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Digital transformation of companies as a tool of crisis management: An empirical research of the impact on efficiency

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ABSTRACT

The economic crisis generated by the coronavirus pandemic has acted as an accelerator for the digital transformation of almost all economic entities, as a result of which it has become a massive phenomenon. However, this situation has shown that the practical development of digital transformation as a tool for business management in the digital economy requires its theoretical understanding, the formation of a theoretical basis and a scientific definition of the essence of digital transformation of companies. In particular, one of the key problems in the implementation of digital transformation at the present time is the assessment of its effectiveness, since in most cases it does not always end successfully. At the same time, knowledge of approaches and criteria for the effectiveness of digital transformation can improve the quality of its implementation. The purpose of the study is to study approaches to assessing the effectiveness of digital transformation, to determine its nature and essence at a theoretical level, as well as to conduct an econometric analysis of the contribution of digital transformation to achieving the company's efficiency.

In the course of the study the existing approaches to defining the essence of digital transformation were studied, its key elements that make up the basis were established, and the existing approaches to assessing the effectiveness of digital transformation of a company and its impact on business efficiency were studied. The absence of a unified approach to assessing the effectiveness of digital transformation and the main reasons for this problem have been established. Based on the results of the regression analysis of a sample of the largest companies of the pre-digital era, implementing digital transformation, the formulated hypothesis about the impact of digital transformation on the short-term performance of the company (profitability) was refuted, which allowed us to assume the strategic nature of this tool, the results of which are formed over a lag of time.

When writing the article, various scientific research methods were used: deduction and induction when conducting empirical analysis of the activities of companies implementing digital transformation, analytical methods and regression analysis.

The obtained results of the study contribute to the development of the theory of assessing the effectiveness of digital transformation of business, anti-crisis management and determine the directions for further theoretical developments.

KEYWORDS:

digital transformation, digital economy, crisis tools, business model, business efficiency, profitability, restructuring.

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1. RELEVANCE AND PROBLEM OF RESEARCH

The economic crisis caused by the coronavirus pandemic has significantly changed the economic landscape around the world. First of all, it accelerated the processes of digital transformation in all sectors of the economy. At the same time, against the background of the growth of digital markets in comparison to the economy as a whole in the current crisis, digital transformation began to play the role of an anti-crisis tool, which led to its widespread use by business. However, before the 2020 crisis, digital transformation as a strategic development tool was not applied massively and did not always end successfully. Despite the abundance of scientific and practical literature on digital business transformation, the understanding of the impact of this tool on business performance has not been formed so far.

The crisis that came due to the coronavirus pandemic led to a significant drop in economic activity: most of the business of traditional sectors of the economy was in crisis. According to World Bank experts, the rate of decline in the economy as a whole may be over 5% in 2020.[1] Leaving aside all the features of the current economic crisis, we note only one of the most significant: the crisis acted as an accelerator for the processes of digitalization and digital transformation of sectors and industries of the economy. This fact is confirmed by the accelerated growth of digital markets against the backdrop of a decline in the economy as a whole: for example, according to forecasts, the growth of the global volume of electronic commerce (e-commerce) in 2020 will be over 25%[2] (for the period 2020-2024, the average annual growth will exceed 8%[3]), digital services - about 3%[4].

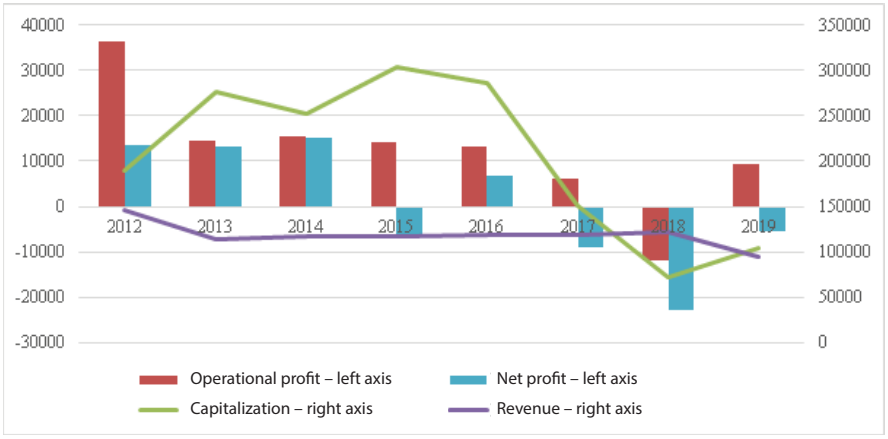
Similar trends can be seen on the example of the dynamics of the total market capitalization of economic sectors in 2020. Thus, the high-tech sector of the economy became the leader in terms of capitalization (more than $ 70 trillion with a growth rate of 35% compared to 2019), followed by the oil and gas sector (capitalization amounted to about $ 6 trillion, having decreased by 35%[5] compared to the previous year).

According to experts, by 2023, more than half of the global GDP will be provided by companies that have carried out digital transformation. This indicates the scale of the contribution of digital transformation[6] to improving the efficiency of companies and, accordingly, ensuring economic growth. In such conditions, the digital transformation of business is becoming one of the key factors in overcoming the crisis: according to experts, 60% of enterprises in the world are already implementing strategies based on digitalization and digital transformation[7].

At the same time, in the context of the transition to the digital economy, which began long before the coronavirus pandemic, businesses and governments cannot succeed without digital transformation, simply by adjusting traditional management methods and models. For this reason, before the onset of the economic crisis, many large industrial companies created in the pre-digital era, faced with a crisis within the company, carried out digital transformation (for example, GE, Nike).

