obtained from Google Scholar. The specificity of the data on the type of journal articles without other sources such as conferences were carried out to obtain a comprehensive DX discussion. Therefore, a total of 186 articles were obtained. Furthermore, data selection based on the topic of Information Systems and screening titles and abstracts related to DX were conducted, resulting in 98 articles. To find in-depth discussions related to DX in developing countries, the next data selection was carried out by screening full-text articles so that 60 relevant articles were obtained. Furthermore, the selected article is used as a source for the analysis of this paper.

3.2. Extracting Data

The data extraction process in this study is based on the research question, including how the trend of the DX stages is and what the main factors at each DX stage in developing countries are. The various DX factors identified from the article in the previous stage (chapter 3.1) are recorded and presented in Table 2.

Digital transformation trend in developing countries	
Identified factor	References
Infrastructure, geographical location	(Raj, Dwivedi, Sharma, Lopes de Sousa-Jabbour & Rajak, 2020; Bakon, Elias & Abusamhadana, 2020; Aguilar-Rodriguez, Bernal-Torres, Aldana-Bernal, Acosta-Aguinaga, Artieda-Cajilema & Chalá, 2021; Anshari & Almunawar, 2021; Robards, Kang, Usherwood & Sanci, 2018; Hong, Zhou, Z., Fang, Y., & Shi, 2017; Idiegbeyan-Ose, Nkiko, Idahosa & Nwokocha, 2016; Igun, 2011; Minghetti & Buhalis, 2010; Chang, Kim, Wong & Park, 2015)
Investment on technology	(Raj et al., 2020; Chang et al., 2015; Aghimien, Aigbavboa, Oke, Thwala & Moripe, 2020; Breunig, Kelly, Mathis & Wee, 2016; Dalenogare, Benitez, Ayala & Frank, 2018)
Challenges in Value-chain Integration	(Raj et al., 2020; Narwane, Raut, Yadav, Cheikhrouhou, Narkhede & Priyadarshinee, 2021; Dalenogare et al., 2018; Majeed & Rupasinghe, 2017)
Access broadband (Internet)	(Bakon et al., 2020; Wang, Guo & Wu, 2021; Hong et al., 2017; Igun, 2011; James, 2005; Acilar, 2020; Ohemeng & Ofosu-Adarkwa, 2014)
Low Maturity Level of Preferred Technology	(Raj et al., 2020; Hong et al., 2017; Petrillo et al., 2018)
Awareness (motivation)	(Alenizi, 2020; James, 2003; Chang et al., 2015)
Language and Content focus	(James, 2005; James, 2004; Arunachalam, 1999)
Socio-economic(income, education, social class)	(van Dijk, 2005; Ragnedda, Ruiu & Addeo, 2020)
Cultural Barriers	(Ohemeng & Ofosu-Adarkwa, 2014; Dimaggio, Hargittai, Celeste & Shafer, 2004)
Capability/ Skill	(Gravili, Benvenuto, Avram & Viola, 2018; Raj et al., 2020; Andreev, Kazanin & Zayed, 2021; Inshakova, Frolova, Rusakova & Kovalev, 2020; Aghimien et al., 2020; Hai, Van & Tuyet, 2021; Narwane et al., 2021; Joshi & Sharma, 2021; Alekseev, Lobova & Bogoviz, 2021; Vagin, Lascencov, Konovalova & Frank, 2021; Kozuh, Maksimović & Zajić et al., 2021; Robards et al., 2018; James, 2007; Kozma, McGhee, Quellmalz & Zalles et al., 2004; Muhamad, Mohamad & Nor, 2021)
Motivation	(Pee, Kankanhalli & On Show, 2010; van Klyton, Tavera-Mesías & Castaño-Muñoz, 2020; Acilar, 2020; Chang et al., 2015; Vagin et al., 2021)

Digital transformation trend in developing countries	
Identified factor	References
Socio-Economic	(Ramazanov, Panasenko, Cheglov, Krasil'nikova & Nikishin, 2021; Wang et al., 2021; Joshi & Sharma, 2021; Gravili et al., 2018; Allen, Natarajan & Price, 2012; Minghetti & Buhalis, 2010; Calderón-Gomez, 2019; Ogbo, Brown, Gant & Sicker, 2020; Alenizi, 2020; Wilson & Wilson 2009; Alekseev et al., 2021; Finkelstein, Shapiro & Mandelman, 2021; Idiegbeyan-Ose et al., 2016)
Age	(Ogbo et al., 2020; Hong et al., 2017; Mubarak & Nycyk, 2017; Robards et al., 2018)
Gender	(Acilar, 2020; Ogbo et al., 2020; Singh, 2017; Tjiptono et al., 2016; James, 2007; Idiegbeyan-Ose et al., 2016; Allen et al., 2012; Alenizi, 2020)
Culture	(Raj et al., 2020; Hai et al., 2021; Aghimien et al., 2020; Bakon et al., 2020; Ramazanov et al., 2021; Aguilar-Rodriguez et al., 2021; Vagin et al., 2021; Gallab, Bouloiz, Kebe & Tkiouat, 2021; Singh, 2017; Mubarak & Nycyk, 2017; Idiegbeyan-Ose et al., 2016; Ohemeng & Ofosu-Adarkwa, 2014; Allen et al., 2012; James, 2007; Calderón-Gomez, 2021; Pianta, 2018; Hong et al., 2017; Minghetti & Buhalis, 2010; Lopes de Sousa-Jabbour, Jabbour, Godinho Filho & Roubaud, 2018)
Resource	(Raj et al., 2020; Andreev et al., 2021; Alenizi, 2020; Hai et al., 2021; Bag, Yadav, Dhamija & Kataria, 2021; Anshari & Almunawar, 2021; Muhamad et al., 2021; Joshi & Shanna, 2021)
Organization	(Raj et al., 2020; Aguilar-Rodriguez et al., 2021; Bag et al., 2021; Dalenogare et al., 2018; Aghimien et al., 2020; Vagin et al., 2021; Calderón-Gomez, 2021; Hai et al., 2021)
Regulation (government)	(Vagin et al., 2021; Raj et al., 2020; Mistry, 2005; Topornin, Pyatkina & Bokov, 2021; Effah & Nuhu, 2017; Ohemeng & Ofosu-Adarkwa, 2014; Vidyasagar, 2006; Anshari & Almunawar, 2021)
Intention to Use	(Calderón-Gomez, 2019; van Klyton et al., 2020; Dalenogare et al., 2018; Pee et al., 2010; Robards et al., 2018)
Partnership	(Aghimien et al., 2020; Allen et al., 2012; Bag et al., 2021; Narwane et al., 2021; Wilson & Wilson, 2009; Kozma et al., 2004)
Disruption Existing Job	(Raj et al., 2020; Finkelstein, Shapiro & Mandelman, 2021; Snowball, Delon-Tarentaal & Sapsed, 2021)
Communication	(Aghimien et al., 2020)
Navigation	(Robards et al., 2018)
Trust	(Aghimien et al., 2020; Joshi & Sharma, 2021; Alenizi, 2020)
Security	(Raj et al., 2020; Joshi & Sharma, 2021; Yudhiyati, Putritama & Rahmawati, 2021; Topornin et al., 2021; Aghimien et al., 2020)
Digital piracy	(Tjiptono et al., 2016; James, 2003)
Marginalization of Workers	(Casilli, 2017)
Flexibility of operations	(Aghimien et al., 2020)
Job efficiency	(Aghimien et al., 2020; Pianta, 2018)
Educational level	(Ogbo et al., 2020; Idiegbeyan-Ose et al., 2016; Allen et al., 2012; Snowball et al., 2021)
Internet use pattern	(Ogbo et al., 2020)
Innovations	(Inshakova et al., 2020; Snowball et al., 2021; Alekseev et al., 2021; Mistry, 2005)
Culture	(Bakon et al., 2020)

