Digital transformation process based-technology infrastructure and employee training: evidence from World Bank

عملية التحول الرقمي القائمة على البنية التحتية وتدريب الموظفين: أدلة من البنك الدولي

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Abstract:

   This paper aims to analyze the requirements to implement successfully the digital transformation process. Principals Components Analysis is applied to identify these requirements in African social care services. Results indicate that in projects where World Bank makes investments both in technology infrastructure and employee training, social care services implement the digital transformation process. Contrariwise, services are still in the digitalization phase in projects where the only investment made is in technology infrastructure.

.**keyword** : digital transformation; digitalization; technology infrastructure; employee training

JEL classification code : M10

ملخص:يهدف هذا المقال إلى تحليل متطلبات تنفيذ عملية التحول الرقمي بنجاح مثل تكوين الموظفين. تم تطبيق تحليل المكونات الرئيسية لتحديد هذه المتطلبات في مشروع التحول الرقمي لخدمات الرعاية الاجتماعية الأفريقية. تشير نتائج البحث إلى أنه في المشروعات التي يقوم فيها البنك الدولي بالاستثمارات في البنية التحتية للتكنولوجيا الرقمية وتكوين الموظفين، خدمات الرعاية الاجتماعية تقوم بتنفيذ عملية التحول الرقمي. من ناحية أخرى، فإن المشاريع التي الاستثمار الوحيد الذي يتم فيها يخص فقط البنية التحتية للتكنولوجيا الرقمية، فإن خدمات الرعاية الاجتماعية الافريقية لا تزال في مرحلة الرقمنة.

الكلمات المفتاحية: التحول الرقمي؛ الرقمنة؛ البنية التحتية التكنولوجية؛ تكوين الموظفين

تصنيف JEL: M10

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1. Introduction :

   A recent study reports that 38% of organizations state that digital transformation will have a considerable effect on their business in the next few years (Verhoef, Broekhuizen, Bart, Bhattacharya, & Dong, 2019). In this respect, digital technologies become an integral part of

firms' functioning. This comes down to the digital age where they evolve. This age refers to the period where processes require digital technologies as medium of communication and coordination to ensure firms' agility and sustainability (Xu, David, & Kim, 2018). To follow the rapid evolution of this era, firms, regardless their activity sector or size, have to digitalize all their processes, procedures but also their business model. In this regard, digital transformation is not about to introduce the latest generation of digital technologies. Therefore, it is about considering it as a continues process which requires to be aligned with the business strategy, to implement digital platforms and to ensure employees training in digital technologies (Ghobakhloo, 2019).

Consequently, this paper proposes the analysis of the following issue: How do firms approach the digital transformation process and how do they pass from digitalization to digital transformation?

The fundamental idea underlying this research question aims to formulate the after mentioned hypotheses:
-Digitalization consists in transforming information into a digital representation using digital technologies.
-Digital transformation is the process which requires digital platforms implementation and employees training.

Digital transformation (DT) is the fact of introducing changes into the whole business model of an organization through the adoption of digital technologies. Some firms content to digitalize their processes and operations without implementing real changes in their way of doing business. In this case, they are still in the digitalization phase if they are not in the digitization stage. This attempt was first approached by (Camarinha-Matos & Afsarmanesh, 1999) to conceive the paradigm of the virtual enterprise. They have established the boundaries between digitalization and digital transformation by designing organization kinds resulting from this transformation.

This paper emphasizes analyzing digitalization and digital transformation process (see Fig.1.) Indeed, it is an enlargement also to previous search proposed by (Fischer, Imgrund, Janiesch, & Winkelmann, 2020) regarding requirements for a digital transformation process. This paper stands for a key feature of digital technologies infrastructure investments (Pradhan, Mallik, & Bagchi, 2018) and

employee training (Sousa & Rocha, 2019) in the digital age using a Principal Component Analysis (PCA) based statistical procedure.