[1] World Bank. URL: https://www.vsemirnyjbank.org/ru/publication/global-economic-prospects.
[2] According to information database Statista. URL: https://www.statista.com/outlook/243/100/ecommerce/worldwide.
[3] According to information database Statista. URL: https://www.statista.com/statistics/220177/b2c-e-commerce-sales-cagr-forecast-for-selected-countries/.
[4] According to information database Statista. URL: https://www.statista.com/outlook/261/100/eservices/worldwide.
[5] According to Mckinsey.com. URL: https://www.mckinsey.com/~/media/McKinsey/Industries/Private%20Equity%20and%20Principal%20Investors/Our%20Insights/A%20rolling%20disruption%20COVID%2019s%20implications%20for%20private%20equity%20and%20portfolio%20companies/A-rolling-disruption-COVID-19s-implications-for-private-equity-and-portfolio-companies-vF.pdf.
[6] According to Statista database. Digital Economy Compass 2020. URL: https://www.statista.com/study/83121/digital-economy-compass/.
[7] In place cited.

Figure 1. Dynamics of financial and economic indicators of GE in the course of digital transformation, million dollars



Source: according to the information and analytical database Thomson Reuters. URL: https://www.thomsonreuters.com.

Thus, the key features of the digital transformation of companies in the modern economy in the context of the so-called coronavirus crisis are as follows.

1. The onset of the economic crisis caused by the coronavirus pandemic has led to the widespread dissemination of the digital economy: the digital transformation of industries and sectors has become a locomotive for the economy's recovery from the crisis and a mass phenomenon. Digital transformation now covers almost all economic entities, in contrast to the period before the coronavirus pandemic, when digital transformation was used only by the largest industrial companies of the pre-digital era in order to adapt to the conditions of the new technological digital revolution.
2. The digital transformation of companies is forced and is due to external factors - the crisis development of the economy. If before the coronavirus pandemic, digital transformation was in most cases proactive, as a company's response either to crisis factors within itself (internal factors), or to technological challenges and changes in environmental conditions (digital technological revolution).
3. From the considered features follows the anti-crisis nature of the digital transformation of companies. Even before the economic crisis due to the coronavirus pandemic, many non-digital companies were already using digital transformation as a tool to overcome the crisis caused by the inconsistency of the company's business model with the changing technological conditions of the digital economy.
4. The crisis caused by the consequences of the COVID-19 pandemic has shown that archaic business models cannot withstand such large-scale and such rapid changes in the market, while companies that actively invested in the digitalization of their business turned out to be the most prepared for the global crisis. For example, the largest retailers Walmart, Target and Best Buy have been actively investing in the development of online commerce over the past years. As a result, in the second quarter of 2020, the revenue of Walmart and Best Buy grew by 97 and 242%, respectively. In general, the online trading sector grew in the second quarter of 2020 by about a third[8].

Despite considerable experience in practical application, digital transformation has not always been successful - the crisis factors in the development of the company have not been overcome yet. Research claims that 70% of all digital transformation of companies ends in failure [Saldani, 2021]. On the one hand, it seems that the established indicators of digital transformation are being achieved. On the other hand, companies still remain in a crisis situation. For example, over the period of digital transformation (2012-2019), GE experienced a significant reduction in the values of key financial and economic indicators: capitalization - by 45%, profit - by 74.5%, revenue - by 35% (Fig. 1).

Today, practice has not developed universal criteria for assessing the effectiveness of digital transformation. At the same time, until now, a unified scientific approach to carrying out such a transformation, its essence and effectiveness assessment has not been formed. Obviously, the lack of understanding of the essence and nature of digital transformation does not allow us to assess its impact on the company's performance. This problem has a scientific and practical nature and is one of the key in this scientific area, since its solution will theoretically justify the tools used in the course of digital transformation and build in practice the process of implementing such a transformation, taking into account the interests of stakeholders and determine the criteria for assessing effectiveness.

Thus, one of the main issues in the development of the methodology and practice of digital transformation of companies is the definition of approaches to assessing its effectiveness, in other words, the definition of indicators and

[8] According to Statista database. URL: https://www.statista.com/outlook/243/100/ecommerce/worldwide.

functional areas, which include these indicators, reflecting the results of the impact of digital transformation on the company's performance.

2. OVERVIEW OF RESEARCH IN THE FIELD OF DIGITAL TRANSFORMATION

All existing research in the field of digital transformation of companies is mainly related to the practical implementation of this process, therefore, the scientific development of the essence of digital transformation of companies goes from practice to theory. A significant part of the research focuses on describing the practical aspects of digital transformation in various industries and sectors of the economy.

The following key areas of research into the process of digital transformation of companies can be identified:

- the formation of practical recommendations of a methodological nature on digital transformation in a company based on an extensive analysis of the successes and failures of such a transformation [Garifullin, Zyabrikov, 2018; Vile, Warner 2019; Kulagin et al., 2019; Moore, 2019; Ovchinnikova et al., 2020; Orlovsky, Korovkin, 2020];
- analysis of the nature of digital transformation as a complex process, including all its elements [Wile, Warner, 2019; Konik, Prokhorov, 2019; Digitalization. Practical recommendations .., 2019]);
- considering the process of digital transformation as a radical change in the business model [Moazed, Johnson, 2016; Linz et al., 2018];
- research of the essence and approaches to the formation of a digital transformation strategy [Digitalization. Practical recommendations .., 2019].

The analysis shows that there is no consensus on the nature and essence of the company's digital transformation, while the methodology for its implementation is formed by the scientific and practical community. However, there remains one more key issue in the study of the essence of digital transformation of a company, which is primarily of practical importance - the assessment of the effectiveness of such a transformation and its impact on the efficiency of the company. In other words, we can say this: does digital transformation affect the company's performance and, if it does, through what indicators of the effects of such a transformation can it be measured?

This issue has been actively covered in the scientific literature in recent years, but no consensus has been reached. In most cases, the authors agree that the effect of digital transformation is barely measurable in real terms, and its direct impact on financial results is negligible. Among such studies, two areas stand out: (1) defining a set of indicators reflecting the effects of digital transformation; (2) a practical study of the impact of digital transformation on company performance.