Digital transformation trend in developing countries	
Identified factor	References
Public Services	(Kumar & Kaur, 2021; van Klyton et al., 2020; Wulansari & Parwanto, 2020; Kassim, Bhattarai, Zamzuri & Othman, 2017; Ahmed & Akhlaq, 2015; Wang et al, 2021; Robards et al., 2018; Hong et al., 2017; Bakon et al., 2020; Acilar, 2020; Garad & Oarnari, 2021; Odat, 2012)

Table 2. DX Comparative Review of DX Stage based on the extraction of literature documents

4. Finding and Analyzing Data

There are nine factors identified in stage 1 of DX, including infrastructure, geographical location; Investment, Challenges in Value-chain Integration, Access, Low Maturity Level of Preferred, Technology, Awareness, Content focus, Cultural Barriers, and Motivation. The findings show that the dominance of the discussion of DX problems in stage 1, especially in developing countries, is infrastructure and geographical location that have a percentage of 29%, and access that has a percentage of 20%. However, other factors in general have a similar value. Cultural barriers in the findings explained how the cyber culture responds to the internet presence.

There are more than 15 factors related to DX problems in stage 2 problems that were identified in the literature review, namely Capability / Skill, Socio Economic, Age, gender, Culture, Resource, Organization, Regulation (government), Intention to Use, Partnership, Disruption Existing Job, Communication, Navigation, Trust, Security, Digital piracy, Marginalization of Workers. DX problem in stage 3 has not been widely discussed especially in developing countries. In this stage, seven factors identified, namely flexibility of operations, Job efficiency, Education level, Internet use pattern, Innovations, Culture, and Public Services.

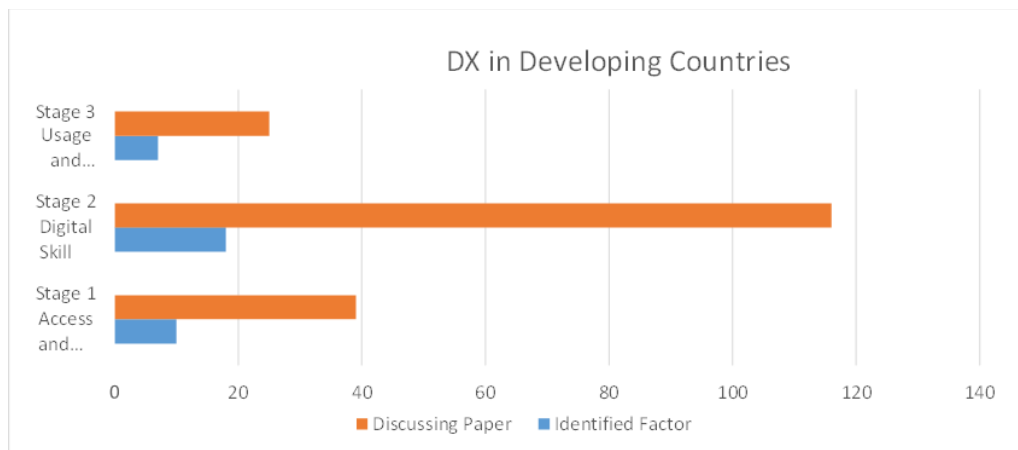


Figure 2. The comparison of DX Stages in developing countries

5. Discussions

Based on the analysis in the literature review, the discussion of the DX problem in stage 2 dominates. Physical problems make up 24% of the discussions. This shows that physical problems have not been completely resolved. In archipelagic and developing countries such as Indonesia, the fulfillment of infrastructure is an important problem due to limited physical access in reaching every corner (Indonesia.go.id, 2017). Furthermore, the economic-social complexities also contribute to digital divide. Income barriers have constrained the ability to invest in digital devices, resulting in the existence of digital divide (Raj et al., 2020). Moreover, broadband cost is not cheap (Bakon et al., 2020; Wang et al., 2021). This is further reinforced by the lack of motivation and awareness of the importance of technology (Alenizi, 2020). In general, low English proficiencies correlate with low technological skills among people in developing countries since most technologies use English as their main language (James, 2005). In cultural dimension, the order of social stratification classifies the acquisition of access to information, where the richer, the bigger the opportunity to obtain information (Ohemeng & Ofosu-Adarkwa, 2014; Dimaggio

et al., 2004). In its development, the emergence of new media has contributed to the exacerbation of knowledge gap between ‘rich in information’ and ‘poor in information’ (Hindman, 2000; Newhagen & Bucy, 2003; van Dijk & van Deursen, 2014). This phenomenon emphasizes the idea that socio-economic status affects the way of obtaining information and knowledge, resulting in a wider knowledge gap between high class and low class (Ragnedda & Muschert, 2017). Just as first phase of digital problems are influenced by socioeconomics, digital expertise problems are also influenced by the same factors. In the absence of material adequacy, especially adequate income, skill improvement will be affected, for example in paid training, digital piracy (Tjiptono et al., 2016; James, 2003). Some developing countries with strong cultures of separating between gender breadths are pushing for widening gaps in internet skills (Raj et al., 2020; Hai et al., 2021). Several researches showed the use of technology in developing countries has converged on several activities such as online banking (Ogbo et al., 2020) and other digital automation like email (Inshakova et al., 2020; Snowball et al., 2021). Digital Culture has emerged in developing countries, despite not all (Bakon et al., 2020) as an effort to avoid being left behind by allowing more access to information through education (Ogbo et al., 2020; Idiegbeyan-Ose et al., 2016; Allen et al., 2012; Snowball et al., 2021). In the end, the gap in the digital realm is influenced by socio-economic status - how the use and benefits of internet affect people’s life opportunities, behaving, starting, and being tied to technology. This is a discussion of the DX problem in the third stage. Although it has not been widely discussed in developing countries, the results of literature review show that the benefits of internet have been addressed in several studies. At least 21% discussed the problem of using and optimizing the benefits of DX. The Extended Factor of the DX problem indicator is presented in this study, Figure 4. These findings are useful for supplementing information in formulating appropriate strategies to bridge the DX problem in developing countries.

