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Oct 31st, 10:45 AM - 12:15 PM

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### Recommended Citation

Limani, Ylber; Hajrizi, Edmond; and Stapleton, Larry, "The Complexity Issues of Enterprise Digitalization and the Organisational Challenges of Operations: The Case of Kosova" (2020). *UBT International Conference*. 76.

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# The Complexity Issues of Enterprise Digitalization and the Organisational Challenges of Operations Management

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**Abstract.** One of the main challenges to business digital transformation is lack of agile approach to the operations digitalization requirements. This problem can be translated on three main related hypothetical issues: business inability to change various things in a short period of time, lack of straightforward strategic line commitment, and failure to take iterative organisational fast approach towards simplification of technology complexity.

This research aims to address the potential causes of organizational inflexibility, strategic issues, and the mode of response to the complex requirements of digitalization process. The target population is composed of Kosovar enterprises with a definite sample. Qualitative research provided forward-thinking knowledge about the theory of complexity and organization, while quantitative research provided testing of research hypotheses related to the three identified causes of the problem.

**Keywords:** Digital Technologies, Data Science, Transformation, Complexity Theory, Agility, Flexibility.

## **1. Introduction**

This paper's aim is to discuss and examine the challenges faces operations management in the era of digitalization and to explain the role and the responsibility of operations management during the digitalization process of enterprises.

Industrial evolution comprises from three documented revolutions until now. The fourth industrial revolution is supposed to be ongoing recently and it is identified with digitalization features of businesses and organizations. While first industrial revolution introduced mechanical production, machines powered by steam and water, the second industrial revolution introduced mass production lines powered by electric energy, third industrial revolution introduced the use of electronics and information technology in automated production. The latest is digital revolution and it is identified by advanced cyber-physical systems development and implementation across the businesses and organizations. The digital revolution represents the most complex industrial revolution which emphasises and advances some of the systems from the previous revolutions and prohibits some other outdated systems. This revolution is accompanied with various emerging digital technologies posing great challenge for many organizations around the globe.

There is growing awareness that the future of many businesses will depend on their readiness to deal with the new and emerging digital technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), Big Data, Cloud Computing, Virtual Reality/Augmented Reality (VR/AR), and other Cyber-Physical Systems that support and enable Industry 4.0. The success of their competitiveness will depend on the degree of investments they will make towards the development or deployment of digital technologies within their businesses and within their business network. Industry 4.0 itself, and the innovations and opportunities it brings in modern-day business, or simply identification as an intelligent manufacturing process, should be the primary strategic goals of modern enterprises.

The main purpose of this research is to bring the theory and some of the practices of digitalization of operations closer to organizations as well as to discuss the challenges that operations management of enterprises within a country in transition may face concerning their readiness to transform their processes towards digital transformation of their business processes. This topic is thoughtfully selected in order to provide the enterprises operating within developing economies with the understanding of the potential opportunities

and/or obstacles for the implementation or the development of digital technologies. Research is further concerned with the identification of advantages of the digital revolution and by discussing the enabling technologies of this revolution.

Successful operations management among others depend on high flexibility level of production systems and processes needed to address the growing variety of customers' requirements, products, and supply chains. This vital flexibility can be achieved by integrating IT across the spectrum: designing, planning, manufacturing, supply chain, and customers. Such a high degree of responsibility is assumed to create the conditions for efficient and effective development of products and services. This integration of information technology was enabled by integrating and functionalizing various cyber-physical systems. This singular approach is become known as a business vision named "Industry 4.0". However, the term and even more its impact on businesses is still unclear. Even at the time we are writing this paper, such a definition is not entirely processed and broadly accepted from the scientific world. It is understood that there is a need for additional scientific work and other complementary approaches and verified advances before we can have an acknowledged definition. Therefore, this paper contributes in addressing this issue and specifically examines the implications and potentials of Industry 4.0, respectively the digitalization on operations management. In short, we assume that digitalization is combining digital technologies and data science to provide increased potential for business operations. Nonetheless, this situation also brings difficulties and challenges for operations management as it increases the demands for flexibility, speed, reliability, cost and ultimately for quality.