Within the framework of the first direction, two approaches to assessing the effectiveness of digital transformation have now emerged - traditional and mixed, differing from each other in the composition of indicators (Table 1). The first approach, as an assessment of the effects of digital transformation, uses traditional indicators characteristic of industrial companies of the pre-digital era and reflecting the efficiency of production (labor productivity, cost reduction) and financial activities (profitability, capitalization). The second direction, along with traditional indicators, uses modern digital ones.

In general, it can be argued that the most frequently used indicators reflecting the effects of a company's digital transformation are financial (growth in income, profitability, capitalization), since the ultimate goal of new business models generated by digital transformation is to generate income, profits and increase value for investors. [Teece, 2010]. At the same time, the intermediate results of digital transformation are monitored using indicators of the effectiveness of operational processes [Libert et al., 2016].

At the same time, the focus on financial performance is also due to the existing paradigm of the theory of efficiency and effectiveness [Kokins, 2020], based on traditional approaches, including the accounting system, formed for companies in the pre-digital era. This is why the hallmark of traditional digital transformation companies in the pre-digital era is their focus on financial growth, while new digital companies seek to boost other growth metrics (users, sales), including digital, rather than profitability.

In the second area, there are also studies that provide conflicting conclusions about the impact of digital transformation on the company's performance. On the one hand, there are studies that show that there is no positive

Table 1
Approaches to assessing the effectiveness of digital transformation of companies

Approach, its characteristics	Authors
Traditional - measuring the effects of a company's digital transformation based on traditional (financial and (or) operational) indicators in the paradigm of the non-digital era	[Ukko et al., 2019]
Mixed - measuring the effects of a company's digital transformation based on traditional (maintenance costs, ROI, return on assets) and digital (customer experience, number of unique and active users of digital services, digital exchange) indicators	[Verhoef et al., 2019]

impact of digital transformation processes on company performance. So, according to one of them[9], based on the analysis of the profitability of US public companies (S&P 500 index), it was found that the profitability of companies engaged in digital transformation (determined by the criterion of whether such companies have the position of a head of digital transformation) is lower than that of companies that do not carry out such transformation.

On the other hand, there are studies that, on the contrary, confirm the significant impact of digital transformation on improving the efficiency of the company. For example, according to [Westerman et al., 2017], companies engaged in active digital transformation receive 9% more income from physical assets, their net profit is 26% higher and their market value is 12% higher.

3. CHARACTERISTICS OF OBJECTS AND METHODOLOGY OF RESEARCH

One of the problems complicating the study of the processes of digital transformation of companies is the lack of an accumulated array of practical data on the results, since digital transformation is a new tool that has not yet received widespread use. However, the more economies of the world were involved in digital transformation, the more economic entities faced with the need to carry out such a transformation. In this regard, for the purposes of our research, we used information about public companies, their financial data and information about digital transformation are available on the Internet.

This study analyzes thirteen large international companies, including Russian ones, from various industries and sectors of the economy that have already begun to implement digital transformation strategies (announced in the public space) (Table 2). What sets these companies apart is their non-digital business models. These companies are representatives of the pre-digital age, that is, they were created in the conditions of technological revolutions that preceded the digital one. This is important for our study, since digital transformation is a tool for adapting to the new conditions of the digital economy for companies in the pre-digital era. It should also be noted that among the surveyed there are companies with successful and unsuccessful results of digital transformation, which makes it possible to increase the objectivity of work results.

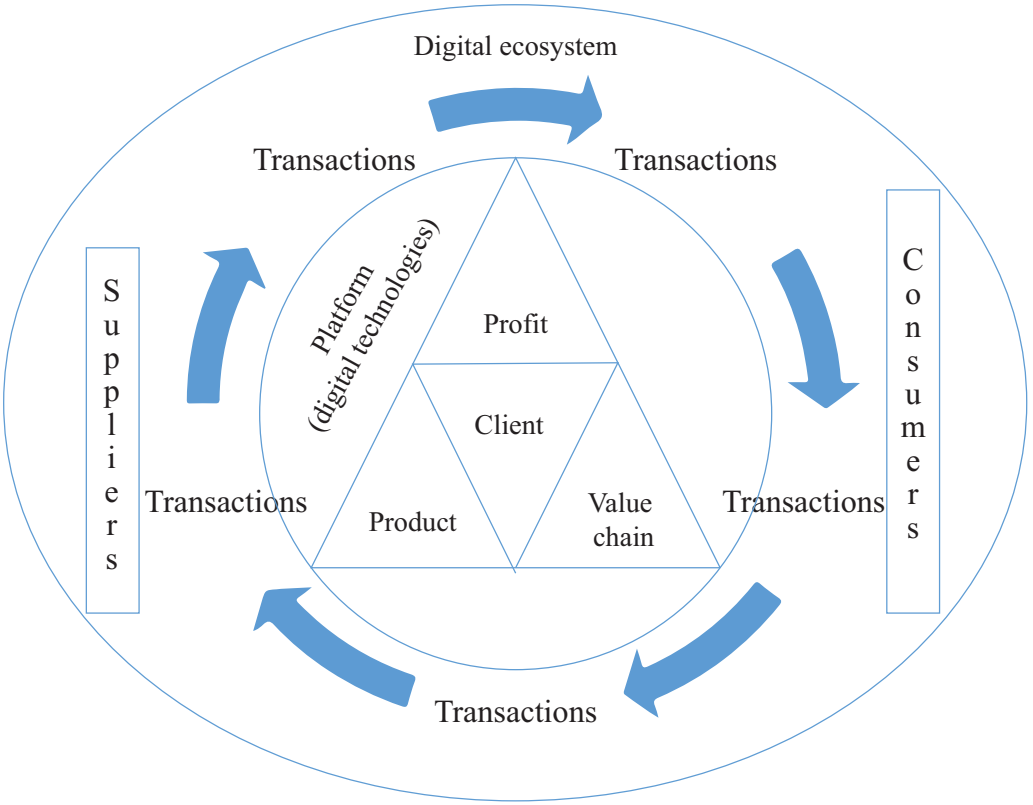
Scientific works of foreign authors, digital strategies of the companies under study, data of their financial statements for the period from 2011 to 2019 serve as an information base for the study.