Fig.1: *Adopted research framework from digital transformation process*
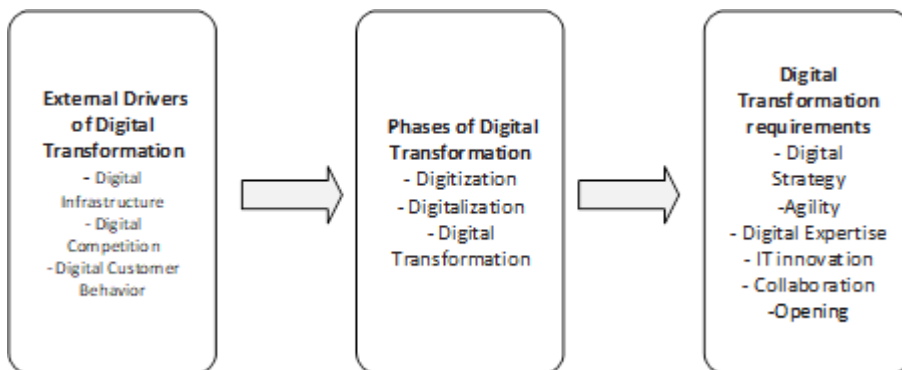
Source: *performed by authors relying on Verhoef et al (2019, p.2)*

Therefore, this paper makes three key contributions: (1) It distinct between digitalization and digital transformation process and how firms can pass from digitalization to digital transformation. (2) It illustrates digital technologies infrastructure as a support to digital transformation and employee training as driver of this process. Also, it emphasizes that digital transformation is the hard core of business model redesigning and customer integration. (3) It presents digitalization as an output of the non-training of employees. With appropriate adjustments, practitioners can use our proposed approach to help firms to go from digitalization to digital transformation. It can also be used by academics to further analyze issues related to digital transformation process requirement.

The rest of this paper is organized as follows. In the first section, we present the relevant literature and the proposed approach. Section 2 illustrates the methodology adopted. In Section 3, we formulate the PCA method for measuring the contribution of digital infrastructure investments and employee training to the digital transformation process using World Bank's digital transformation project evidence from Africa. Section 4 concludes the paper.

2. Literature review :
2.1. Digitalization paradigm :

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Digitalization refers to the changes caused by digital technology implementation without altering the way that business is done (Riedl, Benlian, Hess, Stelzer, & Sikora, 2017). Digitalization paradigm (Fischer, Imgrund, Janiesch, & Winkelmann, 2020), considers digital technology paramount for competitiveness and customer integration. Firms have considerably relied on aligning their operations, structures, and strategies with digital technology strategy to attain several benefits and decrease costs. Although this requires to firms to constantly adapt their organizational structures and culture. With digitalization, companies are applying digital technologies to improve existing business processes by enabling more efficient coordination between processes and enhancing customer value without making major changes in process and procedures (Luo, Fan, & Zhang, 2012).

2.2. Approaching digital transformation:

Digital transformation is an inevitable process (Perkin & Abraham, 2017). Firms adopt or underground this transformation. Digital transformation process is about more than technology. It is also about process, strategy, culture and people. Digital transformation implies fundamental and complete change. It is the reinvention of the way a firm operates (Ferreira, Fernandes, & Ferreira, 2018).

Digital transformation is challenging for firms on two levels. On the first one, firms are attempt to find a new form of customer integration based on online channels and improved customer relationship management systems. All these challenges deal with concrete changes in processes, products and business models value creation. The second level is about the formulation of a digital transformation strategy which must be in adequation with the business strategy (Riedl, Benlian, Hess, Stelzer, & Sikora, 2017).

2.3. From digitalization to digital transformation:

Digitization can be defined as the conversion of analog information into a digital format, so that computers can store processes and transmit this information without changing the value creation process (Verhoef, Broekhuizen, Bart, Bhattacharya, & Dong, 2019). Digitalization describes how digital technologies can be used to modify existing processes. Digitizing and digitalization combined become digital transformation process (Hund, Wagner, & Gewald, 2019).

Digitalization and digital transformation are two concepts that are used interchangeably, but it is paramount to make the difference between them. They present two distinct phenomena which constitute the different stage of digital transformation process. This process passes through three phases (Savić, 2019). The first one when firms automates single operations or; the mid-phase, when related processes are automated and interconnected such as supply chain management) and the last phase which is the most complex one, it is refers to the integration of multiple systems that support business processes and information flows into enterprise management systems (Orlandi, 2016).