The rationality behind conducting this research is supported by several facts. Firstly, we assumed that it was essential to explain the meaning of the digitalization process and factors enabling this process. Secondly, we explained and defined the challenges operations management within enterprises faces in the case of transformation into digitized enterprise model.

The research methodology used is largely designed based on qualitative method taking into account the information mostly is obtained from the-state-of-the-art regarding the relationship between digitalization and operations management. Besides, this research correspondingly uses quantitative approach with practical, arithmetical and comparative data as well as information derived from the conducted survey.

Primary conclusions derivative from this research provides the readers with a forward-thinking approach regarding businesses in their early stages of analysing the possibilities to transform their operations into digitized business model. The subsequent contribution of this research is the exploration of

challenges of operations management in the context of digitalization for a specific country from a developing region.

## **2. Literature research**

### **2.1 Organisation theory- Operations management**

Organisation theory developed as a distinctive social science discipline, representing a frame of thinking and writing that describes, explains and impacts the organizations developments (MacAuley *et.al* 2007). Many managers and leaders find that their organizations are enormously complex (Huczynski, 1996). Scott (2002) suggested that each organizational theory has its primary perspective sectioned into natural, rational and open perspective (Scott, 2002).

There are significant contributions to the field of organizational theory over the 20<sup>th</sup> Century and continuing in the present times as well. The classic organizational theory was oriented on organizational performance and structure, on motivation, and on the surrounding organizations operate. The need for organizations theories resulted from the industrial developments and the creation of large enterprises, which in turn required structural and operational solutions. The first period begins from the Frederick Taylor (1911) with the contribution on Scientific Management, Fayol (1925) with Administrative Theory, Maslow (1954) with Hierarchy of Needs, McGregor (1957) with Theory X-Theory Y, and others. In the second period authors oriented the organizational theory to the behavioural and later with knowledge issues. Herzberg (1966) with Motivation, Simon (1976) with Administrative Behaviour, Schein (1985) with Organizational Culture, Toyota (1991) with Lean Management, and many others.

In the first two decades of the 21<sup>st</sup> Century the authors have written about the organizational design, knowledge economy, digital economy, and circular economy. The state-of-the-art of organizational theory is concerned with the organizational transformation processes, innovation, and lastly with the digital transformation strategy. Nonetheless, this theory virtually marks a stagnation remaining behind practical industrial developments which have advanced significantly in recent period. The situation in this regard seems to be very complicated requiring increased attention and high proactivity by researchers and other authors of various fields. Therefore, the qualitative aim of this research lies, *inter alia*, in contributing to enrich the theoretical aspect, specifically to add value to the existing literature related to the field of enterprise digitalization.

**Tab. 1** List of some of authors engaged in organizational and complexity theory issues

Organizations theory	Crowther, D. (2012).; Neilson G.L. <i>et.al.</i> (2015); Corkindale G. (2011); Ney S. and, Meinel Ch. (2019); Dunne D. (2018); Heizer, J., Render, B., & Munson, C. (2020); Limani Y., Hajrizi E., Stapleton L. (2019);
Complexity theory	Sugarman, (2007); Grobman, (2012); Limani, Y Hajrizi, E., Stapleton, Retkoceri, M. (2019); Gilchrist, A. (2016) <i>Industry 4.0 - The Industrial Internet of Things</i> ; Wegner, (2010); Bozarth et al, 2013; Osburg and Lohrmann, (2017); McKinsey, 2017.

## 2.2 Complexity theory-managing complex systems

The organizational transformation process may be considered as a set of logical operations that enable the system become smart which always require organizational change. Such a system may face the countereffects between growth, drive, and hybrid organizational approach. (Sugarman, 2007). This phenomenon has been one of the reasons for systems theory to generate other multidisciplinary theories such as complexity theory.

Complexity theory supports organizational managers to allow organizational issues to go to an extreme point that may be in the vicinity of the chaotic situation, rather than choosing problems in up-to-date ways and models. This situation allows employees to self-organize to solve problems by keeping the process itself consistent through informal communication instead of applying regular procedures (Grobman, 2012).

Complexity theory allows management to build on some fewer effective resources, and to cause a reasonably level of pressure and concern in the organization in a way such allowances will promote creativity and will maximize organizational accomplishment (Wegener, 2010).