Table 2
Information about the objects of research

Industry/sector	Company	Timing of digital transformation
Automobile	Volkswagen	2019–2023
	Ford	2015 – present time
Power economy	BP	2016 – present time
	Shell	2013 – present time
	Total	2019 – present time
	ExxonMobil	2019–2025
	Sinopec	2012–2030
	Россети	2019–2030
Food	Coca-Cola	2018 – present time
Inter-industry	GE	2013 – present time
Consumer goods	P&G	2012 – present time
Sports goods	Nike	2012 – present time
Entertainment	Disney	2011 – present time

[9] According to Cbinsights's database. Chief digital officers are supposed to spur growth. Why do companies that hire them tend to underperform? URL: https://www.cbinsights.com/research/chief-digital-officers-underperform/?utm_source=CB+Insights+Newsletter&utm_campaign=220b97ae4d-TuesNL_04_30_2019&utm_medium=email&utm_term=0_9dc0513989-220b97ae4d-91165257.

Fig. 2. Formation of a business model in the course of digital transformation of the company



Let us formulate a hypothesis of the study, which we will test within the framework of regression analysis: digital transformation has a positive effect on the efficiency of a company, measured by traditional indicators calculated within the framework of the existing system of financial and accounting reporting.

4. ESSENCE OF THE DIGITAL TRANSFORMATION OF THE COMPANY: THEORETICAL ANALYSIS

Analysis of existing approaches to defining the essence of digital transformation of companies showed that there is no common understanding, but it is possible to establish the basic characteristics of such a transformation that most fully reflect its nature. This is necessary to study the effects of digital transformation.

Studying the essence of digital transformation of a company, first of all, it is necessary to answer important questions: (1) what is the basis of digital transformation and (2) what is the nature of digital transformation in terms of time and management aspects?

Let's consider the main elements of the process of digital transformation of the company (Fig. 2). The basis of the company's digital transformation is the formation of a completely new business model, corresponding to the conditions of the digital world, with its own digital ecosystem. Such a digital business model is a platform one, which is a model of a two-sided market [Tyrol, 2020] with certain economic effects (a significant reduction in transaction costs, a decrease in marginal transformation costs, differentiated pricing on different sides of the platform, the absence of negative economies of scale due to an increase in network effect) [Kochetkov, 2019]. In turn, the basis of the platform business model is digital technologies and IT-technologies, including Internet technologies, which allow to build effective channels of interaction with all contractors of the company - consumers and suppliers. These changes are moving away from the traditional linear value chain to a decentralized one.

Why is a company's digital transformation affecting its business model? This is due to the fact that the latter is the core of the company's activities, which ensures competitiveness in a strategic perspective. This thesis becomes clear if we consider the main elements of the business model [Osterwalder, Pigne, 2020; Schick M., Frankenberger K., 2021]. These elements provide answers to four basic questions for a company to ensure its viability (Figure 2):

- for whom is the business created? Target customer, consumer - the central element of the business model;
- what is a business product (service)? Value proposition - key activities;
- how does the business create products (services)? Value chain, distribution channels, key resources and their suppliers;

- how does the business generate profits? The mechanism of income generation and their flows, the structure of costs.

The last element is key from the point of view of ensuring the survival of the company, because it ensures the financial viability of all lines of business and answers the main question of the company: how does it create value for stakeholders, including owners. That is why, perhaps, intuitively measuring the effectiveness of digital transformation is carried out on the basis of financial indicators, including the company's capitalization.

Thus, the digital transformation of the company implies the following breakthrough changes in the business model.

1. Moving from a linear value chain, characteristic of the pre-digital era, to a decentralized platform based on a network effect due to greater customer and supplier engagement, in which value is formed by creating links between consumers and manufacturers.
2. Customer-centric and customer-oriented - a deeper understanding of customer needs - products (services) are becoming more personalized, individualized through the use of digital technologies.
3. Formation of a digital business ecosystem that provides seamless interaction of all stakeholders based on digital services.

Currently, there is no absolute answer to the second question about the nature of digital transformation from the point of view of temporal and managerial aspects in the scientific community. First of all, this concerns the temporal parameter of the effects of digital transformation and follows from the existence of various approaches to measuring the effectiveness of digital transformation. The use in most cases of financial and operational indicators, which in their essence are short-term, as criteria for assessing the effectiveness of digital transformation suggests that the latter is not considered as a process characterized by a long time lag in terms of achieving positive effects. From a practical point of view, such effects have not yet been evaluated.

However, it is possible to raise objections to the prevailing point of view, which follow from the basis of the company's digital transformation. On the one hand, digital transformation processes relate to changes in the business model - the core of the company's strategic development, therefore, all changes caused by digital transformation are strategic in nature, that is, the consequences are observed in the long term. This does not mean that there are no operational changes in efficiency, including those expressed in positive dynamics of financial indicators - such changes do occur, but, as practice shows, not necessarily always, which as a result leads to improper conclusions about the failure of the transformation being carried out.