5.1. Identified Extended Factors of Digital Transformation Stage in Developing Countries

This research also presents an extended factor of the Digital Transformation previously discussed, Table 3. In previous research, motivation on the use of digital technology was interpreted as an individual’s effort to gain digital access. Motivation is categorized in Perceived Ease of Use, Perceived Usefulness, etc. Socio-economy has a comprehensive impact on the DX stage, especially in developing countries. Some other obstacles to DX adaptation in developing countries are digital resource processing. This includes data quality, digital sources and data sharing, digital leadership (Hai et al., 2021; Bag et al., 2021), and HR resources that are open to technological trends. Some of the organizational barriers that have arisen in several DX studies in developing countries include: Ineffective Change Management, organizational performance in using technology, project management that lacks support automation of activities, Absence of expected benefits on the use of technology, weak continuation of improvement, not yet established technological capital such as devices, digital equipment and organizational agility (Vagin et al., 2021). Overall government support for the successful adoption of Digital Transformation is necessary such as regulation of technology utilization and healthy competition procedures that support local businesses in the face of industry 4.0 and politics. Meanwhile, there are several factors that influence and hinder the achievement of digital partnerships in developing countries, including distrust among partners, collaborative relationships, and partnering goals, lack of defined partnering procedures, the difficulty in finding the right digital partners, sharing of resources, extension of product lines, as well as sharing of responsibilities and commitment in digital partner. In summary, the extended factors affecting DX in developing countries are presented in Table 3.

Main Factor	Sub Factor	Explanation
Motivation	Motivation	Motivation to use technology drives individual efforts to gain access.
	Perceived Ease of Use	The perception of the ease of use refers to the extent to which an individual believes that using a particular system will be free from effort/easy.
	Perceived Usability	Perceived usability refers to the extent to which an individual believes that using a particular system will improve performance.
	Subjective Norm	An individual’s perception regarding the extent to which an essential social reference will require a certain behavioral performance.

Main Factor	Sub Factor	Explanation
		Encourages one to use technology and he is willing to comply, he tends to behave accordingly.
	Perceived Behavioral Control	When a person senses that there are significant situational obstacles in using technology, his confidence in successfully carrying out behaviors weakens, and this reduces his intention to engage in behaviors to avoid disappointment.
	Adaptive attitudes	The behavior of willing to adapt to the technology.
Socio-Economic	Education and income	Education and income affect technology adoption rates.
Age	(Age)	Age affects the patterns of internet usage
Gender	(Gender)	Gender affects the Internet. Gender and age are the main determinants of the frequency of Internet use for new activities, such as playing online games.
	Obstacles to access	Many women have difficulty in accessing and using ICT, especially in developing countries.
	(Lack of) education and skills and technological literacy	Digital literacy leads to a lack of convenience in using technology and accessing the Internet.
	Affordability	Affordability in the economy, education, and employment affects the main obstacles in accessing ICT.
	Gender biases and sociocultural norms	Socio-cultural norms can encourage gender stereotypes concerning the use of technology. Culture can cause gender bias in technology adoption.
	Domestic responsibilities	Domestic roles, such as raising children, making food, and taking care of the home, can prevent women from accessing and using new technologies.
	Language	Limitations of the language used in accessing technology.
	Time	Time constraints that certain genders have due to domestic obligations.
	Perceived benefits	lack of awareness of the potential benefits that the Internet can bring.
	Self-confidence	Lack of confidence in using
		technology because of a stereotype
		stating that a certain gender is more
		dominant in using it.
	Illiteracy	Illiteracy is an essential barrier for
		women and girls to access online
		services
	Computer anxiety	fear of technology and distrust of its benefits.
Culture	(Culture)	
	Socio-cultural	More and more social practices are
		mediated with internet technology
		devices, such as smartphones.
		Cyberculture is becoming
		increasingly common among young people

Main Factor	Sub Factor	Explanation
	(1) Culture and IS development;	Cultural patterns influence how information systems are developed.
	(2) Culture, IT Adoption, and Diffusion;	Cultural patterns affect the technology acceptance.
	(3) Culture, IT Use, and Outcomes;	Culture is associated with the use of IT and how to take advantage of it.
	(4) Culture, IT Management, and Strategy;	Culture plays a role in how to evolve technology and creating strategies.
	(5) IT Influence on Culture; and	Technology brings influence to culture.
	(6) IT Culture, or the value attributed to IT by group.	IT Culture is part of IT values
	Resistance to change	Companies that conventionally conduct operations for many years have a natural tendency to resist change.
Resources	(Resources)	The resources in question are trust, data quality, education, awareness, digitization process, and participation of all stakeholders related to technology.
	Data Quality	The large volume of data collection through various technologies used in Industry 4.0 causes difficulties in extracting useful data.
	Digital resources and data sharing	Digital resources are digital data or databases to present information. Limited data sharing hinders the adoption and development of digital technology.
	Digital Leadership	Leaders must be the pioneers in innovating digital transformation thinking, changing leadership methods, and managing work within the organization.
	Developing digital human resources	Establish Human Resources that can accept new production technology trends.
Organization	(Organization)	Organization adaptation to technology
	Ineffective Change Management	Ineffective management during the process of changing employees, executives, third-party channel partners, and value chain members.
	Organizational Performance	The use of technology has a fundamental purpose in improving organizational performance.
	Project management,	Project management is a process that targets particular attention or problems in connection with a specific business arrangement, in this case, technological support for the automation of object-oriented activities to obtain good productivity.
	Expected benefit	There is no expected benefit in the use of technology. Technology is used in a basic manner.
	Continues Improvement	The process of continuous improvement, also often called the sustainable improvement process, is an ongoing effort to improve a product, service, or process by utilizing technology.
	Capital	Technological capital, such as devices, digital equipment.
	Agility	The company's agility in accepting and adapting to technology.
	Digital Strategy Alongside Resource Scarcity	Industry 4.0 requires consistent availability and data flow both horizontally and vertically, within and across organizations.
Regulation (government)	(Regulation)	Regulations governing digital adaptation
	Regulatory Framework	There is a lack of standards and government regulation across the industries that embraces industry 4.0.