The transformation process required for product and service creation is become a very complex when considering the implications of industry 4.0. This is a result of increasing and multiplying interaction within various components of such a multifaceted system and its functionality. The continues increasing in product and service demand, increasing the complexity of logistics and progressively active delivery requirements, has demanded the development and

implementations of advanced operations management techniques. The integrations of supply network changed the way organizations and businesses cooperate. The cyber-physical systems offer the simulation and modelling of complex operations by enabling businesses to forecast the processes and changes. The practice of simulations and modelling establishes the required decision-making process and planning the resources required from the Industry 4.0.

### **2.3 Linking operations management with digitalization process**

Interconnection between systems requires interaction between different digital technologies, such as big data, radio frequency identifier, sensors, cloud systems and other cyber-physical systems such as automated machines, intelligent machines, etc. The employment of digital technologies in transformational processes directly means their employment in the process by which operations management is directly dealt with (Bozarth *et al*, 2013; Limani, et al. 2019). From the perspective of world economies digitalization perceives operations as a holistic system challenged with needs to ensure market stability and sustainability. In the organizational and business field all operations have to be related to computer systems and information management in the network, which causes greater efficiency (Osburg and Lohrmann, 2017). The new digital structure of industries and businesses within them incorporates various analytical tools in order to increase the effectiveness and efficiency in the production and creation of products and services and in their delivery to consumers. This view also affects the increase of competitiveness and differentiation of businesses. The integration of production and creative technologies with information technologies enables the connection of process control, operations management and strategic business planning (CGI, 2019; Limani, *et al* 2019).

In almost all industries, the expectations of costumers for digitalization are growing. Clients are demanding for digital products and services implying indirectly the new performance indicators such as speed and acceleration, accuracy and quality, suitability and reliability, low cost and flexibility (WEF, 2017; McKinsey, 2017). Nonetheless, the digital technology potential raises original new questions about the position and role of operations management. Questions are particularly important taking into account the time, resources, and leadership involved the attention that organizations have already invested to improving the way they manage their operations (McKinsey, 2017) According to McKinsey (2017) despite the digital developments and large investments that will be made in digital technology, the role and importance of operations management will grow above the conventional but very important



one of the last centuries, into modern agile and responsive management (McKinsey, 2017).

Digitalization skills can improve business operations and revenue growth, input-output transformation process, supply chain and customer experience (Deloitte, 2018). The merging of digital and physical technologies would affect how customers, employees and other shares of the business landscape expect to experience and interact with an organization (Sniderman a, *et al.* 2016).

### **3. Problem definition and research approach**

It is assumed that the management of operations in developing and developed countries has the same challenges due to the digitalization requirements. However, dealing with these challenges is different in the two cases of countries. The challenges of Operations Management in the context of digitalization for developing regions such as Kosovo may be the case representative of the Balkan countries as there is no major difference in digital developments between these countries.

The adoption of such digital technologies in these regions is troubled with complications and tech adoption failure factor/variables are riskier and sometimes additional factors are loaded, depending on the country's specifics. This means that manufacturing and service providing firms are typically far from ready to adopt digital technology in their business operations.

Structural-organizational and technological-complex categories of factors appear to have major impact on the readiness of businesses to adopt digital technologies within their operations. Among identified from both categories are factors related to lack of investment in digital technology, lack of staff's skills, political factors, economic factor, administrative factor, etc.

In order to address the above discussed issues and to break the problem in less complex parts, a couple of analytical questions are formulated

The theoretical analysis of key influencing factors in the implementation of digital technologies in business operations is supported by the metrics resulting from the survey of Kosovar businesses in this context. The testing of organizational theory and that of complexity is carried out based on the analysis and testing of the factors that are expressed as variables, respectively arguments.

- To what extent businesses are acknowledged related to the right digital technology they need for digitalization of their operations?
- Which factors mostly influence the adoption of digital technologies?
- How much enterprises are investing in raising staff skills to the appropriate level required for digitalization of business process?

- What is the investment level enterprises are making in digital technologies, enablers of digitalization?
- What are the main challenges of Operations Management in the context of business process digitalization?

The metrics generated by the quantitative research were used to test the hypotheses raised.