On the other hand, given the digital nature of the transformation under study, the positive effects of its implementation, logically, should also be digital, but in this case we are faced with institutional barriers caused by the inconsistency of existing institutions formed in the pre-digital era with new business conditions, which is a characteristic of the technological digital revolution. This

Fig. 3. Place of digital transformation in the system of anti-crisis management of the company

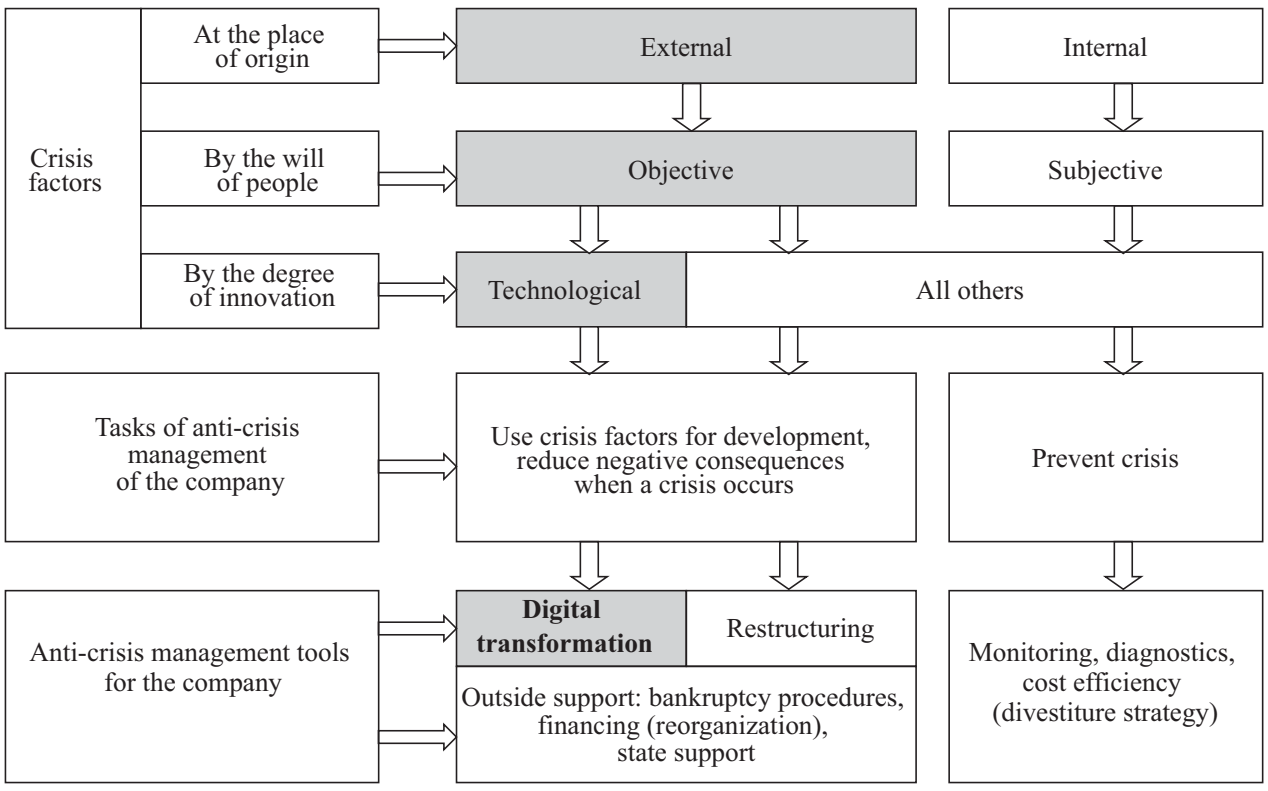


Table 3
Comparative characteristics of restructuring and digital transformation as tools of anti-crisis management

Comparison criterion	Restructuring	Digital transformation
Object	Legal entity	Business (income-generating activity)
Subject	Assets, property rights, business, debt, management system	Business model
Application of technologies	Does not imply new technologies	Introduction of digital technologies
Purpose	Restoring solvency and financial stability, reducing transformation costs	Ensuring business survival, reducing transaction costs
	Minimizing the negative consequences of the crisis, increasing the efficiency of activities (reducing costs)	
Coverage of company subsystems	All subsystems	
Resource constraints	Limited resources, including temporary	
Characteristics of the external environment	Crisis factors	
Characteristics of the internal environment	Conflict	

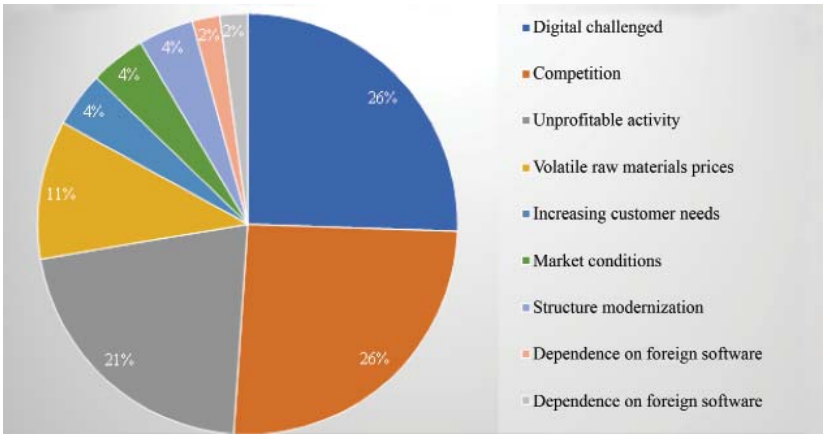
topic has been thoroughly investigated in the works [Peres, 2013; Kochetkov, 2020]. In particular, one of the problems is that the existing accounting system in companies, including financial (accounting) accounting, is focused on industrial companies of the pre-digital era and does not allow for digital effects to be taken into account.