2.4. Requirements for digital transformation process :

It is not an easy transformation. It is often depending on the strategy and culture of the firm, and the speed with which managers are ready to adopt new practices and replace their business model . Digital transformation requires some aspect to be reached successfully. Firms have to address, simultaneously, multiple dimensions of digital transformation encompassing their operations, organizational structures, strategies and culture. In reference to (Fischer, Imgrund, Janiesch, & Winkelmann, 2020), digital transformation process requires six aspects to be accomplished in order to redesign the entire business model. These requirements help to ensure consistent results and take advantage of opportunities for improvement.

To approach digital transformation process, it is crucial for firms to formulate a digital strategy which must be aligned with the overall strategy (Bouwman, Nikou, Molina-Castillo, & Reuver, 2018). Due to this new era, firms adopt an agile organizational structure and management system. Digital expertise is paramount to perform tasks that become more accurate and complex. Coordination and communication are very important in the digital age to guarantee the collaboration and connexion with different internal and external stakeholders (Kherbachi, Khan, & Malek, 2019). Another aspect which is important in the designing of the digital process is an open culture to guarantee the change's sustainability to help creativity and risk-taking (Giotopoulos, Kontolaimou, Korra, & Tsakanikas, 2017).

3. Study Methodology :

In this section we present the PCA-based methodology to determine how digital transformation process is approached on the basis of digital technology infrastructure and employee training. First,

we illustrate the overview of the methodology, then we present the case study applied to World Bank digital transformation project evidence from Africa. A real dataset coming from the world Bank databases is used.

3.2. Methodology framework and content:

To approach the digital transformation process, it is necessary to set up a digital technology infrastructure and ensure the employee training. The proposed methodology allows us to describe the technology infrastructures' investments   across the use of several platforms and their contribution to the transition from the digitalization to the digital transformation process. Also, we present how employee technological skills development can potentiate organizations digital transformation.

Fig.1. illustrates the digital transformation process requirements. In this paper, we focus on digital technology infrastructure and employee training. Technology infrastructure is the foundation of all technology investments, including the communications network, shared customer data, computers, data center and servers (Li, Su, Zhang, & Mao, 2017). The implementation and beneficial exploitation of digital technologies requires specific knowledge, expertise, skills and competences that workers can mainly acquire through education and training (Hanaysha, 2016).

The use of PCA method, conducted using R Studio 1.2.5033.0 software, enables us to identify and retain just the most relevant information, thus reducing the problem dimensionality and improving the performance of the digital transformation process presentation. In the rest of this section we describe the case study. The choice of this method is justified by the large-scale used which is made up of 700 observations and 7 variables where only one variable is qualitative (it is considered as an additional variable).

To evaluate the performance of the proposed methodology, we consider the World Bank digital transformation project. This project aims to guarantee financing to governments for activities that create the physical/social infrastructure necessary to reduce poverty and create sustainable development through Investment Project Financing (IN). Further, to fund policy reform, often through rapidly- disbursed budgetary support, rather than project-based physical investments through Development Policy Lending (AD). In our case, the project is about digital technology infrastructure for assistance and social care services. The world Bank makes investment in technological infrastructure both hardware and software. These investments concern the server that records big data concerning customers and the Open Communication Platforms. Also, it supports the employee training costs.

The World Bank guarantee financing to African governments for activities that create the physical/social infrastructure necessary to reduce poverty and create sustainable development such as social care services (The World Bank, 2018).

The investments made by the World Bank concern countries with needed financing. To identify these countries, it takes into account the country's economic situation, governance, environmental/natural resource management, and poverty and social aspects. Fig.2 shows the African countries concerned by the World Bank projects. As illustrated in the same Figure, there are two clusters. The first one gathers countries that lead off the digital transformation process (IN). The second cluster concerns countries that are still in the digitalization phase (AD).

