ESTIMATION OF DIGITAL TRANSFORMATION IN SOUTH ASIAN ECONOMIES: AN APPLICATION OF BROAD-SPECTRUM APPROACH

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ABSTRACT

The study aims to estimate the status of digital transformation (DT) in developing economies. Since there has been a gap in the measurement of digital transformation, this study will help in improving the economic performances of SAARC countries in the future. Herein, a study of the rankings of Digital transformation is being presented by the South Asian Association for Regional Cooperation SAARC (Bangladesh, Bhutan, India, Nepal, the Maldives, Pakistan and Sri Lanka) using a set of indicators under the prevailing scenarios of digital transformation. Composite digital transformation indicators can primarily be grouped into three dimensions: the financial sector digital transformation, industrial sector digital transformation, and services sector digital transformation. Each identified indicator happens to be independent of the other, which could be easily used to put value (individual) based on accurate statistics coupled with the available observation for each country by using PCA (Principal of Component Analysis). The exercise brought about the results that showed that Bangladesh stands at the top of being the most DT country insofar as SAARC nations are being considered. Subsequently, Bangladesh is followed by Sri Lanka. The Maldives has been found to be at the lowest echelon of digital transformation. However, other countries of the SAARC region have been found to lie in the middle of this research's spectrum. India and Pakistan have consistently been at the centre slot after considering the results of all four scenarios. This framework provides new vistas of opportunities for the policymakers to put their might regarding digital transformation to good use with a view to bringing other regions up insofar as digital transformation is considered.

INTRODUCTION

Digital transformation (DT) is a wide concept that ranges from the organizational level encompassing industries, societies and countries (Daszko and Sheinberg, 2005). The glaring innovation in the field of technology buttressed by information, communication and their proliferating use makes way for a new form of transformation, which is digital transformation (Oswald and Kleinemeie, 2017). Digitalization uses technology to increase productivity (Tilson et al., 2010). Digitalization is impacting the whole world, altering the work pattern of technology and business. The economy of the digital world is different from that of the industrial age (Berman, 2012). Modern business transformation is related to the various developments put forth to overcome the digital parallax among various tiers of economy and business (Bygstad et al., 2022). Customer channels influenced by this modern norm of conducting affairs are a manifestation of globalization. Each of the preferred approaches to embracing technology is highly susceptible to improved business and society (Holmström, 2022). The developed industry needs a prime focus on converting the existing data and tools into a formulated

structure (Kraus et al., 2022). This digital approach can help to overcome the various internal barriers of digitization. Customer preference and channels are of key significance as the digital product revolves around providing them with vital management services (Maroufkhani et al., 2022). Technology is the foundation of digital transformation. Innovative solutions help to secure the existing systems for the effective disposal of resources. Modern business is highly motivated and revolutionized by digitization (Hilbert, 2022).

In modern times organizations as well as countries are making their way around to adopt these mushrooming technologies so as to enhance their daily operations through, internet of things, cloud technologies and big data analytics (Osigweh Yg, 1989). Key opportunities of digital transformation for developed as well as developing economies are creating new and advanced business models to increase overall production by bringing in use technology and to enhance customer experience (Mergel et al., 2019). The world at large is adopting digitalization in the wake of the transparency it brings about in the modern economic field (Mazzone, 2014). Organizations

have preferred to shift their business structure onto the digital domain so as to bring speed, accuracy, and more customer interaction (Bruner and Connolly, 2011). Digitalization is fast taking place in the knowledge economy (Yoo et al., 2012). In this new modern world, antediluvian concepts of learning have been replaced with new vistas of opportunities owing to the rampant digitalization such as digital classrooms, e-commerce, e-books and many more opportunities thereto (Wang et al., 2018). Communication in the modern world holds key importance due to the volume and nature of this swift response among various structures (Holmström, 2022). Each digital business requires an effective communication channel in order to have an impactful result of digital transformation. Secure data lines and effective communication between the various industries are highly influential and significant. Communication via modern means is required to have definite business development around the globe (Bygstad et al., 2022).

New supply chains are being brought forth to modernize dilapidated markets through digital transformation (Mergel et al., 2019). The growth of the population requires solutions for the modern supply chain. A product in excess in one part of the world must be transported well to the other regions of scarcity (Al-Ruithe et al., 2018). Depending upon the digital map of the modern economy, supply chain models to have effective disposal of resources can be developed. Digital transformation would enable the business to have an effective and sustainable model of logistics and supply chain around the globe with a prime focus on the availability of the product (Andriole, 2017). The digital world is now moving towards artificial intelligence. Global product production and digitization are highly dependent on the significance of societal and economic development (Ghosh et al., 2022).