Main Factor	Sub Factor	Explanation
	Procedure	Government protection is necessary to ensure healthy competition procedures in the market to support local businesses and SMEs to be prepared in facing industry 4.0.
	Politic	Political problems, such as corruption, delays in service delivery, lack of public sector accountability, and so on, are believed by many to be overcome by ICT utilization.
Intention to Use	(Intention to Use)	Intention to use technology
	Users in mobility	connectivity in mobility is now the most common way of using the Internet among young people.
	Basic User	Standard use of technology. Merely using/operating it without any clear expectation of benefit.
	Cyber consumer	Young internet users position themselves as consumers in using the Internet.
	Digital citizenship	Digital citizenship refers to user- developed voluntary behavior, such as recommending service, helping other users, and having system failure tolerance.
	ICT Use intention and behavior	How firm the intention of using technology is.
Partnership	(Partnership)	Digital Partnerships are organizations that come together to share resources with the ultimate goal of achieving digital transformation.
	Distrust among partners	When it comes to digital partnerships, trust issues can arise from fears of data loss and confidentiality, as it has been noted that some organizations have not reached the level of open data sharing for fear of their information being leaked to their competitors.
	Collaborative relationships	Getting a positive impact from the forms of digital collaboration, such as the ability to develop new products, expand into new markets, develop customer segments, develop new capabilities or add to the existing ones, support the existing customers, and have Access to new technologies and new data.
	Partnering goal,	It is necessary to have a common goal of partnership in digital cooperation.
	Lack of defined partnering procedure	The undefined partnership procedure in digital cooperation results in the failure of Digital Partnering.
	Getting the right digital partner	Challenge in choosing the right technology partner and forming a successful digital partnership.
	Sharing of resources	They are sharing digital resources in project implementation.
	Extension of product lines	Digital Partnerships allow for the expansion of product lines.
	Sharing of responsibilities	Digital Partnerships can reduce the risks of digital organizational transformation by dividing responsibilities.
	Commitment to digital partner	Commitment is a crucial issue in digital partnerships to achieve the goals of joint digital transformation.

Table 3. Extended Factor

5.2. Identify Factors of Digital Transformation Stage in Developing Countries

In all stages of the DX problem, domain culture has a contribution, Figure 3. It cannot be ignored that the presence of culture at every stage gives rise to phenomena that are important for further research. In addition, the socio-economic domain is consistently present in its influence on DX, although in different embodiments.

The income (economic) factor arises in its influence in gaining access or physicality to technology. Since social and digital inequalities are so closely intertwined, the analysis of digital inequality must take the cultural and social systems in which technology is embedded into account. The results of the literature review reveal how the cultural dimension are consistently present. This opens the opportunities of how the DX problem can be properly analyzed from a sociological point of view. Culture is a dimension that affects every step of the Digital Transformation problem. At stage 1, cultural barriers appear as hindrance to technology and insecurity in using it. There is a gap in the cultural behavior between the upper and lower social class which connotes the breadth of access. The socio-economic dimension discusses income, education, and gender, which are considered as capitals in engagement with digital transformation. Motivational access is the early identification of technology gap. Without the presence of motivational access, the desire to own and use will not occur. The findings in this study confirm that the motivation and ownership of access have begun to shift, although it has not been fully resolved. The stages after access ownership are skills and arrangements.

