Identification and classification of the effects of digital transformation on business

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Abstract. Digital business transformation is a business transformation process that implies using innovative technologies in order to create completely different business models, new products and services. The purpose of this article is to identify and classify the effects of digital transformation on business. This paper presents an overview of some of the main technologies used as means of digital transformation, as well as various effects that they cause when implemented in enterprises. Among the explored technologies: robotization, artificial intelligence, big data, virtual and augmented reality, the Internet of Things and blockchain. Not only that, but also a list of methods for calculating the effectiveness of the implementation of those technologies is presented. Three groups of methods are examined: financial, qualitative, probabilistic. Based on conducted research a comprehensive overview of various effects that implementation and usage of digital technologies brings to enterprises was formalized. Presented findings allow to assert that digital transformation has very impressive impact on enterprises regardless of their area of business.

Keywords: Digital Transformation, Digital Transformation Effects, Digital Technologies.

1 Introduction

Nowadays the use of digital technologies is such a common occurrence we can't imagine our lives without it. Automation and digitalization have a significant impact on every activity, changing the established rules and procedures. Gradually, such changes became ubiquitous, in connection with which experts began to talk about such a phenomenon as "digital transformation". Nowadays the importance of digital transformation processes is recognized both by the global business community and by the governments of various countries. This is confirmed by the emergence of various initiatives and programs to support digitalization in companies, various industries, as well as at the state level.

Digital business transformation is a business transformation process that implies using innovative technologies in order to create completely different business models, new products and services. Digital transformation aims to improve the decision-making process within the company, switching up the product variability based on the clients' demands, as well as optimizing staff workload [1]. Using these digital technologies becomes crucial in transformation processes and transformation projects often times face difficulty without them [2].

This paper presents an overview of some of the main technologies used as means of digital transformation, as well as various effects that they cause when implemented in enterprises. As well as that, a list of methods for calculating the effectiveness of the implementation of those technologies is presented. The goal of this paper is to identify and classify the effects of digital transformation on business.

2 Materials and Methods

Based on numerous studies we can identify some of the most popular digital technologies currently used in enterprises:

1. Robot process automation. Robot process automation – robotization of office processes, which allows to reduce the time required for performing manual routine operations and increases operational efficiency by reducing operational risks [3].
2. Artificial Intelligence (AI). Artificial intelligence technologies are designed to perform complex computer tasks and optimize the use of human resources [4].
3. Big data analysis and predictive analytics. The speed and quality of big data processing affects the efficiency and productivity of companies. Predictive analytics solutions are used to analyze large amounts of data and generate predictions. This technology includes functions of statistical modeling, analysis of historical indicators and planning of results [5].
4. Virtual and augmented reality (VR/AR). Virtual and augmented reality technologies are technologies for projection or augmentation of reality using technical means. This allows companies to reduce the cost of performing processes through the design and simulation of work steps [6].
5. Internet of Things (IoT). The IoT can be described as a group of various devices and sensors connected into a singular network for the purpose of data collection and exchange. The devices and sensors can also be controlled remotely through this network. In order to analyze the collected data it is often required to use big data analysis tools since the amount of data received is difficult to process in any other way [7].
6. Blockchain. A blockchain is a database that stores information about the actions of all its participants in the form of a "block chain". One of the main attributes of this technology is the data security and accuracy. Every piece of information entered into the system has to be confirmed by another user, which reduces the risks of fraud or misuse of information [8].

A large number of companies express their expectations for the rise in operational efficiency and cost savings through digitalization. According to various researches, the greatest economic effect in 2018 was brought by the robotization of business processes, as well as solutions for big data analysis and predictive analytics [9, 10]. And if solutions based on RPA technology allow you to free staff from routine operations, solutions based on big data can both increase productivity and improve the quality of human decisions. This influences various costs, reducing them, allows for better equipment functionality and increases customer service quality and improves planning capabilities.