Digitalization has proven to be cost-efficient since it cuts down costs, such as paper costs, and has the records saved for eons to come both for the organizations and the countries at large (McDonald and Rowsell-Jones, 2012). It is incumbent for the world at large after getting through the pandemic and after debilitating the financial institutions that the entire edifice of the financial sector needs an overhaul in which digitalization will reign supreme (Mazzone, 2014). However, where on one side organizations are adapting to digital transformation in developing economies to adapt to digital transformation is hard (Fitzgerald et al., 2014). The deficit in IT skills, paucity of digital infrastructure, dearth of digital literacy, privacy concerns, cultural mindset and budget constraints are the main impediments to the adoption of digital transformation for developing economies (Mertens and Wiener, 2018). Hence, the digital transformation is huge, to say the least, and not only covers the breath and implications of the word thereof but also brings about the practical use of the term (Freeman, 1989). To bring digitalization in developing economies in close contact with developed economies has been the main purpose of this undertaking. This had also been the intention and the outcome of the work United Nations' 2030 Agenda for Sustainable Development (Bexell and Jönsson, 2017). The world is moving towards severe climate change. The changes in the ecosystem are highly dependent upon the approach that the masses adopt (Hilbert, 2022). Digital transformation can help the public

realize the importance of climate change for the planet's future. Focusing on the various key elements of climate change digital transformation can help in reducing pollution and carbon emissions (AlNuaimi et al., 2022).

McKnight and Chervany (2001) study further underlines the fillip that e-commerce gets in the wake of the digital economy. Chanias and Hess (2016) have investigated sustainable goals by merging them with the new world owing to the wake of the mushrooming digitalized economy under the tutelage of digital transformation. Every country faces energy problems that come in handy in pricing and sustainability (Tushman and Romanelli, 1985). Alternative modes need to be considered for the additional power production capacity. In the process, new energy intermediaries will emerge, which will add new impetus (Chanias and Hess, 2016). The escalating demand of DT is no doubt dire need of the hour, but to cope with the environment has also been a major challenge (Bruner and Connolly, 2011). However, it is suggested that some other studies have pointed out a couple of the same-sounding issues. To tap them fully, an in-depth study insofar as Pakistan is considered can have been undertaken to keep in mind the sustainability and transformation of the digitalized economy. The aim of undertaking this study is to measure the untapped potential of digital transformation (DT). The study's key objective is to measure the DT level of developing countries. In the end, this study will suggest the future course of policy options based on the study findings.

The subject has been tackled by bringing in use quantitative just as well as qualitative techniques however; there has been a soaring trend in the transformation of the manufacturing firms into the digital zone among different industries (Vial, 2021). Therefore, the results of digital transformation are burgeoning before our eyes. Vollmann (1996) found out that if one were to undertake the study wherein rankings are to be done the frequencies need to be ascending to descending order of digital transformations followed by creation of value, efficacy of operations. However, the results of digital transformation that is taking place around us are profound and speak for themselves these studies take an unfathomable dive into the process of what really brings about this profound change. Bartunek and Moch (1987) reported that they identified a couple of drivers after ransacking the interviews of 16 individuals spanning over 6 sub-industries, e.g. automotive in addition to that, some more drivers are just as important. Having said this, those are not ranked as high, but some other factors have also been used to improve the workforce in terms of safety and usefulness. Van Veldhoven and Vanthienen (2019) created a maturity level that assessed the readiness and strength coupled with the weakness of the engagement with digital transformation to adopt the current technological transformation and to bid adieu to the already obsolete traditional methods in the sector. However, after the author applied the method to the target audience, he was made aware that the industry is already aware of its strength and weakness inter –alia owing to the digital transformation. It is thus known to all and sundry that DT can transform manufacturing sectors as well, but the change is uncertain to throw the light off. Thus, in the same vein Morakanyane et al. (2017) came up with the new seven repressors to name

actions that guide organizations towards digital transformation that too without hiccups. In addition to this, Alekseevna et al. (2017) comes up with new mediums to tackle the adoption of DT. (1) Innovation done after rigorous experimentation. (2) Radicalized transformation has been done after putting to use changes. (3) Adaptation of sustained

advantages brought about after going through fleeting changes. Figure 1 explains the application of broad spectrum approach for this study at hand, which means the inclusion of financial sector DT, Industrial Sector DT and Services Sector DT, thereby making it a conceptual framework of the digital transformation index.