DIGITAL TRANSFORMATION IN DEVELOPING COUNTRIES

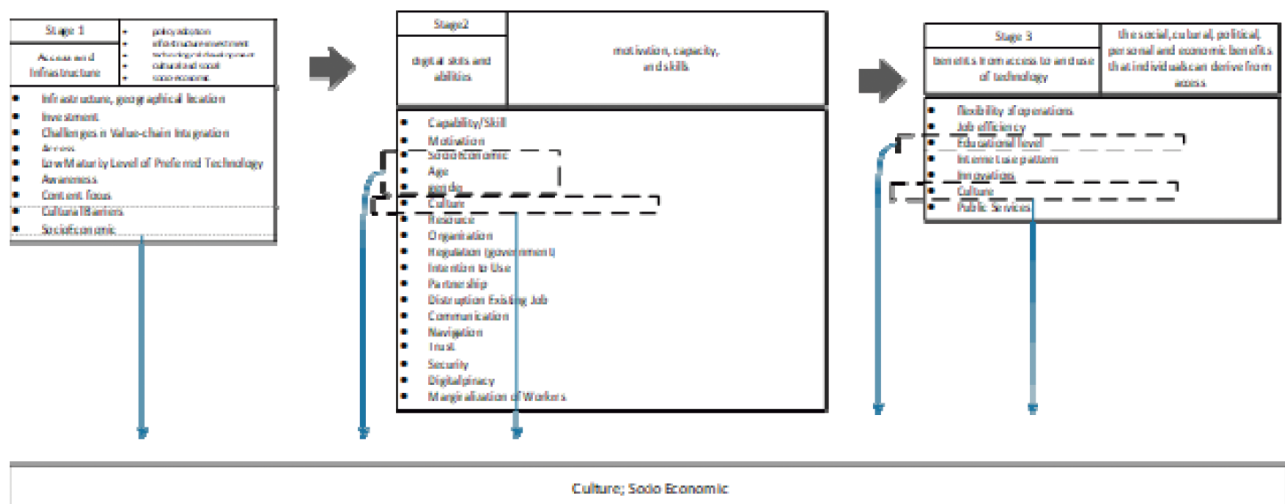


Figure 3. Framework DX in Developing Countries

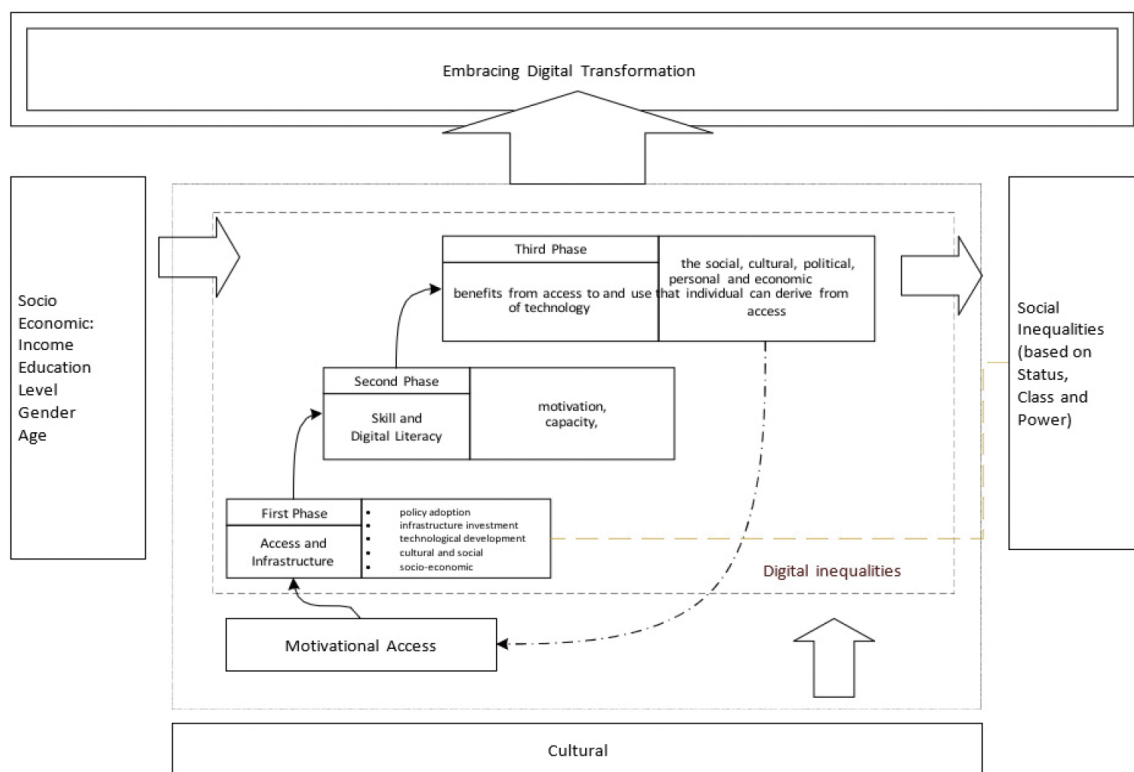


Figure 4. DX Gap Stage Analysis

6. Conclusions

Exploring the stages of DX is essential. Such a rapid development of DX requires proper brushing for it can bridge the existing problems. This paper identifies the DX stage in developing countries which has shifted from the first stage to the second stage. The first stage of DX discusses motivation and access. The dominant factors discussed in the DX phase 1 study of developing countries are access, infrastructure, and motivation. On the other hand, cultural barriers contribute to the digital problem of stage 1. Culture, as a long traditional process, affects people's motivation. This paper also provides future research prospects related to this cause. The dominance of the stage 2 discussion in developing countries exceeds the DX problem in stage 1 for about 50% while the rest are the problems in stage 1 and stage 3. Digital and Regulatory Skills and government participation are among the dominant factors discussed in phase 2 of the DX in developing countries. Future research prospects to explore solving skill problems are needed to produce the right policies to resolve issues in the second stage 2. Furthermore, in stage 3, income and innovations were identified in the literature review even though the percentage was around 20%. Meanwhile, in the advanced stages of DX on outcomes and innovations, it is possible to emerge new digital media. In the end, physical obstacles will be repeated. Although it is not yet a dominant problem in developing countries, the emergence of DX phase 3 discussions in developing countries needs to be explored further in order for the policymakers can respond to the situation in the third stage and for in the end the gap does not become wider. Several key factors that became controls at each stage of DX were identified, namely culture and socio-economics. The literature review results reveal how the cultural dimension consistently presents. This opens up the opportunities of how the DX problem can be properly analyzed from a sociological point of view.

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References

- Acilar, A. (2020). Exploring the gender digital divide in e-government use in a developing country. *International Journal of Public Administration in the Digital Age*, 7(4), 1-15. <https://doi.org/10.4018/IJPADA.20201001.oa1>
- Aghimien, D., Aigbavboa, C., Oke, A., Thwala, W., & Moripe, P. (2020). Digitalization of construction organisations—a case for digital partnering. *International Journal of Construction Management*, 22(10), 1-10. <https://doi.org/10.1080/15623599.2020.1745134>
- Aguilar-Rodríguez, I.E., Bernal-Torres, C.A., Aldana-Bernal, J.C., Acosta-Aguinaga, A.G., Artieda-Cajilema, C.H., & Chalá, P. (2021). Relationship between social culture, industry 4.0, and organizational performance in the context of emerging economies. *Journal of Industrial Engineering and Management*, 14(4), 750-770. <https://doi.org/10.3926/jiem.3560>
- Ahmed, E., & Akhlaq, A. (2015). Digital commerce in emerging economies: Factors associated with online shopping intentions in Pakistan. *International Journal of Emerging Markets*, 10(4), 634-647. <https://doi.org/10.1108/IJoEM-01-2014-0051>
- Alekseev, A.N., Lobova, S.V., & Bogoviz, A.V. (2021). Digitalization and Quality of Labor: Contradictions in Developing Countries and The Prospect s Of Harmonization. *International Journal for Quality Research*, 15(3), 733-752. <https://doi.org/10.24874/IJQR15.03-04>
- Alenizi, A.S. (2020). A systematic literature review for understanding the antecedents of the digital open government matrix. *International Journal of Electronic Government Research*, 16(1), 1-17. <https://doi.org/10.4018/IJEGR.2020010101>
- Allen, L., Natarajan, V., & Price, D. (2012). Social and cultural factors as a determinate of ICT expenditures: An empirical study. *International Journal of Information Systems and Change Management*, 6(2), 102-111. <https://doi.org/10.1504/IJISCM.2012.051147>
- Andreev, A.I., Kazanin, A.G., & Zayed, N.M. (2021). The Relationship Of Science And Personnel Policy Development In The Problem Field Of The Digital Economy. *Academy of Strategic Management Journal*, 20(1), 1-10.
- Anshari, M., & Almunawar, M.N. (2021). Adopting open innovation for SMEs and industrial revolution 4.0. *Journal of Science and Technology Policy Management*. <https://doi.org/10.1108/JSTPM-03-2020-0061>
- Bag, S., Yadav, G., Dhamija, P., & Kataria, K.K. (2021). Key resources for industry 4.0 adoption and its effect on sustainable production and circular economy: An empirical study. *Journal of Cleaner Production*, 281, 1-12. <https://doi.org/10.1016/j.jclepro.2020.125233>
- Bakon, K.A., Elias, N.F., & Abusamhadana, G.A.O. (2020). Culture and digital divide influence on e-government success of developing countries: A literature review. *Journal of Theoretical and Applied Information Technology*, 98(9), 1362-1378.
- Breunig, M., Kelly, R., Mathis, R., & Wee, D. (2016). *Getting the most out of Industry 4.0*. <https://www.mckinsey.com/business-functions/operations/our-insights/industry-40-looking-beyond-the-initial-hype>
- Bumann, J., & Peter, M. (2019). Action fields of digital transformation—a review and comparative analysis of digital transformation maturity models and frameworks. *Digitalisierung Und Andere Innovationsformen Im Management*, 2(November), 13-40.
- Calderón Gómez, D. (2019). Technological capital and digital divide among young people: An intersectional approach. *Journal of Youth Studies*, 22(7), 941-958. <https://doi.org/10.1080/13676261.2018.1559283>