Among the effects of the introduction and use of new digital technologies, the following are noted [11]:

- increased productivity and process efficiency;
- reduced labor costs;
- cost reduction;
- innovation emergence within company, the adoption of new tools;
- emergence of a new channel of interaction with customers / suppliers.

The greatest economic effect in Russian companies is achieved through robotization of business processes, as well as solutions for big data analysis and predictive analytics. It is estimated that autonomous machines and systems, using predictive models based on big data analysis, can increase operational productivity by up to 30%.

According to the entrepreneurs who invest in robots, the most important reasons behind manufacturing robotization are as follows [12]:

- manufacturing efficiency increase;
- manufacturing cost reduction;
- uniform product quality maintenance;
- closing staffing gaps;
- work safety improvement.

All research explicitly shows that the companies who have implemented the manufacturing line automation or industrial robots mainly gained measurable economic benefits. The manufacturing growth, reduced manufacturing costs, increased product sales, bigger competitive advantage, improved manufacturing flexibility and higher product quality were indicated as the most important benefits.

The results of studies carried out in Russian companies have shown that one robot replaces on average 4.5 staff units. Telecommunications companies report biggest improvements with one robot being able to fill in for over 10 regular staff members, similarly, retail companies reported one robot’s ability to replace approximately 7 human workers.

Artificial intelligence allows to control not only self-driving cars, but also companies, technological and production processes in industry. In particular, more and more companies plan to organize all their processes – from the purchase of consumables to control of manufactured products and their shipment – in a way that would allow them to be carried out using artificial intelligence.

In agriculture, the introduction of AI means the ability to monitor animal health and coordinate their location, feed delivery and diet regulation. For example, AIs have learned to identify weeds and gently dispose of them (by pulling out or treating them with chemicals). Smart assistants are able to identify plant diseases or pests that attacked them from photographs, as well as deliver the necessary drugs to a point. This helps to economize on the use of pesticides and herbicides [13].

The use of Big Data analysis can also improve enterprise efficiency. For example, Big Data analysis allows to develop adaptive trajectories and strategies. The analysis, based on the experience of the company and its interaction with various counterparties, makes it possible to determine the opportunities and potential threats to the company's activities [14]. With that in mind, the company's strategy can be formed according to which course will contribute to the company's development the best. Also, the analysis of Big Data provides a thorough control over the execution of the formed strategy. By analyzing information about both the current state of affairs and about events that have already occurred, it will be possible to trace the trajectory of the company, its compliance with the set plans, and also form an adjustment plan if necessary. It is equally important to ensure transparency of all activities of the company as a whole. The ability to access and analyze a wide range of various data will allow to further integrate company's employees and partners into all kind of enterprise's processes. In doing so the company will get a better understanding of market trends and demands, as well as create opportunities to improve the services provided.

VR and AR technologies are also very useful in enterprises. Among the most common uses are visual cues to help a worker complete operating, repair, and installation tasks [15]. They are used in the aerospace, transport, oil and gas, as well as energy industries, construction, healthcare, and many others. Using hints like these can increase productivity, improve workflows, and reduce the various risks associated with human error.

VR and AR are also used to improve customer experience by introducing customizable and unique methods of interaction with a company, brand or product. This technology allows the companies to engage the customer, increase marketing opportunities, increase sales and the level of competitiveness of the brand. Another useful application – data visualization and design which can reduce costs, increase production efficiency, and identify design flaws early, making them particularly useful in the aerospace and construction industries.

The impact of the IoT on an enterprise can be found in several areas. Thus, companies using IoT technologies are becoming more flexible and able to meet market challenges. There is also a tendency towards labor force rotation. Older workers are retiring and traditional technological skills disappear with them. Companies that invest in the IoT are more likely to adapt to the global transformation of the workforce. The move to IoT is also helping to mitigate various information security risks. For example, modern smart manufacturing practices such as "Bring Your Own Device" (BYOD) threaten the overall security of company's information infrastructure [16, 17]. Using the Internet of Things would make it possible to neutralize all potential threats to the infrastructure integrity.

