

Dmytro Kabachenko ¹
Olena Churikanova
Svitlana Oneshko
Ruslan Avhustyn
Valeria Slatvinska

APPLICATION OF INFORMATION TECHNOLOGIES FOR MANAGEMENT DECISION MAKING IN THE CONDITIONS OF THE INSTABILITY OF THE EXTERNAL ECONOMIC SPACE

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Abstract: *The objective of the article lies in determining the place of information technologies in the process of making management decisions, as well as determining the current level of their implementation with the formation of forecasts for the near-term prospect. Methodology. The assessment of the level of information technology development has been carried out on the basis of Statista (2021) and Gagliodi (2020) data by applying deduction methods, graphical and comparative methods. Results. The analysis of statistical data has revealed that the growth rate of the use of information technology in management decision making has slowed down in 2020-2021. The data obtained show that the IT market is currently focused on the supply of devices and software for remote working. Services on supporting decision-making are used less often, although in the current unstable environment, they should be the ones to pull the focus of leaders onto themselves.*

Keywords: *Information technologies, Management decisions, COVID-19 pandemic, Information services market, IT market forecast*

1. Introduction

In modern conditions of instability of the external environment, the complexity of decision-making is increasing in comparison with the past, when the condition for achieving the set goals was only human and physical resources. Needless to say that these factors are necessary conditions for success; however, they are not enough to make effective management decisions. Access to information through information technology (IT) and information systems (IS) becomes an integral part of success (Ming, Teng & Jodaki, 2020).

Thus, regardless of the size of the business, information technology plays a leading role

in its organization: whether it concerns everyday tasks, or about planning and strategic management of the enterprise. Companies typically use IT technology in the following three areas, namely: to provide information processing, to assist in decision-making, and to support innovation (Calvello, 2019). Constant change of conditions of external environment of the organizations' activities creates additional requirements to constant development of information technologies. Moreover, it is often a common practice when the cost of purchasing IT and IP, in the opinion of the organization, is too high, and it is perceived by them as an ineffective investment. Taking this into account, the relevance of this

¹ Corresponding author: Dmytro Kabachenko
Email: ocenka_2000@i.ua

scientific research is due to the need to assess the ratio of the benefits of IT and the costs of their purchase, as well as the necessity to determine their role in the process of making managerial decisions in modern conditions of an unstable economic environment.

2. Literature Review

Every day, business entities need to choose among possible solutions. The results of the selection may have a short-term effect; however, they may also be long-term. It depends on the decision has been made successfully or unsuccessfully, and whether in due time (Neziray& Berisha-Shaqiri, 2018).

For the last few years, advances in computer information technologies (IT) have led to the appearance of a wide range of systems used by managers in making and implementing decisions. These systems have been created from scratch for specific purposes and differ significantly from standard electronic data processing systems. However, it is quite common practice when managers do not apply these systems in their work. At the same time the technicians, responsible for their development, have a limited idea of the directions of their use (Alter, 1976). Along with this, Merriam-Webster (2021) defines IT as a technology including the development, maintenance and use of computer systems, software and networks for the development and dissemination of data.

Over time, IT have been spread in modern organizations - from the largest manufacturing firms to the nearest pharmacy and rates have increased significantly. This is related to the fact that enterprises, involved in international trade, contact global competition and strive to succeed in this direction (Pineros Espinosa & Gomez Santos, 2017). It is small surprise that some organizations will prosper, others will fail. In particular, those who learn to use and

supervise information technologies to their advantage will be able to withstand the onslaught of competition.

Currently, the mission of many companies around the world lies in creating technologies that will assist in management decisions (even for the companies - developers) (Darioshi & Lahav, 2021). Artificial intelligence and complex algorithms are a practical reality nowadays. An example is the activities of the MobilEye Company; it has announced the launch of an autonomous car on the market by 2025, which will fully replace a person. The developer has already released an assistant that corrects driver behaviour, helping them make better decisions and avoid accidents (An & Rau, 2019).

The use of IT provides an opportunity to make information more accessible to decision makers, increasing the quality and quickness of their adoption (Ming, Teng &Jodaki, 2020). Technologies facilitate collaboration between people by ensuring joint business decisions. For instance, business representatives use information technologies in order to inform employees about decisions made, as well as to ensure the implementation of these decisions (Linton, 2017; Cardinal, 2020).

It should also be mentioned that information technologies are very important at the stage of business expansion. After all, managers are obliged to control each department in order to be sure that the goals and tasks are completed on time. The owner should control competitors, usually pursuing one goal: to attract customers. These conditions make it necessary to have information systems based on artificial intelligence in order to provide an opportunity for employees and managers to collaborate and process operations quickly (Christiansen, 2021). Analysts of Comodo One (2021) believe that effective information system can provide an organization with better planning, decision-making, and, consequently, getting the desired outcomes.