5. ANTI-CRISIS NATURE OF DIGITAL TRANSFORMATION

The next aspect of the nature of digital transformation lies in its anti-crisis nature (Fig. 3), which is due to the following reasons:

- in most cases, digital transformation is applied when external objective factors of a technological crisis occur, caused by changes in the external environment as a result of technological revolutions, while it is impossible to prevent such crises, unlike crises of a subjective nature, therefore, the task of anti-crisis management in this case is to use crisis factors for development;
- digital transformation acts as a new anti-crisis tool, similar in content to the traditional tool (restructuring) and used in the event of a crisis caused by technological factors;
- the main goal of digital transformation is to ensure the survival of business in the new technological conditions of the external environment. Business survival is the basic goal of crisis management [Kovan, 2013].

Fig. 4. Reasons for digital transformation by companies



The analysis of the main reasons for the digital transformation of companies on the example of our sample showed that they are primarily due to environmental factors (Fig. 4). The top 3 main reasons for digital transformation include digital challenges caused by the formation of the digital economy, competitive pressure and a financial crisis.

Despite the close similarities between digital transformation and the traditional anti-crisis instrument for company restructuring, one can identify the distinctive features of the first instrument (Table 3). The key differences lie in the subject matter, purpose and applicability of digital technologies. Since the use of digital transformation is a response to the challenges of the external environment, it is impossible to manage the transformation of any one element of the business model: it requires the formation of a radically new digital business model, which can be achieved only by changing all its elements. Such a radical change in the business model leads to the transformation of all other structural elements of the company (assets, capital, including the ownership structure, management systems).

6. EVALUATION OF DIGITAL TRANSFORMATION EFFECTS OF COMPANIES: EMPIRICAL ANALYSIS

The assessment of the effects of digital transformation of companies within the framework of this study is based on the following limitations.

1. As the main effects of digital transformation, an increase in the efficiency of a company is considered, expressed through a set of traditional indicators, the calculation of which is based on the existing accounting system - revenue, operating and net profit. The last two indicators are usually considered as the basis for assessing the performance of the company [Coquins, 2020; Purlik, 2020]. The logic of using these indicators is associated with the possibility of evaluating, on their basis, all types of company activities (operating, financial, investment), as well as taking into account the analysis of the influence of the external environment. Thus, revenue is the only indicator that reflects the effectiveness of the interaction of a business with the external environment as a first-level factor influencing its profitability (although traditionally revenue is not considered as an indicator of business performance). Operating income reflects the efficiency of operating activities, and net income reflects all three activities of the company.

However, the proposed indicators are short-term in nature, do not capture strategic changes and their calculation is based on the accounting model of financial and economic analysis [Kochetkov, 2020]. As an alternative, indicators based on the value model of financial analysis are usually used, for example, the capitalization of a company or its fundamental value, which do not have the drawbacks of "accounting" indicators. At the same time, when building a regression model of the impact of digital transformation on the company's capitalization, a statistical insignificance of the coefficient of determination emerged, which does not allow us to draw a conclusion about the negative or positive impact of digital transformation on the company's capitalization.

It was noted earlier that there is currently no consensus among the scientific community on the impact of digital transformation on the economic activity of a company due to the difficulty of determining a universal indicator of digital transformation that reflects the corresponding effects. In some cases, such indicators as the volume of R&D expenditures, traditional financial and economic indicators are taken for research, or the fact of the presence of a CDO (Chief Digital Officer, literally - the director of digital technologies) is taken into account. But specific indicators of the effectiveness of digital transformation are

Fig. 5. Results of regression analysis of the impact of digital transformation on revenue

```
Random-effects GLS regression                   Number of obs      =       130
Group variable: year                            Number of groups   =        10

R-sq:  within  = 0.1147                         Obs per group: min =        13
       between = 0.2530                                        avg =      13.0
       overall = 0.1011                                        max =        13

                                                Wald chi2(1)       =     14.40
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0001
```

revenue	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
transformation	-85634.02	22564.76	-3.80	0.000	-129860.1	-41407.9
_cons	194054.6	16199.31	11.98	0.000	162304.6	225804.7

Fig. 6. Results of regression analysis of the impact of digital transformation on operating profit

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Random-effects GLS regression                   Number of obs      =       120
Group variable: year                            Number of groups   =        10

R-sq:  within  = 0.0546                         Obs per group: min =        12
       between = 0.4733                                        avg =      12.0
       overall = 0.1076                                        max =        12

                                                Wald chi2(1)       =     12.54
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0004
```

ebit	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
transformation	-9776.66	2760.673	-3.54	0.000	-15187.48	-4365.84
_cons	19975.09	2065.1	9.67	0.000	15927.56	24022.61

Fig. 7. Results of regression analysis of the impact of digital transformation on bottom line

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Random-effects GLS regression                   Number of obs      =       130
Group variable: year                            Number of groups   =        10

R-sq:  within  = 0.0726                         Obs per group: min =        13
       between = 0.4720                                        avg =      13.0
       overall = 0.1232                                        max =        13

                                                Wald chi2(1)       =     16.19
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0001
```

profit	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
transformation	-6580.899	1635.718	-4.02	0.000	-9786.848	-3374.951
_cons	12060.18	1230.377	9.80	0.000	9648.685	14471.67

not yet formed in sufficient quantities and are not public. This imposes significant restrictions on the study.

2. As the main base of the study, we took those companies, information on the digital transformation of which, as well as their financial statements are in the public domain.

3. Business efficiency is influenced by many factors, which are quite difficult to identify and formalize in full, and therefore it is not always possible to obtain reliable estimates of the contribution of digital transformation to efficiency gains.