IoT enables seamless interoperability between all departments and throughout the entire business process. A group of devices connected to a single network are used for that purpose allowing to monitor and analyze data in every part of the company.

It is possible to use IoT in companies of any scale, from big to small, allowing any of them to successfully automate the enterprise processes. No matter the size of the company, IoT allows to monitor and control all the manufacturing processes from one place [18, 19]. Changing the production plan according to estimated demand through the production scalability can be more easily achieved with the use of software products integrated into the production process.

Among the effects of using blockchain in enterprises, one should note decentralization, a high level of security, the speed of transactions, as well as a decrease in enterprise costs [20]. The absence of a centralized system allows companies to get rid of the need for any type of mediation, which, in turn, reduces the risks associated with the unreliability of partners, and also reduces both time and money costs. Also, security is ensured through the transparency of the system, which increases the trust of partners and suppliers. This is achieved through the use of cryptography and digital signatures in the system for identification, which also reduces the risk of fraud.

Digital technology effects can be evaluated using various methods, differing with approach and indicators, etc. Those methods are usually divided into the following group [21]:

1. Financial: NPV, IRR, ROI, Pay back, EVA, TCO;
2. Qualitative: BSC, IE, PM, TEI, REJ;
3. Probabilistic: ROV.

Table 1 shows the comparative characteristics of these methods.

Table 1. Methods for calculating the effectiveness of the implementation of digital technologies.

Method	Key points	Advantages	Disadvantages
Financial Methods			
Net present value, NPV	Defines the project's effects as a difference between operating expenses and income; is a useful tools in estimating if the company will have economic profit	Allows to figure out if the costs of the project will be justified by the revenue and by how much	No risk analysis
Internal rate of return, IRR	Provides with a way to calculate the interest rate from the digital technology implementation project with is later compared to the payback rate with risks considered as well	Gives an opportunity to compare projects regardless of the funding that they received	Requires difficult calculations

Return on investment, ROI	Gives a basic analysis of the return on investment in assets	Shows the approximate remainder of the benefits that the company will receive over the initial investment of capital	No risk analysis
Payback rate	Represents the period during which the overall effect replaces the capital invested in the first stage	Clearly indicates that a shorter payback rate means a project is more preferable	Does not take into account the future value of money
Economic Value Added, EVA	Evaluates the difference the company's net operating worth and the added amount of all of the various costs that go towards the digital technology implementation	Allows to evaluate not only the effects caused by the implementation of a technology but also the effects from the whole infrastructure transformation	Results of evaluations can only be used in dynamics
Total cost of ownership, TCO	Helps to more precisely evaluate the costs of company's IT-infrastructure; takes into account not only direct, but also indirect costs	Allows to compare the company's achievements to other companies from the same field	It isn't possible to evaluate various parameters connected to new product development
Qualitative methods			
Balanced scorecard, BSC	Divides company's goals into several directions; the goals determine how the implementation of technologies should happen; this method is most suitable for evaluating IT in companies	Allows to further formalize indicators of effectiveness	Each company may have to come up with its own indicators
Information Economics, IE	Projects are evaluated based on how well they fit with the predetermined criteria	Before proposing a project, all its objectives are considered, as well as company's business priorities	Risk analysis is not entirely reliable as it is subjective
Portfolio Management, PM	Regards IT investments and staff as assets and uses same regulations to control them as any other investments	IT investments and all their parameters are observed and assessed like a separate investment project	Requires drastic changes in company's organizational structure and administration system
Total Economic Impact, TEI	Helps determine all costs, positive effects and risks of integrat-	Allows to analyze risks	Can only be applied in very few cases

	ing digital technologies into the company		
Rapid Economic Justification, REJ	Evaluates digital technology implementation based on the business priorities of the company, its development plans and most important financial indicators	Allows to better the understanding between management and IT departments, and helps identify the effect the technologies had on the business results	Is not able to effectively evaluate IT infrastructure transformation projects as a whole
Probabilistic methods			
Real Options Valuation, ROV	Projects are studied by their manageability aspects throughout its implementation	The capability to impact the approximate parameters throughout the project's implementation	Takes a lot of time to perform the analysis and is very laborious

3 Results

Based on conducted research a comprehensive overview of various effects that implementation and usage of digital technologies brings to enterprises was formalized. It is presented in Table 2.