The use of IT leads to changes in the specifics of decision-making, the remuneration system and the performance assessment system. This system is called the organizational architecture “three-legged stool” (according to the collective viewpoint of Brickley, Smith and Zimmeran). This three-legged stool shows the role of balancing and aligning these elements, working together in order to influence the effectiveness of the organization. Altering one component steadily provokes the alter of the others in order to maintain the necessary balance and effectiveness of the organization (Revija, 2014).

A company with a great IT platform, or the one that employs professional IT specialists, find it easier to build, configure and deploy a management information system (Segal b, 2021). An important direction of using information technology in business is the creation of communication opportunities through appropriate platforms (conferences, video chats, corporate and general Internet), the ability to conduct virtual meetings with staff and clients in all corners of the globe, without wasting time and money on travel. The ability to promptly involve in all work processes, regardless of the geographic location of the head, has a positive effect on the effectiveness of management decisions and allows real-time monitoring of their implementation (Donohoe, 2019). In addition, IT technologies can be used by companies to evaluate indicators, for example, to analyse customer data: who has overdue bills or who has stopped consuming one’s company’s products (Calvello, 2019).

It is quite common practice to transfer responsibilities for the implementation and upgrade of IT in enterprises to profile managers. These responsibilities include hardware software, information systems programming and design, and website development. IT managers help coordinate the technological direction of their organizations by creating business plans, managing online processes and monitoring network security (University of Wisconsin,

2020). Transferring these processes to specialized employees increases the efficiency of the work performed and provides the opportunity for managers to comprehensively monitor all processes both inside and outside the company.

There is a special technology that is used by head of organization in the process of decisions making. It’s called the Decision Support System (DSS) (Olavsrud, 2020). This system, in turn, is divided into three sub-categories, namely: Decision Support System, Group Decision Support System and Group Support System (Delahunty, 2017).

By the way, DSS is responsible for collecting and analyzing data, with their subsequent synthesis towards generating comprehensive information reports. This distinguishes the DSS information application from a normal operational application, the function of which is only to collect data. This system can be fully automated or human-guided. A combination of both options is also allowed. Ideal systems independently analyze all information and actually make solutions in the user’s stead or allow him adopting informed decisions faster (Segal a, 2021).

An example of the positive effect of using IT is the experience of Xero Company; they wanted to save its resources and simplify the process of managing them. As a result, an automated system of benefits and ASA compliance technology was introduced. This has led to reducing costs and increasing workflow efficiency (Profiles Asia Pacific, 2017).

Along with this, it should be mentioned that the measure of using IT in the practice of decision-making in nowadays conditions has been little studied in the scientific literature.

2.1. Aims

The main purpose of the investigation lies in determining the influence of IT on the decision-making process at each stage of its adoption. In addition, particular attention is

paid to the analysis of the state of IT development in the world and studying the impact of the Covid-19 pandemic on the IT market, as well as services for making management solutions.

As a result of the investigation conducted, we aim to confirm or refute the following hypotheses, namely:

H1. In nowadays conditions of economic instability, effective management decisions cannot be made without using of IT.

H2. The spread of the COVID-19 pandemic, as one of the largest economic shocks in the last decade and a half, will halt spreading information technology in default of additional funds available on the part of business representatives.

H3. In 2022-2023, the IT market will grow fast; consequently, this will affect the spread of IT for management decision making.

3. Materials and methods

The methodological basis of the exploration includes the works of investigators, statistics, conclusions of analysts, scientific articles in the field of IT, based on which conclusions are formed about the state of development of IT in the world.

Methods of analysis, synthesis, deduction, graphic, formalization, logical abstraction, theoretical knowledge, monographic, systematization and classification, etc. have been used. In order to evaluate the level of IT development in the world, Statista data (2021) has been used in part of the study of the total value of information technology for 2016-2023; study of the dissemination of information technologies by regional principle in 2019-2022, as well as data from Gagliodi, (2020) and Statista, (2021a) regarding the prognosis of changes in spending on IT in the context of their components.

4. Results

The process of making a managerial decision starts with the awareness of the fact that decision-making is necessary. This means that at the present moment, the organization is at the crossroads and the management body should decide which way to move on. At this stage, the nature of future choices and the rates involved are assessed (Wilson, 2021). It is importantly to clearly define the time limits within which a decision should be made, forasmuch as some are urgent and some may be pending.

The next stage of management decision-making is the gathering of source data: determining the type of information required and methods of collecting it. Managers receive information from external and internal sources. IT plays an considerable role at this stage forasmuch as it gives managers access to a huge volume of information stored digitally. We propose to analyse the impact of IT on the information collection process using Figure 1.