Digital Transformation Index (DTI)

Application of Broad Spectrum Approach

Financial Sector DT

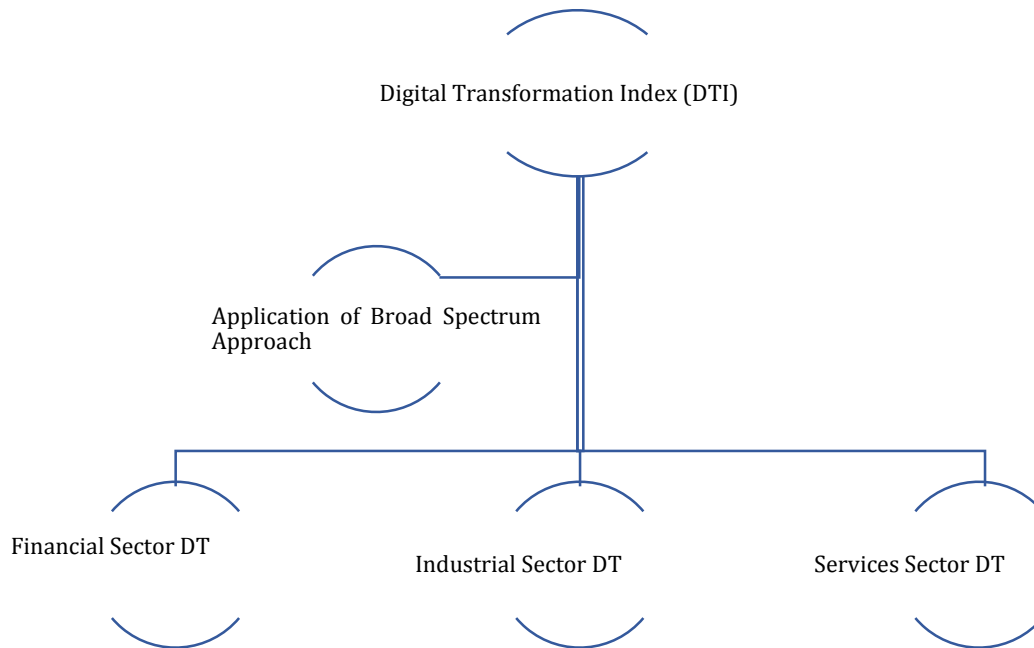Industrial Sector DT

Services Sector DT

Figure 1. Conceptual framework of digital transformation index.

Having said this, a couple of factors can be given credit to the success of digital transformation. Among these are the oversimplifying of the network-based process of digital transformation and changes in the behavior in the wake of the situation in the market thereto. Everything aside, the pandemic has enhanced the need for DT manifolds (Berman, 2012). Never before had the planet felt the need to bring in use as much DT as has been brought about in the last couple of years. However, its negative impacts cannot also be ignored. It is thus a need of time to undertake a study such as this one to weigh all the options since we are on the same course as yet.
The review of literature of the study is divided into two broad categories; one, A systematic mapping of existing literature to explore the available knowledge about digital transformation in developing economies; two, a review of literature to examine the methodologies employed to estimate the digital transformation, how to develop the digital transformation definition, and why it is required to estimate this phenomenon (Andriole, 2017). Herein, the general concept of digital transformation is taken into consideration, and profuse examples have been given after going through the studies. It has been known to all and sundry through the plethora of studies that the concept of digitalization and digital technology are far from each other to be called the same (Bekkhus, 2016). Therefore, measuring them requires a different conceptual framework that has been aforementioned in the section before. The results not only depend upon the digitalization of the economy but in how efficiently it has been digitalized. People do get it wrong when they say digitalization is equal to DT (McAfee, 2009; Yoo et al., 2012). For starters, researchers