- Calderón-Gómez, D. (2021). The third digital divide and Bourdieu: Bidirectional conversion of economic, cultural, and social capital to (and from) digital capital among young people in Madrid. *New Media and Society*, 23(9), 2534-2553. <https://doi.org/10.1177/1461444820933252>
- Casilli, A.A. (2017). Digital labor studies go global: Toward a digital decolonial turn. *International Journal of Communication*, 11, 3934-3954.
- Chang, Y., Kim, H., Wong, S.F., & Park, M.C. (2015). A comparison of the digital divide across three countries with different development indices. *Journal of Global Information Management*, 23(4), 55-76. <https://doi.org/10.4018/JGIM.2015100103>
- Correa, T. (2016). Digital skills and social media use: how Internet skills are related to different types of Facebook use among 'digital natives.' *Information Communication and Society*, 19(8), 1095-1107. <https://doi.org/10.1080/1369118X.2015.1084023>
- Dalenogare, L.S., Benitez, G.B., Ayala, N.F., & Frank, A.G. (2018). The expected contribution of Industry 4.0 technologies for industrial performance. *International Journal of Production Economics*, 204, 383-394. <https://doi.org/10.1016/j.ijpe.2018.08.019>
- Das, K., Gryseels, M., Sudhir, P., & Tan, K.T. (2016). *Unlocking Indonesia's digital opportunity*. McKinsey&Company.
- Dimaggio, P., Hargittai, E., Celeste, C., & Shafer, S. (2004). Digital inequality: From unequal access to differentiated use. In *Social Inequality*, (pp. 355-400).
- Dobrolyubova, E., Alexandrov, O., & Yefremov, A. (2017). Is Russia Ready for Digital Transformation? *Communications in Computer and Information Science*, 745, 431-444. https://doi.org/10.1007/978-3-319-69784-0_36
- Dutta, S., & Lanvin, B. (2021). *Shaping the Global Recovery: How digital technologies can make the post-COVID world more equal. The Network Readiness Index 2021*.
- Effah, J., & Nuhu, H. (2017). Institutional barriers to digitalization of government budgeting in developing countries: A case study of Ghana. *Electronic Journal of Information Systems in Developing Countries*, 82(1), 1-17. <https://doi.org/10.1002/j.1681-4835.2017.tb00605.x>
- Falagas, M.E., Pitsouni, E.I., Malietzis, G.A., & Pappas, G. (2008). Comparison of PubMed, Scopus, Web of Science, and Google Scholar: strengths and weaknesses. *The FASEB Journal*, 22(2), 338-342. <https://doi.org/10.1096/fj.07-9492sf>
- Finkelstein Shapiro, A., & Mandelman, F.S. (2021). Digital adoption, automation, and labor markets in developing countries. *Journal of Development Economics*, 151, 1-15. <https://doi.org/10.1016/j.jdeveco.2021.102656>
- Gallab, M., Bouloiz, H., Kebe, S.A., & Tkiouat, M. (2021). Opportunities and challenges of the industry 4.0 in industrial companies: a survey on Moroccan firms. *Journal of Industrial and Business Economics*, 48(3), 413-439. <https://doi.org/10.1007/s40812-021-00190-1>
- Garad, A., & Qamari, I.N. (2021). Determining factors influencing establishing e-service quality in developing countries: A case study of Yemen E-government. *International Journal of Electronic Government Research*, 17(1), 15-30. <https://doi.org/10.4018/IJEGR.2021010102>
- Gravili, G., Benvenuto, M., Avram, A., & Viola, C. (2018). The influence of the Digital Divide on Big Data generation within supply chain management. *International Journal of Logistics Management*, 29(2), 592-628. <https://doi.org/10.1108/IJLM-06-2017-0175>
- Hai, T.N., Van, Q.N., & Tuyet, M.N.T. (2021). Digital transformation: Opportunities and challenges for leaders in the emerging countries in response to covid-19 pandemic. *Emerging Science Journal*, 5(Special Issue), 21-36. <https://doi.org/10.28991/esj-2021-SPER-03>
- Harzing, A.W., & Alakangas, S. (2016). Google Scholar, Scopus and the Web of Science: a longitudinal and cross-disciplinary comparison. *Scientometrics*, 106(2), 787-804. <https://doi.org/10.1007/s11192-015-1798-9>