As shown in Fig.2 The World Bank launched the digital transformation project in 58 African countries. All of these countries are concerned by the digital transformation process and only 18 are

affected by both digitalization and digital transformation. It comes down to the great need of these countries to develop their social care services to guarantee the development and sustainability of their governments.

Fig.2: African countries concerned by the World Bank project

Source: performed by authors using R Studio packages

3. Study Results :

The World Bank supports the African countries to develop their social care services by assisting them to digitalize these services. In this regard, it develops two types of project which are Investment Project Financing (IN) and Development Policy Lending (AD) which aim to guarantee the sustainable development and poverty reduction. Most of the investments concern the financing of investment projects (IN) with 96.43% of the total of the project.

We use the different costs to explain the digital transformation requirements. These costs concern the digital technology investments regarding hardware and software (i.e., the sum value of these two costs) and the employee training regarding the project costs as illustrated in Eq.1 with a ratio.

$$DT = \frac{\sum_{i=1}^{3} Ct_i}{Pc}$$

(1)

Where Ct is the employee training, software and hardware costs and Pc is the project cost.

Table 1: *Statistical presentation of World Bank project data*

	Var.type	Mean	Sd	p-value	n
Project type	Factor	-	-	-	2
DT	Number	-	-	-	-
Project cost	Number	137714386	836417787	< 2.2e-16	700
Hardware	Number	58 192 86	37 4664 64	< 2.2e-16	700
Software	Number	67652629	110124388	< 2.2e-16	700
Total costs	Number	72764771	112045596	< 2.2e-16	700
Training costs	Number	3665771	13365251	< 2.2e-16	700

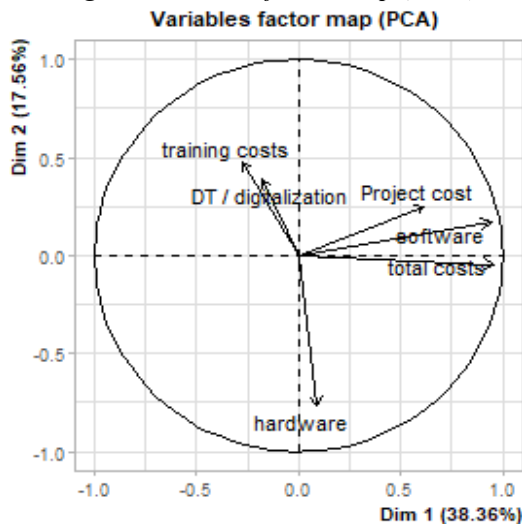**Source:** *performed by authors using R Studio*

As illustrated in Tab.1, p-value < 2.2e-16 so we reject the null hypothesis at the critical value α=0.05. So, there is a significant difference between the observed distribution and the forecast distribution. Therefore, the population is not evenly distributed in each category of project. This means that some social care services are in the digitalization phase; others are in the digital transformation phase and the rest is still in the digitization stage.

Fig. 2. presents the labeled variables that are best represented on the map. These variables contribute to the construction of the PCA plan. As

shown in this figure, the plan is constructed on the basis of the different costs and the digital transformation process (DT/ digitalization). Training costs and digital transformation are strongly coordinate. This means that digital transformation process requires the development of employee skills and expertise in terms of digital technologies. For this reason, the world Bank engages investment in employee training.