would put more reliability to both concepts, but as time went by and more studies were conducted on the subjects then, only the bifurcation of both concepts came forth. Digital transformation is more to do with the change in technology (Tschmuck, 2012). It, therefore, requires technology at its disposal and a plethora of factors to name a few cultural dependences, including the development of talent inter alia (Tilson et al., 2010).
Table 1 succinctly mentions the different authors' different definitions to make it easy to grasp the concept of DT. There are many definitions to corroborate the statement and effect of DT. In order to just name a few DT has been known to improve the decision-making not only at the organizational level but of the societies at large De Bem et al. (2022), Demlehner and Laumer (2019), opens the gamut of advantages (Mergel et al., 2019). That being said, there are also some authors who have excluded the creation of values and optimization (Rogers, 2016). However, there have been insurmountable challenges to say the least, about the DT that have been identified by Morakanyane et al. (2017). After taking every aspect into consideration, there are many studies that take a different view on DT. Like, as has been the case with some of the past studies, some authors started feeling DT be as a slight change in technology Chanias and Hess (2016). Some of them thinks DT to be more radicalized process to take place in this millennium (Janowski, 2015; Loebbecke and Picot, 2015; Wang et al., 2018).While some researchers associate DT with business models Berman (2012), Fitzgerald et al. (2014), McAfee (2009), Mi´ci´c (2017), Tidd and Bessant (2020), Rogers (2016), George and Schillebeeckx (2022), Westerman

et al. (2014), others view DT as a paradigm or as a process (Berman, 2012; Janowski, 2015; Wang et al., 2018). There are those who are in the know of the glaring difference between the booths, and then there are those who think there is not much difference (OECD, 2018). It is only important to understand this phenomenon of such a dynamic topic better

because handsome researchers have empirically examined the various elements of DT to wrap their heads around it. For instance, Morakanyane et al. (2017) thought digital transformation could be categorized with limitations. However, that has not been the case, and it can be done by enabling the DT.

Table 1. Digital transformation over the decade.

Sr. No	Reference	Sector	Brief
1	Westerman et al. (2014)	Industry	Digital transformation through general self-assessment based on 6 dimensions
2	Besson and Rowe (2012)	Industry	Heavily focused on technology considering 4 dimensions. No details about development process, operations, or assessment methodology
3	Fitzgerald et al. (2014)	Industry	A general assessment to bring about as many as three scenarios, first being abstract concepts of DT, followed by DT marketing and at last Digital Business Factor.
4	Munck and Verkuilen (2002)	Academic	It identifies barriers and provides suggestions on how to overcome them for progressing to the next stage
5	Daszko and Sheinberg (2005)	Industry	Explained the hindrances of DT and then suggestions as to how to override the hindrances of DT thereto.
6	Dziallas and Blind (2019)	Industry	Aspects of organizational transformation due to DT for the smart manufacturing industries
7	Jodlbauer and Schagerl.(2016)	Industry	This paper randomly qualifies as the sampling of DT data qualitatively.
8	Besson and Rowe (2012)	Industry	Identified barriers that crop up during the measurements of DT.
9	Tushman and Romanelli (1985)	Industry	Emphasized the effective use of data and information so as to implement Information and communication Technology (ICT)
10	Andriole (2017)	Industry	A digital index is used to describe DT and archetypes are used in combination with two main dimensions depicting the digital maturity in a 2 × 2 matrix.
11	Vial (2021)	Academic	Comes up with an inscriptive methodology to measure digital maturity.
12	Osigweh Yg (1989)	Academic	Explained a 6 steps process to measure the dimensions of DT for the industry roadmap.
13	Vollmann (1996)	Academic	This study brings into sharp focus the CMMI model to come through DT and have it compared with other business models.
14	Carroll (2020)	Industry	Organizations undergoing DT require to focus more on conversion and adaptation i.e. people and process than new digital technologies
15	O'Brien (2012)	Industry/ Academic	Attaining DT is not possible without a management that is enough progressive and not only accepts changes rather creates conducive environment for this change through digital culture, design, analysis and strategies
16	Carroll et al. (2021)	Industry	Digital transformation is not a state rather a continuous process of evolution and development

Source: Author's own elaboration from literature.

METHODOLOGY
Study Area
The study area comprises 7 different economies. Not only do these countries make up to the research required for this topic, but they also make one of the world's most recognized groups popularly known as SAARC (South Asian Association for Regional Cooperation). The SAARC was established under UN article 52 to represent the developing countries of South Asia. The developing countries of this group are Bangladesh (BGD), Bhutan (BTN), India (IND), Nepal (NPL), the Maldives (MDV), Pakistan (PAK), and Sri Lanka (LKA), representing the association of South Asian Association for Regional Cooperation (SAARC). Geographically the SAARC region covers an area of 61,2341,34 km2. This area covers statically 4.7 percent of global land. Moreover, this area covers 14 percent of the world's agricultural needs world's population (Gurung, 2017). The new emerging trends of ICT and DT in this area make it a suitable selection (Collier and Mahon 1993). Gross Domestic Product (GDP) falls much less than developed

countries. The SAARC is moving moves towards rapid economic transformations and making a significant improvements in digital transformation.