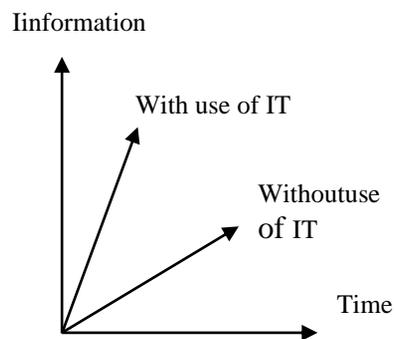


Figure 1. The impact of information technologies on the speed and volume of information collection

Source: Pineros Espinosa, R, & Gomez Santos, 2017

Figure 1 shows that the use of IT allows processing more information in less time.

Additionally to increasing efficiency and reducing time, IT helps properly distribute the stream of information in the organization

in a hierarchical manner. This is achieved by expanding the ability to access information from the executive level to the level of lower managers, increasing the effectiveness of decentralized solutions. After all, the decision-making process takes time and more accuracy, which can be ensured by providing the opportunity for employees to interact with each other and have immediate access to information and decisions made by senior and middle management sectors.

On the other hand, the facility of access to a huge amount of information can provoke the effect of “information reload”, which in turn will hinder the process of decision-making (Hurwitz, Lahav, & Mugerma, 2020). In this case, IT also resolves the situation through the inherent ability to format information, as well as present it in an easy-to-understand form.

The reliability of information, which requires no proof, also plays a considerable role. Studies conducted by Darioshi & Lahav (2021) have revealed that about 75% of financial sites contain false information. Therefore, one of the main tasks of IT should be provision of access to reliable information at the right time.

However, alone data will not improve business decisions. Many IT departments believe that the boundaries of their responsibility are limited only to deliver big amounts of data to the person, who makes decision. In practical terms, raw data does not meet the needs of decision makers creating a divide between IT and business.

Provided with information, managers determine the different paths along which the business will move in the future. Besides, it is being clarified which alternative best meets the goals identified at the decision-making stage. That alternative is chosen that has the greatest chance of success and is most stand together the values and culture of the company. Based on the above, we can make conclusion that IT helps form an information base, which is the bottom for further decision-making.

However, the positive influence of IT on the decision-making process does not end there. After all, artificial intelligence can help a person make decisions by presenting past experience, which will measure the likely success of each decision. Once the decision is made, we need to evaluate the outcome and determine how well it meets our expectations. This requires gathering even more information and analyzing it qualitatively. Technologies are best suited for these purposes. Technology solutions ensure an checkup of all relevant data, providing an opportunity for stakeholders to concentrate on more important aspects of decision-making.

Consequently, it is almost impossible to keep up with the times, to expand one’s business without the use of IT, especially in the conditions of an unstable environment. All the above information confirms H1.

It is extremely important to identify early signals in time concerning the necessity to exchange the current decision-making system by the application of IT (Figure 2).

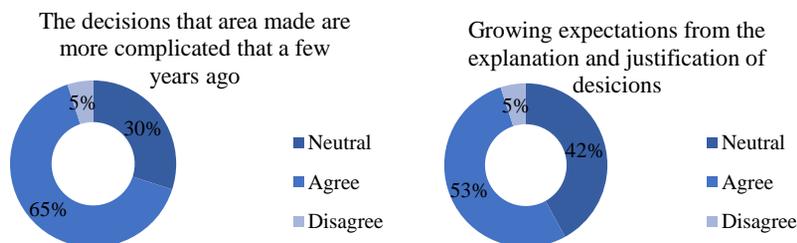


Figure 2. Early signals of the necessity to exchange the existing management decision-making system (Source: Rollings, 2021)

Therefore, if the complexity of decisions increases, as well as expectations from the outcome of management decisions, the organization should start applying IT in its activities.

The degree of use of IT in the decision-making process require on the development of IT in the country as a whole. From year to year, the cost of IT in the world is growing (Figure 3).Moreover, it planning that by 2023, the growth rate of IT costs will accelerate, and in 2023 it will reach 5,82 trillion USD.

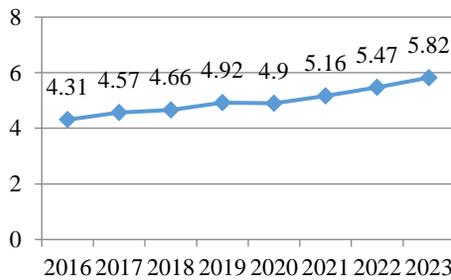


Figure 3. Total value in the information technology market for 2016-2023, trillion USD.

Source: Statista (2021c)

Significant disparities in the level of IT use in different regions of the world are observed (Figure 4).In particular, IT is mostly distributed in North America and Asia.As of 2021, the level of IT use is 35% and 32%, respectively.This indicator is slightly lower in Europe - 22%.In Latin America and Africa, applying of IT is 5%.