Fig. 2: *Variables factor map (PCA)*

Source: performed by authors using R Studio packages

Fig.4. illustrates the correlation matrix between the different variables. It indicates the dependency degree between them. By analyzing this matrix, we can observe that there is a strong correlation between the hardware (0.18), software (0.95) and the total costs. This means that the World Bank makes investments on the digital technology infrastructure for the benefit of African countries. These investments concern servers to record big data concerning customers (hardware) and Open Communication Platforms (software). This operation aims to digitalize African social care services (see Fig.3.).
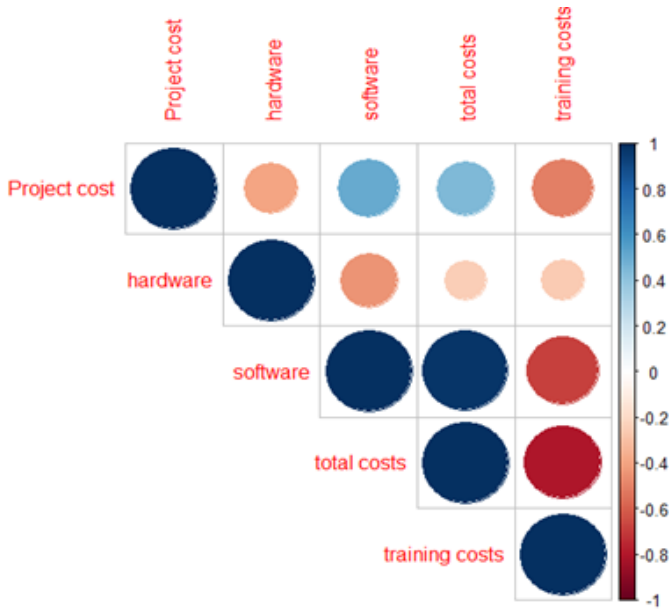
Fig.3: *Contribution of technology infrastructure to digital transformation process and digitalization*
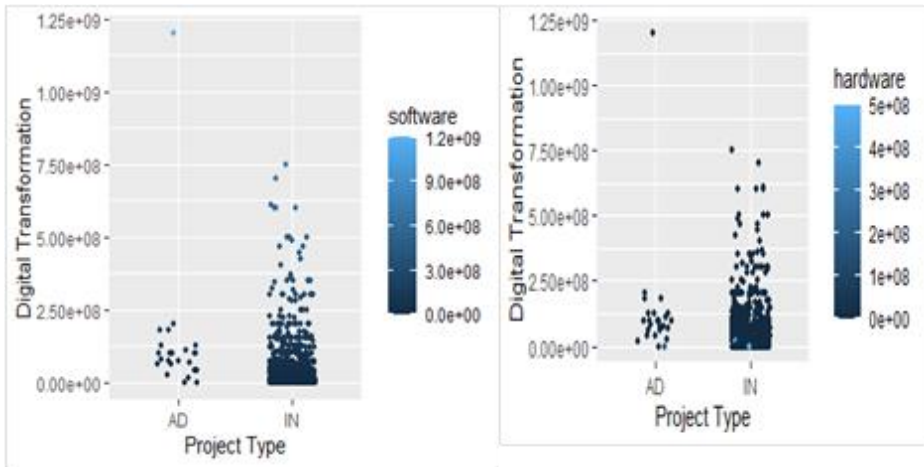
Source: *performed by authors using R Studio packages*

The same Fig (4) shows the correlation that exist between digital transformation (DT) and training costs (0.053). This can be explained by the investments made by the World Bank on the employee training. The purpose of this training is to develop the employee skills and competences in terms of digital technologies manipulation. The ultimate goal of this investment is to pass from the simple digitalization of processes to the digital transformation to ensure the agility and the sustainability of African social care services.

Fig.4: *Correlation matrix*

Source: performed by authors using R Studio packages

Fig.5. indicates that when the World Bank engages investments (IN) in employee training in addition to those made in digital technological infrastructures, social care services are in a process of digital transformation. In the development project (AD), the only investment made is in digital technology infrastructure. In this case, the social care services concerned are still in the digitalization phase, so they improve their operations without modifying the whole processes and business model.