Principal Component Analysis
Digital transformation is estimated by several pragmatic and empirical indicators or parameter which is difficult to figure out. The PCA can preferably reduce the dimensionality of both large and small multivariate data sets while still accomplishing its fundamental structure to maximum scope possible. Thus, PCA has usually been employed while dealing with management and human resource data (Berelson, 1952). This research showcases a significant variation in digital transformation analysis, i.e., indicators section and it employs the highly advance empirical method- Principal Component Analysis (PCA) for this investigation. Normally, factor extraction technique employed in this research was principal components analysis (PCA). It is usually assumed that the specified factors or items are mutually correlated,

because the PCA will help to formulate a new group of mutually uncorrelated factors (Oleinik, 2011). The study by Cook (1997) found that the issue of linearity, normality and homoscedasticity are not much significant yardsticks in PCA. But, the problem of multicollinearity is usually undesirable while using PCA. In the beginning, the PCA was performed to determine factors with Eigen value (the rule of thumb is Eigen value must be greater than 1) and the diagram of the screed was also checked (Oleinik, 2011).

Process of Factor Extraction

The most appropriate approach that should understand while the application of PCA is the factor rotation approach. It refers to the process taken to the rotation of axes to help the explanation of empirical results (Oleinik, 2011). The decision-making process about the rotation of axes depends on the degree to which the researcher believes that mutual correlation exists among various items or factors.

Cronbach's Alpha Test (Test for Factor Reliability)

The factors determined from PCA were then verified for reliability by using the Cronbach's Alpha test. It estimates internal reliability by measuring inter or intra-items correlation within each of the newly determined factors. Only those factors are considered for the final analysis in which Cronbach's Alpha value is greater than 0.60 (Oleinik, 2011). It is observed that any items loading negatively onto a factor had to be recorded in order to conduct the Cronbach's alpha. This is necessary

because all items within a factor must be unidirectional in order to conduct a Cronbach's alpha (Bessant et al., 2001).

Estimation of Digital Transformation Index

The analysis is done after uploading the data in SPSS, and the data cleaning and imputation of missing data or values is performed. Findings from the quantitative part will be empirically estimated to deal with the specific research objectives and analyze the association among various factors of digital transformation. The empirical results of the quantitative part are given in the next chapter; however, this section describes the structure and framework of specific methods employed and their rationale. Table 2 shows the variables used in measuring the digital transformation of SAARC economies. The normalized data is used for the index-building process. Each factor has equal importance in the digital transformation success outcomes; therefore, this study assigned equal weight to each factor. This study adopted the weighting process used by Akmajian et al. (2017) and Bartunek and Moch (1987). These studies suggest that an a priori decision to apply the equal weighting method for the aggregation process gives an evidently unbiased choice of assigning weights. In order to avoid the biasness, the study at hand is required. The aggregation process is the last step in computing the digital transformation index, which yields 0 to 1 score. A lot of approaches, such as compensatory and non-compensatory, are available to create a balance between different dimensions. The aggregation process followed in the current study is proposed.

Table 2. Indicators of digital transformation index (DTI) over the time period 1990-2020.

Indicator Name	Data Source	Study Source
Number of Mobile User	GFDD	Galindo-Martín et al. (2019)
Number of Internet User	GFDD	Galindo-Martín et al. (2019)
Online Bank branches per 100,000 adults	GFDD	Galindo-Martín et al. (2019)
ATMs per 100,000 adults	GFDD	Boneva, (2018)
Online Private credit by deposit money banks to GDP (%)	GFDD	Boneva, (2018)
Online Deposit money banks' assets to GDP (%)	GFDD	Galindo-Martín et al. (2019)
Online Deposit money bank assets to deposit money bank assets and central bank assets (%)	GFDD	Galindo-Martín et al. (2019)
Online Financial system deposits to GDP (%)	GFDD	Boneva, (2018)
Industry (including construction), value added (constant 2010 US$)	WDI	Galindo-Martín et al. (2019)
Industry (including construction), value added per worker (constant 2010 US$)	WDI	Boneva, (2018)
Manufacturing, value added (constant 2010 US$)	WDI	Boneva, (2018)
Manufacturing, value added (annual % growth)	WDI	Galindo-Martín et al. (2019)
Services, value added (annual % growth)	WDI	Galindo-Martín et al. (2019)

Table 3. Theoretical threshold level.