The first simple hypothesis is formulated in the context of complexity issues related to the technology types identification and knowledge.

*The first assumption is that businesses from the studied developing region are not sufficiently acknowledged about the types and the capacity of digital technology they need to digitize their business operations.*

The second hypothesis formulated in the context of organizational domain. Low investment in staff skills in a studied country (Kosovo as a case of developing country). The hypothesis aims to clarify whether there is a relationship between the level of investment and the level of skills of staff to use digital technology.

*The second assumption aims to find if staff skills to use digital technology is affected by the investment level on staff skills to use digital technology digitalization of business processes in developing countries.*

The adoption of Industry 4.0 technology in developing countries depends on investment on digital technology.

### 3.1 Research approach

We used our approach to the research needs. In the Fig. 1 the research methodology is presented.

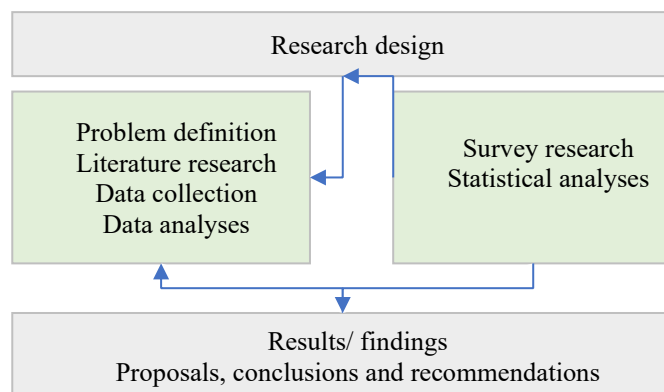


Fig 1 Research approach (Limani, *et al.* 2019)

Case study research is conducted with randomly selected businesses from random industries.

The survey evidence:

Population: N=72 enterprises;

Sample: company IT managers of various levels;

Research method: survey-quantitative research, and case study qualitative research. Research instrument: structured questionnaire with closed-ended-questions combined by leading, importance and Likert questions.

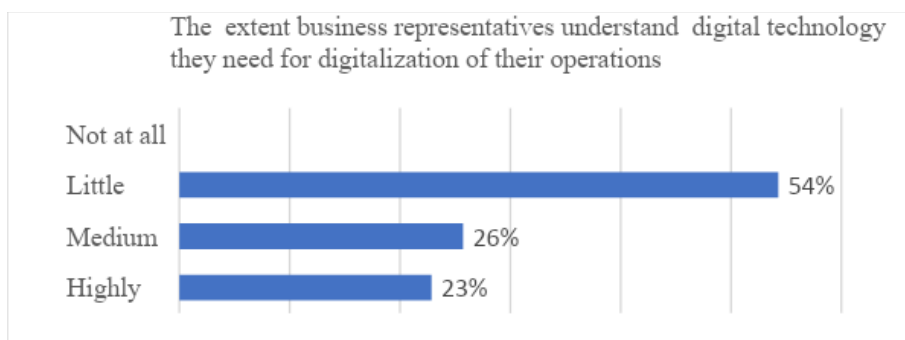
#### 4. Results analysis

Organizational and technological categories of factors appear to have major impact on the readiness of businesses to adopt digital technologies within their operations. The main factors identified by this research are presented in the table 2. Most important questions from the survey and the answers are presented in the figures 2 and 3.

**Table 2.** Structural and technological factors influencing the digitalization of business operations

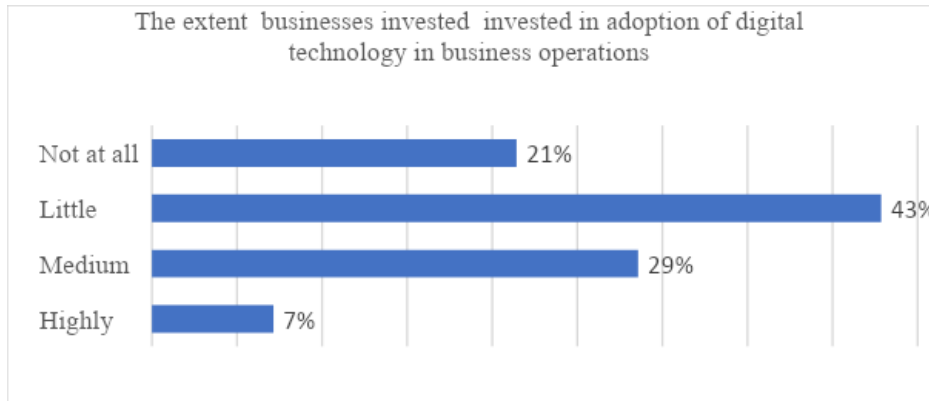
Organizational-structural	Complex-technological
Amount of investment in digital technology; Staff skills level; Level of technology knowledge Digital technology adoption level	Digital technology types and capacity. Artificial Intelligence, IoT, Automation, and VR/AR are typical digitalization complexity factors.