Fig.5: *Contribution of employee training to digital transformation process*
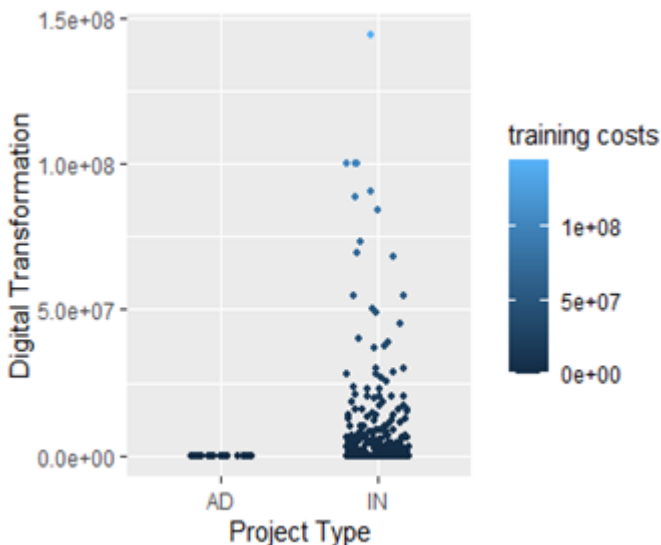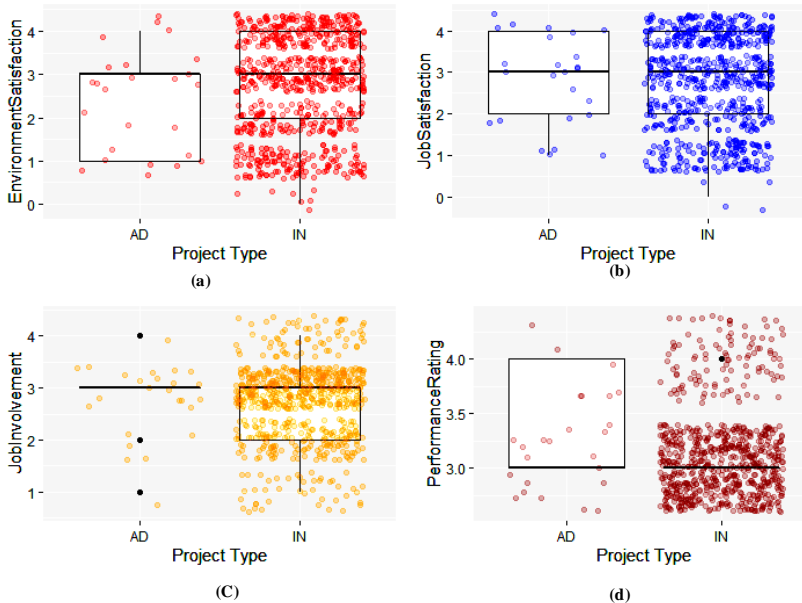
Source: performed by authors using R Studio packages

With this study, we have attempted to explore how digital technology process is supported not only by digital technology infrastructure but also by employee training. This research complements previous literature by providing robust statistical evidence on the impact of these requirements on the digital transformation and digitalization. In doing so, we provide new insights into the difference between digital transfomation and digitalization and we cannot use them interchangeably in all situations. The World Bank data regarding african social care services enabled us to examine the requirements of digital transformation process through two projects which are Investment Project Financing (IN) and Development Policy Lending (AD) , focusing on diffrent investments made in technology infrastructures and employee training.

The World Bank was engaged with African social care services to help them in their digital transformation process. In this optic, to pass from the simple digitalization to a digital transformation process, it makes efforts regarding employees. It offers them a satisfying work

environment and job satisfaction to guarantee their involvement to increase project performance.

Fig.6: Passing from digitalization phase to digital transformation process

Source: performed by authors using R Studio

The first important result shows that the implementation of the digital transformation needs more than a technology infrastructure. The employee skills and competences are the key to modify entirely the business model of social care services. The second important result indicates that the digitalization requires only a digital technology infrastructure. Because in this phase social care services don't make major modifications in their processes, they just improve their operations.

4. Conclusion :

This paper afforded a method for measuring the requirement to successeed the digital transformation implementation. We presented a framework that enables managers to design passing from digitalization

to digital transformation process which is paramount in the digital age to guarantee firms' agility and sustainability. First, we reviewed the relevant literature on digital transformation, technology infrastructure and employee training to predict the requirement of digital transformation process. It also described the difference between digitalization and digital transformation. Then quantitative model is formulated for measuring digital transformation. In the Investment Project Financing (IN), digital infrastructure and employee training are the drivers of the implementation of the digital transformation process. Therefore, in the Development Policy Lending (AD), the technology infrastructure investments are enough to digitalize firms without making major changes in their processes.

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