Factor/Indices	Functional Type	Upper Bound	Lower Bound
Digital Transformation Composite Index	Lower Value is Bad (LB)	1	0
Financial Sector Digital Transformation Index	Lower Value is Bad (LB)	1	0
Industrial Sector Digital Transformation Index	Lower Value is Bad (LB)	1	0
Service Sector Digital Transformation Index	Lower Value is Bad (LB)	1	0

Note: LB = Lower is bad for index.

Table 4. Reading of index score.

Index r (0-1)	< 0.20	0.20 -0.40	0.40-0.60	0.60-0.80	0.80>
Index	Very Low DT	Moderate DT	Good DT	Well DT	Very High DT

Table 3 is a theoretical threshold level showing the upper and lower bound. The digital transformation composite and sub-dimensional index scores range from 0 to 1. The advantages of constructing a digital transformation index are as follows: (1) composite index provides the overview of the general scenario, (2) sub-dimension indices allow making the comparison between dimensions, and (3) they reflect the significance of each dimension for digital transformation outcomes. Table 4 shows the reading of index score encompassing very Low DT, Moderate DT, Good DT, Well DT and very High DT.

RESULTS AND DISCUSSION

The last measurements of each of the four dimensions of digital transformation for developing economics are presented in Figure 2. The score of composite DT is the highest for Bangladesh among all the selected developing economies, indicating that DT is the most secured in the country thereof compared to the rest of the countries. In the same vain for the composite Development index Bangladesh was followed by Sri Lanka and Pakistan. India, Nepal and Bhutan are at the middle of the ladder. Maldives is at the lowest echelons of DT (Figure 2 and 3).
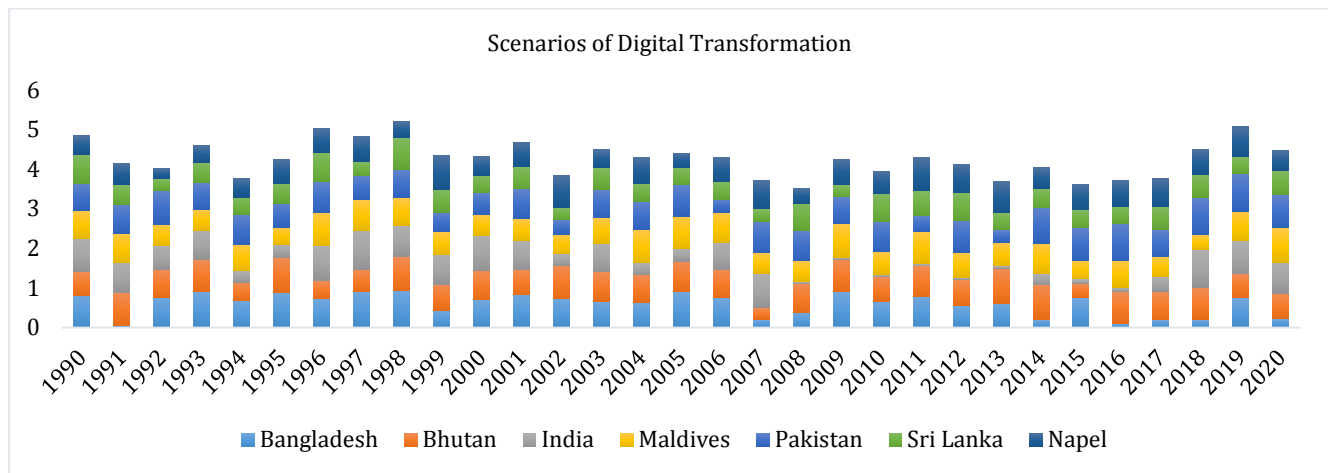