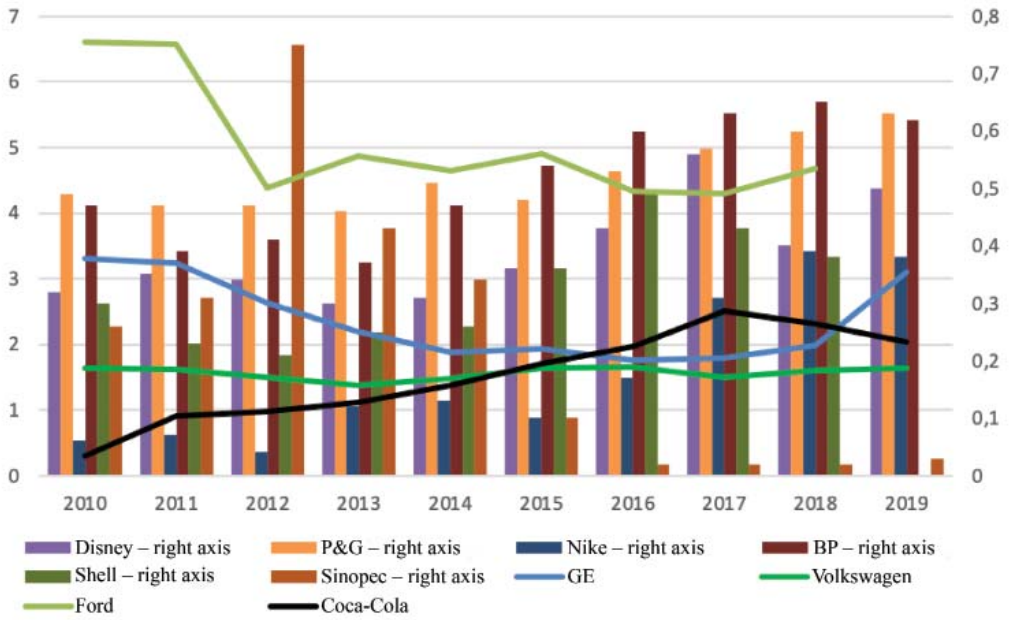
To conduct our study, regression models of the influence of the digital transformation process (independent variable) on the corresponding indicator of the company's performance (dependent variable) were built, without changing other parameters (assumption), based on the generalized least squares method, taking into account random effects (regression type) for each from performance indicators. Due to the unlimited number of externalities, they are not included in the model. The model specification looks like this:

Table 4
Regression analysis of the impact of digital transformation on the performance indicators of the company

Regression parameter / dependent variable		Revenue		Operational profit		Net profit	
Regression type (random effects)		GLS regression					
Grouping (group variable)		year		year		year	
R^2 (R-sq)	Within	0.1147		0.0546		0.0726	
	Between	0.253		0.4733		0.472	
	Overall	0.1011		0.1076		0.1232	
corr (u_i, X) = 0 (assumed)[a]							
Number of observations		130		120		130	
Number of groups		10		10		10	
Observations per group	Minimum	13		12		13	
	Average	13.0		12.0		13.0	
	Maximum	13		12		13	
(Wald chi2)		14.4		12.54		16.19	
P-value of the hypothesis that the model is adequate (Prob > chi-2)[b] (model adequacy test)		0.0001		0.0004		0.0001	
Independent variable (transformation)	**Estimated coefficient (coef.)[c] (mln USD)**	**–85634.02**		**–9776.66**		**–6580.899**	
	Standard error (Std. Err.)	22564.76		2760.673		1635.718	
	Z-statistical (z)[d]	–3.80		–3.54		–4.02	
	P-value (P > z)	0.0		0.0		0.0	
	95% Conf. Interval	–129860.1	–41407.9	–15187.48	–4365.84	–9786.848	–3374.951

[a] The prerequisite that the correlation u (errors of the model with random effects) with the tested (dependent) variable (in our case, the performance indicator) is 0. This prerequisite is necessary to build a model with random effects.
[b] P-value is the value at which the research hypothesis is rejected. Three levels are commonly used in econometrics: 10%, 5%, and 1%. In our cases, the P-value does not exceed 1%, which is less than all levels, which means that the hypothesis is not rejected, therefore, the model is adequate.
[c] This coefficient shows the influence of a factor (independent variable, in our case, digital transformation) on the value of the dependent variable (in our case, an indicator of efficiency).
[d] Statistical value for a given number of observations, which is taken from a special reference book to determine the P-value.

Fig. 8. Dynamics of the values of the ratio of financial dependence



Source: по данным информационно-аналитической базы Thomson Reuters. URL: https://www.thomsonreuters.com.

$$KPI = \beta_0 + \beta_1 \times \text{transformation} + \varepsilon_t, \quad (1)$$

Where *KPI* is the corresponding indicator of the company's performance (dependent variable), β_0 is a constant, β_1 is the coefficient for the independent variable of digital transformation (shows the impact of digital transformation on KPI), transformation is the independent variable of digital transformation, which takes the value 0, e0 if the transformation has not been carried out, and 1, if it is carried out, ε_t is the variable of random errors.

The summary results of the regression analysis of the impact of digital transformation on the performance indicators of the company, obtained on the basis of processing the studied data using the STATA analysis software package, are presented in table. 4, in relation to each performance indicator - in Fig. 5-7[10]. In order to draw conclusions, it is necessary to pay attention to the value and sign of the estimated coefficient, P-value (coefficient significance), model adequacy test (Prob > Chi²). In our case, the model is adequate for each indicator of the company's performance (the P-value is less than 1%)[11].

Regression analysis showed the following results: digital transformation has a negative impact on such indicators of the company's performance as revenue, operating profit and net income. This is confirmed by negative values of the estimated coefficient (Table 4). The digital transformation process led to a reduction in the value of dependent variables reflecting the company's performance: the volume of revenue during the analyzed period decreased on average by $ 85.6 billion, operating profit - by $ 10 billion, and net profit - by $ 6.5 billion. ...

The obtained results of the regression analysis, which showed the negative impact of digital transformation on the company's performance, allow us to make the following assumptions.

1. Digital transformation of a company is not a leading factor in improving performance in the short term. Performance efficiency is a multifactorial process, determined not only by internal factors, but also by environmental factors, however, it is difficult to formalize these factors within the framework of a regression model, nevertheless, they should be taken into account. In particular, such factors relate to the conjuncture of a specific market (in the case of energy companies, energy prices, which have a greater and faster impact on revenues and profits than technological changes within the company).