- Hindman, D.B. (2000). The rural-urban digital divide. *Journalism and Mass Communication Quarterly*, 77(3), 549-560. <https://doi.org/10.1177/107769900007700306>
- Hong, Y.A., Zhou, Z., Fang, Y., & Shi, L. (2017). The digital divide and health disparities in china: Evidence from a national survey and policy implications. *Journal of Medical Internet Research*, 19(9), 1-13. <https://doi.org/10.2196/jmir.7786>
- Idiegbeyan-Ose, J., Nkiko, C., Idahosa, M., & Nwokocha, N. (2016). Digital divide: Issues and strategies for intervention in Nigerian libraries. *Journal of Cases on Information Technology*, 18(3), 29-39. <https://doi.org/10.4018/JCIT.2016070103>
- Igun, S.E. (2011). Bridging of digital divide in Africa. *International Journal of Information and Communication Technology Education*, 7(1), 11-20. <https://doi.org/10.4018/jicte.2011010102>
- Indonesia.go.id (2017). Indonesia.go.id - Suku Bangsa. In *Indonesia.go.id*. Available at: <https://indonesia.go.id/profil/suku-bangsa/kebudayaan/suku-bangsa>
- Inshakova, A.O., Frolova, E.E., Rusakova, E.P., & Kovalev, S.I. (2020). The model of distribution of human and machine labor at intellectual production in industry 4.0. *Journal of Intellectual Capital*, 21(4), 601-622. <https://doi.org/10.1108/JIC-11-2019-0257>
- James, J. (2003). Free software and the digital divide: opportunities and constraints for developing countries. *Journal of Information Science*, 29(1), 25-33. <https://doi.org/10.1177/016555103762202041>
- James, J. (2004). Reconstructing the digital divide from the perspective of a large, poor, developing country. *Journal of Information Technology*, 19(3), 172-177. <https://doi.org/10.1057/palgrave.jit.2000019>
- James, J. (2005). The global digital divide in the Internet: Developed countries constructs and Third World realities. *Journal of Information Science*, 31(2), 114-123. <https://doi.org/10.1177/0165551505050788>
- James, J. (2007). From origins to implications: Key aspects in the debate over the digital divide. *Journal of Information Technology*, 22(3), 284-295. <https://doi.org/10.1057/palgrave.jit.2000097>
- Joshi, S., & Sharma, M. (2021). Digital technologies (DT) adoption in agri-food supply chains amidst COVID-19: An approach towards food security concerns in developing countries. *Journal of Global Operations and Strategic Sourcing*, 15(2), 262-282. <https://doi.org/10.1108/JGOSS-02-2021-0014>
- Kassim, E.S., Bhattarai, R.K., Zamzuri, N.H., & Othman, A.K. (2017). Social commerce in the digital age: Analysis of adoption differences among consumers in Malaysia and Nepal. *Pertanika Journal of Social Sciences and Humanities*, 25(S), 309-317.
- Kozma, R., McGhee, R., Quellmalz, E., & Zalles, D. (2004). Closing the digital divide: Evaluation of the World Links program. *International Journal of Educational Development*, 24(4), 361-381. <https://doi.org/10.1016/j.ijedudev.2003.11.014>
- Kozuh, A., Maksimović, J., & Zajić, J. O. (2021). Fourth industrial revolution and digital competences of teachers. *World Journal on Educational Technology: Current Issues*, 13(2), 160-177. <https://doi.org/10.18844/wjet.v13i2.5651>
- Kumar, P., & Kaur, H. (2021). Determinants of e-commerce adoption: A literature-derived model for developing nations. *International Journal of Business Information Systems*, 37(2), 182-199. <https://doi.org/10.1504/IJBIS.2021.115374>
- Li, F., Nucciarelli, A., Roden, S., & Graham, G. (2016). How smart cities transform operations models: A new research agenda for operations management in the digital economy. *Production Planning and Control*, 27(6), 514-528. <https://doi.org/10.1080/09537287.2016.1147096>
- Lopes de Sousa Jabbour, A.B., Jabbour, C.J.C., Godinho Filho, M., & Roubaud, D. (2018). Industry 4.0 and the circular economy: A proposed research agenda and original roadmap for sustainable operations. *Annals of Operations Research*, 270(1-2), 273-286. <https://doi.org/10.1007/s10479-018-2772-8>

- Majeed, M.A.A., & Rupasinghe, T.D. (2017). Internet of things (IoT) embedded future supply chains for industry 4.0: An assessment from an ERP-based fashion apparel and footwear industry. *International Journal of Supply Chain Management*, 6(1), 25-40.
- Minghetti, V., & Buhalis, D. (2010). Digital divide in tourism. *Journal of Travel Research*, 49(3), 267-281. <https://doi.org/10.1177/0047287509346843>
- Mistry, J.J. (2005). A conceptual framework for the role of government in bridging the digital divide. *Journal of Global Information Technology Management*, 8(3), 28-46. <https://doi.org/10.1080/1097198X.2005.10856401>
- Mubarak, F., & Nycyk, M. (2017). Teaching older people internet skills to minimize grey digital divides: Developed and developing countries in focus. *Journal of Information, Communication and Ethics in Society*, 15(2), 165-178. <https://doi.org/10.1108/JICES-06-2016-0022>
- Muhamad, M.Q.B., Mohamad, S.J.A.N.S., & Nor, N.M. (2021). Navigating the future of industry 4.0 in Malaysia: A proposed conceptual framework on SMEs' readiness. *International Journal of Advanced and Applied Sciences*, 8(7), 41-49. <https://doi.org/10.21833/ijaas.2021.07.006>
- Narwane, V.S., Raut, R.D., Yadav, V.S., Cheikhrouhou, N., Narkhede, B.E., & Priyadarshinee, P. (2021). The role of big data for Supply Chain 4.0 in manufacturing organisations of developing countries. *Journal of Enterprise Information Management*, 34(5), 1452-1480. <https://doi.org/10.1108/JEIM-11-2020-0463>
- Newhagen, J.E., & Bucy, E.P. (2003). Media access: Social and psychological dimensions of new technology use. In *Media Access: Social and Psychological Dimensions of New Technology Use*. <https://doi.org/10.4324/9781410609663>
- Nikkei Asian Review (2018). *Internet economy to be worth \$240bn in Southeast Asia by 2025*. Available at: <https://asia.nikkei.com/Business/Business-trends/Internet-economy-to-be-worth-240bn-in-Southeast-Asia-by-2025>
- Odat, A.M. (2012). E-government in developing countries: Framework of challenges and opportunities. *Journal of Theoretical and Applied Information Technology*, 46(2), 578-582.
- Ogbo, E., Brown, T., Gant, J., & Sicker, D. (2020). when being connected is not enough: An analysis of the second and third levels of the digital divide in a developing country. *Journal of Information Policy*, 11, 104-146. <https://doi.org/10.5325/JINFOPOLI.11.2021.0104>
- Ohemeng, F.L.K., & Ofosu-Adarkwa, K. (2014). Overcoming the Digital Divide in Developing Countries: An Examination of Ghana's Strategies to Promote Universal Access to Information Communication Technologies (ICTs). *Journal of Developing Societies*, 30(3), 297-322. <https://doi.org/10.1177/0169796X14536970>
- Pagani, M., & Pardo, C. (2017). The impact of digital technology on relationships in a business network. *Industrial Marketing Management*, 67, 185-192. <https://doi.org/10.1016/j.indmarman.2017.08.009>
- Pee, L.G., Kankanhalli, A., & On Show, V.C.Y. (2010). Bridging the digital divide: Use of public internet kiosks in Mauritius. *Journal of Global Information Management*, 18(1), 1-24. <https://doi.org/10.4018/jgim.2010091102>
- Pianta, M. (2018). Technology and Employment: Twelve Stylised Facts for the Digital Age. *Indian Journal of Labour Economics*, 61(2), 189-225. <https://doi.org/10.1007/s41027-018-0124-5>
- Ragnedda, M. (2017). *The Third Digital Divide A Weberian Approach to Digital Inequalities*. Available at: <https://www.routledge.com/The-Third-Digital-Divide-A-Weberian-Approach-to-Digital-Inequalities/Ragnedda/p/book/9781138346932>
- Ragnedda, M. (2018). Conceptualizing digital capital. *Telematics and Informatics*, 35(8), 2366-2376. <https://doi.org/10.1016/j.tele.2018.10.006>
- Ragnedda, M., & Kreitem, H. (2018). The three levels of digital divide in East EU countries. *World of Media. Journal of Russian Media and Journalism Studies*, 1(4), 5-26. <https://doi.org/10.30547/worldofmedia.4.2018.1>
- Ragnedda, M., & Muschert, G.W. (2017). Theorizing digital divides. In *Theorizing Digital Divides*. <https://doi.org/10.4324/9781315455334>