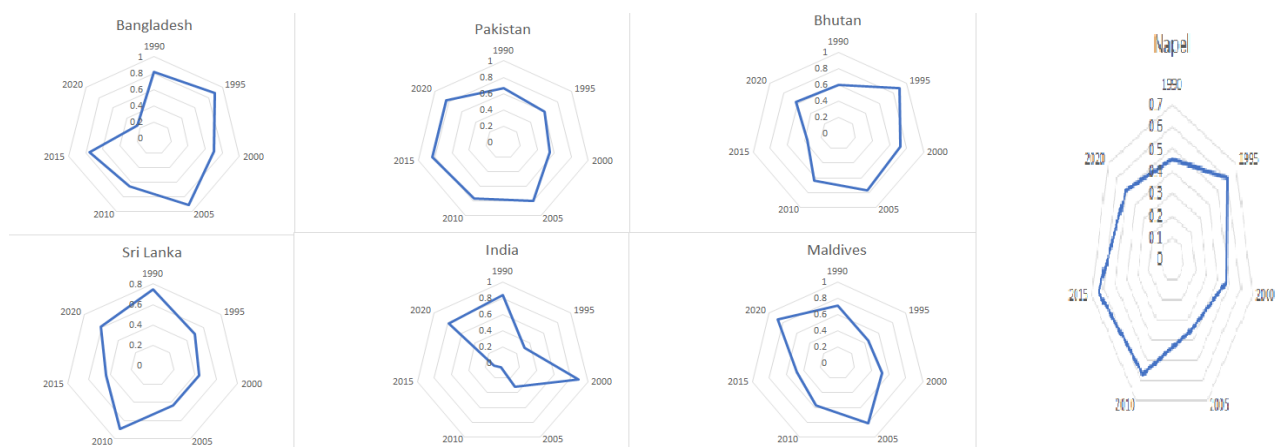Figure 2. The scores of Composite DT for the SAARC nations.

Figure 3. Values of selected SAARC nations for the year 1990-2020 under DT scenario.

Table 5. Scores of CDT, FSDT, ISDT, SSDT and DT ranks of SAARC nations.

Country	CDT	FSDT	ISDT	SSDT	DT Rank
Bangladesh	0.75	0.55	0.84	0.26	1
Bhutan	0.31	0.53	0.53	0.49	4
India	0.41	0.57	0.38	0.44	3
Maldives	0.25	0.32	0.43	0.58	7
Nepal	0.37	0.45	0.29	0.22	6
Pakistan	0.42	0.49	0.52	0.56	5
Sri Lanka	0.63	0.57	0.59	0.81	2

The financial sector DT represents the dimensions of FSDT that have been brought under use to measure and rank the selected countries insofar as four scenarios are considered.

Unlike the rankings of our composite digital transformation index, the results of FSDT were different in the wake of the numbers and prevailing situations in different countries.

Insofar as FSDT is considered Sri Lanka and India take the top of the echelon. Bangladesh and Bhutan are in the middle of the echelon. Pakistan, followed by Nepal and Maldives, are at the lowest echelons of FSDT (Table 5 and Figure 3).

Table 5 shows the Industrial sector DT would be most adequate for Bangladesh which Sri Lanka, Bhutan and Pakistan are following by taking into consideration all four scenarios of DT. Maldives and India are at the lowest ladder of ISDT. The same method will come about again for SSDT, where we see Sri Lanka being at the top of the echelon of SSDT, followed by Maldives and Pakistan. Bhutan and India lie at the centre of SSDT. Bangladesh and Nepal are at the lowest echelon of SSDT. The services sector DT would change differently for each country under different scenarios of DT. In the end this study has brought about the rankings by using the average of the results of CDT, FSDT, ISDT, SSDT. Bangladesh stands at the top of the ranking among SAARC countries, followed by Sri Lank and India. Bhutan and Pakistan in DT ranks lie in the middle at 4th and 5th positions. Nepal and Maldives are at the lowest echelons of DT ranks.

CONCLUSIONS

Digital transformation of any country could only be assessed only after they have had indicators assigned to them. However, assigning the weight requires a deep knowledge of the indicators to avoid repetition. Weight of each selected indicator changes from country to country. Only after digital transformation is measured can we rank the countries. The index constructed to measure Digital Transformation has shown Bangladesh being at the top in digital transformation while Maldives is at the bottom of SAARC region. Pakistan and India have been found to be at the centre of the digital transformation Index. This research is one of the few pieces of research conducted on this topic. There have been some limitations, such as the availability of data and the lack of literature in SAARC countries. Nevertheless, among other things, this study provides a direction as well as an opportunity to refine this methodology to measure digital transformation in the future. By using this research in future, the determinants of digital transformation can be brought about. Furthermore, the impact of digital transformation can be checked on the economies, i.e. Growth, Trade Foreign Direct Investment (FDI).

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