2. Perhaps digital transformation is a tool to improve performance in a strategic perspective. When carrying out it, it is necessary to take into account a certain time lag, which does not allow obtaining high returns on capital investments in the short term and reflecting the efficiency of transformation in economic indicators of a short-term nature. This thesis suggests that the assessment of the effectiveness of the company's digital transformation process itself cannot be measured by financial and economic indicators of a short-term nature. The management, which has embarked on a course towards digital transformation, needs to realize that the desire to get financial returns from it in the short term can lead the company to a crisis state, since there is a time lag between the introduction of digital technologies and the actual effect of them.

[10] Interpretations of the indicators of these figures are presented in table. 4.
[11] Hayashi F. (2017). Econometrics / Tr. from English M: Business.

3. One of the reasons for the negative impact of the digital transformation process on the efficiency of companies is the lack of their own financial resources, which was compensated by large-scale borrowing. In conditions of high dependence on borrowed capital, there is always a strong volatility of financial results from external factors of the crisis due to the effect of financial leverage: the negative development of crisis factors in the external environment generates a significant drop in net profit compared to revenue.

Almost all the companies under study in the course of digital transformation had a high dependence on borrowed funds (Fig. 8[12]): for almost half of the companies (line diagram), the value of the leverage ratio during the analyzed period exceeded 1. This indicates not only complete dependence on creditors, but also about the deprivation of equity capital at a loss (the activity is ineffective). The other half of the companies (bar graph) are also highly leveraged (more than 50% on average).

High dependence on capital, the presence of net losses also indicate the crisis state of most of the companies under study. It can be assumed that the unfavorable financial health of the company does not allow effective digital transformation in case of using borrowed funds as a source of financing for such a transformation because there are high financial risks caused, in particular, by negative changes in the external environment. They are aggravated by the risks of ineffective business models changes in the course of digital transformation and the high speed of technological changes in the external environment. A change in the business model may simply not keep pace with the technological transformations that have taken place in the economy, including those caused by the actions of competitors, or the transformed business model may have a significantly reduced lifetime. Consequently, the main risk of digital transformation lies in the impossibility of considering it as a universal means of ensuring sustainability in a strategic perspective.

This assumption is supported by practical research. For example, a Mckinsey study found that companies that were digitally transforming while implementing a full range of remediation measures almost doubled their total return on equity compared to companies that did not implement restructuring measures. Thus, the digital transformation must also be accompanied by traditional measures for the financial recovery[13] of the company. Следовательно, проведение цифровой трансформации должно сопровождаться также традиционными мерами по финансовому оздоровлению компании.

4. The existing traditional accounting system, the principles of which were laid down in the pre-digital era and on the basis of which the efficiency of the company is currently assessed by external investors and other stakeholders, does not allow to capture digital changes and effects in the company's activities due to its digital transformation.

The obtained results of the study of the relationship between the digital transformation process and the efficiency of the company's activities confirm the previous studies [Li et al., 2018; Ukko et al., 2019], according to which digital transformation does not directly affect the company's financial results, affecting only the operational level of efficiency (productivity) in the short term. At the same time, according to the named researchers, the key drivers of digital transformation are the managerial abilities of management and the modernization of operational processes, but such factors are difficult to formalize within the framework of financial statements. The authors place special emphasis on the long-term orientation of the company's digital transformation, which, as a result, smooths noticeable changes in financial indicators.

7. CONCLUSION

Let's summarize. The economic crisis caused by the coronavirus pandemic, as well as the new technological digital revolution that began a few years before it, made the digital transformation of companies an uncontested way of developing them. Digital transformation has embraced almost all economic entities that wish to remain competitive in a strategic perspective. Mass digital transformation has led to an abundance of practical literature on the experience of such transformation. However, the theoretical understanding of this process lags behind practice. The lack of a theory of digital transformation, a theoretical analysis of the essence of its nature gave rise to a number of scientific, theoretical and practical problems that have not been eliminated so far. In particular, practice shows that digital transformation of companies turns out to be not always successful. Often, companies in a crisis situation, after carrying out the corresponding transformation, also continue to remain in a crisis state, as a result of which the wrong conclusions are made about the effectiveness of digital transformation. An important direction in the further development of the theory of digital transformation of companies is the formation of a theoretical basis for assessing its effectiveness, theoretical substantiation of the impact of digital transformation on business efficiency. A review of scientific and practical literature showed that there is no consensus on these issues.

The conducted research uses regression analysis of a sample of the largest companies and does not allow us to assert with a sufficient degree of confidence about the positive direct impact of digital transformation on the company's financial results in the short term. This process assumes a certain time lag, and therefore the results of digital transformation can be seen only in a strategic perspective. One of the key obstacles to assessing the effectiveness of digital transformation is the need to adapt existing institutions to the conditions and needs of the digital economy. The existing accounting system does not capture digital effects and does not allow to show their impact on financial results. In order to obtain more reliable conclusions, further research

[12] The figure shows the dynamics of the values of the financial dependence ratio, calculated as the share of borrowed capital in the total capital (assets) of the company.
[13] According to the consulting company Mckinsey.com. URL: The numbers behind successful transformations, 17.10.2019. https://www.mckinsey.com/business-functions/transformation/our-insights/the-numbers-behind-successful-transformations.

is required based on the accumulated array of practical data. The key task for science and practice in the field of digital transformation is the formation of a new data accounting system corresponding to the conditions of the digital economy and a universal indicator reflecting the effects of digital transformation.

One of the important results of practical research is the establishment of the anti-crisis nature of digital transformation as a tool for company management. It is important that if a company is in a crisis situation, its digital transformation must necessarily be accompanied by financial recovery at the same time, or at least not lead to an increase in the impact of crisis factors.

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