- Ragnedda, M., Ruiu, M.L., & Addeo, F. (2020). Measuring Digital Capital: An empirical investigation. *New Media and Society*, 22(5), 1-24. <https://doi.org/10.1177/1461444819869604>
- Raj, A., Dwivedi, G., Sharma, A., Lopes de Sousa-Jabbour, A.B., & Rajak, S. (2020). Barriers to the adoption of industry 4.0 technologies in the manufacturing sector: An inter-country comparative perspective. *International Journal of Production Economics*, 224, 1-50. <https://doi.org/10.1016/j.ijpe.2019.107546>
- Ramaswamy, V., & Ozcan, K. (2016). Brand value co-creation in a digitalized world: An integrative framework and research implications. *International Journal of Research in Marketing*, 33(1), 93-106. <https://doi.org/10.1016/j.ijresmar.2015.07.001>
- Ramazanov, I.A., Panasenkov, S.V., Chegllov, V.P., Krasil'nikova, E.A., & Nikishin, A.F. (2021). Retail transformation under the influence of digitalisation and technology development in the context of globalisation. *Journal of Open Innovation: Technology, Market, and Complexity*, 7(1), 1-49. <https://doi.org/10.3390/joitmc7010049>
- Reddy, S.K., & Reinartz, W. (2017). Digital Transformation and Value Creation: Sea Change Ahead. *NIM Marketing Intelligence Review*, 9(1), 10-17. <https://doi.org/10.1515/gfkmir-2017-0002>
- Reis, J., Amorim, M., Melão, N., Cohen, Y., & Rodrigues, M. (2020). Digitalization: A Literature Review and Research Agenda. In: Anisic, Z., Lalic, B., Gracanin, D. (eds), *Proceedings on 25th International Joint Conference on Industrial Engineering and Operations Management – IJCIEOM. IJCIEOM 2019. Lecture Notes on Multidisciplinary Industrial Engineering*. Springer, Cham. https://doi.org/10.1007/978-3-030-43616-2_47
- Robards, F., Kang, M., Usherwood, T., & Sancu, L. (2018). How Marginalized Young People Access, Engage With, and Navigate Health-Care Systems in the Digital Age: Systematic Review. *Journal of Adolescent Health*, 62(4), 365-381. <https://doi.org/10.1016/j.jadohealth.2017.10.018>
- Singh, S. (2017). Bridging the gender digital divide in developing countries. In *Journal of Children and Media*, 11(2), 245-247. <https://doi.org/10.1080/17482798.2017.1305604>
- Snowball, J., Delon-Tarentaal, & Sapsed, J. (2021). Innovation and diversity in the digital cultural and creative industries. *Journal of Cultural Economics*, 45, 705-733. <https://doi.org/10.1007/s10824-021-09420-9>
- Tjiptono, F., Arli, D., & Viviea (2016). Gender and digital privacy: Examining determinants of attitude toward digital piracy among youths in an emerging market. *International Journal of Consumer Studies*, 40(2), 168-178. <https://doi.org/10.1111/ijcs.12240>
- Topornin, N., Pyatkina, D., & Bokov, Y. (2021). Government regulation of the Internet as instrument of digital protectionism in case of developing countries. *Journal of Information Science*, 1-14. <https://doi.org/10.1177/01655515211014142>
- Vagin, S.G., Lascencov, Y.N., Konovalova, M.E., & Frank, E.V. (2021). Quality and Safety in The Digital Economy: Specifics of Developing Countries. *International Journal for Quality Research*, 15(3), 773-796. <https://doi.org/10.24874/IJQR15.03-06>
- van Deursen, A.J.A.M., & van Dijk, J.A.G.M. (2019). The first-level digital divide shifts from inequalities in physical access to inequalities in material access. *New Media and Society*, 21(2), 1-22. <https://doi.org/10.1177/1461444818797082>
- van Dijk, J.A.G.M. (2005). The deepening divide: Inequality in the information society. *The Deepening Divide: Inequality in the Information Society*. <https://doi.org/10.4135/9781452229812>
- van Dijk, J.A.G.M. (2020). Closing The Digital Divide: The Role of Digital Technologies on Social Development, Well-Being of All and the Approach of the Covid-19 Pandemic. *Telematics and Informatics*, 34(8), 1-10. Elsevier Ltd.
- van Dijk, J.A.G.M., & van Deursen, A.J.A.M. (2014). *Digital Skills Unlocking the Information Society* (1st ed.). Palgrave Macmillan. <https://doi.org/10.1057/9781137437037>

- van Klyton, A., Tavera-Mesías, J.F., & Castaño-Muñoz, W. (2020). Digital local information services in developing countries: Evidence from Colombia. *Journal of Librarianship and Information Science*, 52(4), 1197-1208. <https://doi.org/10.1177/0961000620907970>
- Verhoef, P.C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Qi Dong, J., Fabian, N. et al. (2021). Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*, 122, 889-901. <https://doi.org/10.1016/j.jbusres.2019.09.022>
- Vidyasagar, D. (2006). Digital divide and digital dividend in the age of information technology. *Journal of Perinatology*, 26(5), 313-315. <https://doi.org/10.1038/sj.jp.7211494>
- Wang, T., Guo, X., & Wu, T. (2021). Social Capital and Digital Divide: Implications for Mobile Health Policy in Developing Countries. *Journal of Healthcare Engineering*, 2021, 1-13. <https://doi.org/10.1155/2021/6651786>
- Wilson, J., & Wilson, H. (2009). Digital divide: Impediment to ICT and peace building in developing countries. *American Communication Journal*, 11(2), 1-9.
- Wulansari, I.Y., & Parwanto, N.B. (2020). Asian E-commerce engages global trade openness: The role of information and communications technology, social, and security indicators. *International Journal of Innovation, Creativity and Change*, 11(12), 110-136. <https://doi.org/10.53333/ijicc2013/111207>
- Yudhiyati, R., Putritama, A., & Rahmawati, D. (2021). What small businesses in developing country think of cybersecurity risks in the digital age: Indonesian case. *Journal of Information, Communication and Ethics in Society*, 19(4), 446-462. <https://doi.org/10.1108/JICES-03-2021-0035>

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