Table 2. Effects of using digital technologies in enterprises.

Technology	Changes caused	Effect on the business
Robot process automation	Staff reduction	Manufacturing cost reduction
	Introduction of a more uniform product quality maintenance protocol	Higher product quality
	One robot replacing multiple human staff members	Increased enterprise efficiency
	Reducing the risk of human errors	Work safety improvement
	No need for additional training of personnel when changing production nomenclature	Manufacturing flexibility improvement
Artificial Intelligence	Automated execution of various processes	Increased enterprise efficiency
	Higher levels of data control	Improved workflows
	Implementing predictive analytics	Increased enterprise flexibility
	Providing additional support in decision-making	Improved quality of business decisions
Big data analysis	Developing adaptive trajectories and strategies	Increased manufacturing efficiency and flexibility
	Thorough control over the execution of the formed strategies	Stricter adherence to plans
	Ensuring transparency of all	Increased level of trust in the

	activities of the company as a whole	company both among clients and partners
	Deeper involvement of employees and partners in various processes of the company	Better understanding of market needs when making decisions Improved experience of all participants of company's activities
	Alleviation of the complexities in execution of various tasks by employees	Increased productivity
	Reducing the risk of human errors	Improved workflows
Virtual and augmented reality	Improving customer experience	Increase of marketing opportunities
	Engaging the customer through unique methods of interaction with a company/brand/product	Increased sales and higher level of competitiveness of the brand
	Introducing new way of analysis achieved through data visualization and design	Cost reduction and increased production efficiency
	Enabling labor force rotation	Higher chances to adapt to global transformation of the workforce
Internet of Things	Improving information infrastructure security protocols and control mechanisms	Increased information security
	Allowing better scalability of production	Opportunity to adjust production capacities to potential demand
	Enabling seamless interoperability of all parts of the company	Improved workflows and higher level of productivity
Blockchain	Allowing companies to get rid of the need for any type of mediation	Lower chances of risks associated with the unreliability of partners Reducing time and money costs tied to dealing with a longer chain of communication
	Ensuring a high level of security and transparency of the system	Increased trust of partners and suppliers
	Decentralization	Decreased enterprise costs

Based on the presented findings it is evident that digital transformation has very impressive impact on enterprises regardless of their area of business. The most common effects are increase in enterprise efficiency, flexibility and productivity, improved workflows, as well as decrease in enterprise costs. It is also important to point out how digital transformation allows companies to better the quality of their products, increase sales and improve work safety throughout the entire enterprise, as well as create a deeper relationship with clients that helps companies in creating a stronger market

presence. Digital technologies also provide tools aimed at advancements in enterprise at strategy levels: decision-making and planning become easier and more precise; it becomes easier to track the progress of implementation of the adopted strategies. With digital transformation also comes higher level of information security, greater trust of clients, partners and suppliers, as well as lower chances of risks associated with the unreliability of partners.

Conclusions

The purpose of this article was to identify and classify the effects of digital transformation on business. In order to do that an overview of some of the main technologies used as means of digital transformation was presented, as well as various effects that they cause when implemented in enterprises. Next, a list of methods for calculating the effectiveness of the implementation of those technologies was compiled. The following conclusions were obtained:

- Digital transformation allows for an increase in enterprise efficiency, flexibility and productivity, improves workflows, and decreases enterprise costs.
- Better quality of products and increase in sales can also be listed among effects of digital transformation.
- Implementation of digital technologies on strategy level helps in decision-making and planning, making it easier and allowing to find better solutions.
- Digital transformation amplifies the level of information security which increases the trust of potential clients and partners in the company.

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