The adoption of digital technologies in Kosovo is troubled with complications and technology knowledge and financial issues businesses are facing.



**Fig. 2** The understanding level of business representatives related to digital technologies

The implementation of digitalization process seems to be not completely safe taking into consideration additional not positive factors are active.



**Fig. 3** The level of investments in digital technologies from businesses

### *Hypothesis testing*

Businesses from the studied developing region are not sufficiently acknowledged about the types and the capacity of digital technology they need to digitize their business operations. This hypothesis is tested and strongly accepted. Taking into account the premise that the successful adoption of digital technologies in business operations mainly depends on the amount and quality of knowledge, and another premise triggering that the business representatives and other staff are not sufficiently equipped with the required knowledge related to the digital technology types and capacities.

The second hypothesis is also accepted. That means staff skills to use digital technology is affected by the investment level on staff skills to use digital technology digitalization of business processes in developing countries.

## 5. Conclusions and recommendations

### *Conclusions*

We have drawn a sequence of conclusions that we want to share with our audience. Given that the research is still under development towards the extended version, at that point in this version we have focused on some key arguments that summarize this volume of research as presented below.

Enterprise digitalization process is a complex process and it requires high business operations level. This conclusion is drawn based on the examination of the organization's theory and the complexity theory in the literature and is considered in the case study. From the case study it follows that the level of operations, respectively the structural part must be significantly improved in order to achieve an acceptable level of coping with technological complexity.

Kosova businesses are still limited equipped and prepared to implementing digital technologies in their business processes. The case study, specifically quantitative research results in the confirmation that businesses of a developing country-Kosovo, are not equipped to the level required to successfully implement digital technologies in their business operations. In this case both organizational-structural as well as technological-complexity factors play most significant role.

We believe that the organisational and complex factors are most important issues in successful implementation of digitalization in business operations. Therefore, the successful implementation of digitalization practices in any enterprise requires full harmonization between organizational-structural and technological-complexity factors.

Enterprises should become alert when approaching the technological-complexity issue. It can add hazard, and the effects of such complexity are, by definition, unpredictable, propagating and prone to phase transitions. We have concluded that this complex issue in itself is not well explained nor understood in the literature on information systems project management and large-scale information systems deployment. It is highly important for enterprises to understand and highlight that complexity is a specific system state, where the system variability maybe very high and very risky.

### *Recommendations*

A working recommendation framework for businesses is expected to be published in the extended version of this research. In this version we will limit our discussion to some of the key recommendations that we believe are very important for businesses in the context discussed in this research paper.

We recommend businesses to increase efforts in mobilizing the whole business functions for digitalization of business operations in order to get more balancing operations structural-organization and technology-complexity issues.

Operations managers, IT managers and other business representatives engaged in digitalization process should be equipped with the required skills concerned with all effects and consequences digitalization can produce on operations management practices.

Although some technologies that have been implemented are not yet completely standardized, companies should keep in awareness that maximizing standardization reduces the possibility of complex system variability. Consequently, our recommendation to enterprises is to maximize efforts to standardize the digitalization process. Of course, such an incentive requires multidimensional and multi-disciplinary commitment.

The application of standards for business digitalization architecture in business operations in accordance with business operations requirements should be considered as a priority issue in every stage of digitalization process.

Leaders and managers need to understand that the process of identifying and understanding digital complexity is not an easy task and requires serious and ongoing commitment. Understanding the autonomous and self-organizing systems in both organizational and complex environments should become one of strategic business priorities.

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