The spread of COVID-19 has negatively affected the information technology industry. As may be inferred from Figure 3 for 2019-2021, the growth in the level of IT use did not take place. Moreover, it is expected that in 2022 the IT industry will develop only in Latin America: from 5% to 6%.In Asia, there will be a rollback to 31% (this level was not for the entire study period).For all other regions, IT application will remain at the level of 2021.

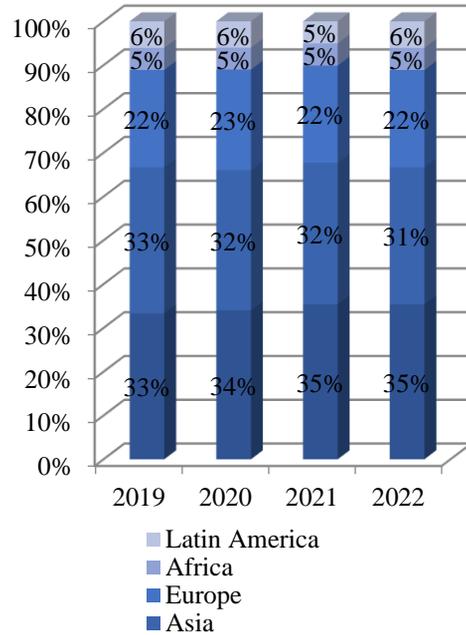


Figure 4. Dissemination of the information technology (IT) industry worldwide from 2019 to 2022, by regions

Source: Statista (2021b)

We propose to define the dynamics of alter in the value of IT technology for 2019-2021, drawing up the results of the study in the Table 1.

Owing to IT market instability during the pandemic, researchers have unanimously monitored the spending decline in all major IT areas in the world in 2020. In this regard, the biggest blow was dealt to the purchase of the device and the central data processing systems. This data processing system is one of the technologies providing support in management decision making. On the other hand, in the circs of the pandemic, the demand for remote conferencing tools and public cloud offerings has grown. A phased increase in all areas of the IT market can be observed in 2021. The biggest growth was observed in corporate software and central data processing systems (5,2%).

Table 1. Worldwide IT Spending Forecast, millions of U.S. Dollars

	2019		2020		2021	
	Spending	Growth, %	Spending	Growth,%	Spending	Growth,%
Data Centre Systems	214.911	1.0	208.292	-3.1	219.086	5.2
Enterprise Software	476.686	11.7	459.297	-3.6	492.440	7.2
Device s	711.525	-0.3	616.284	-13.4	640.726	4.0
IT Services	1.040.263	4.8	992.093	-4.6	1.032.912	4.1
Communications Services	1.372.938	-0.6	1.332.795	-2.9	1.369.652	2.8
Overall IT	3.816.322	2.4	3.608.761	-5.4	3.754.816	4.0

Source: Gagliodi, 2020

Because of the instability of the IT market during the COVID-19 pandemic, researchers have unanimously monitored the decline in spending on all major IT areas around the world in 2020. In this regard, the biggest blow was dealt to the acquisition of the device and the central data processing systems. This data processing system is one of the technologies providing support in management decision making. On the other hand, in the conditions of the pandemic, the demand for remote conferencing tools and public cloud offerings has grown. A gradual

increase in all ambit of the IT market can be observed in 2021. The biggest growth was observed in corporate software and central data processing systems (5,2%).

Based on the dictades provided by the statistical platform Statista (2021), we can sight that the segment of PCs and tablets in 2021 will grow by almost 17%, which is connected with growth in remote jobs, providing an opportunity to continue working in quarantine conditions (Table 2).

Table 2. Forecast of changes in IT spending in 2020-2021 in the conditions of the spread of COVID-19

Characteristics	Pre-Coronavirus	Probable (end of March 2020)	Pessimistic (end of March 2020)	Forecast – May, 2020	Forecast – September, 2020	Forecast – April, 2021	Forecast – October, 2021
Mobile phone	9%	6%	-1%	-	-5%	-3.1%	-3%
PC/Tablet	-6.3%	-8%	-13%	-	6.1%	13.6%	16.9%
Device overall	-	-	-	-12.4%	-	-	-
Server/Storage	0.8%	-1%	-3%	-	2.1%	1%	2.3%
Software	8.7%	8%	7%	-1.9%	3.3%	6.6%	6.6%
IT Services	3.2%	3%	2%	-2.6%	-2.2%	-2.2%	-2.2%
Network	2.6%	-	-	3.8%	-	4.3%	-2.1%
Peripheral	-3.8%	-	-	-	-9.8%	-4.9%	-2.5%

Source: Statista (2021a)

In addition, the data in the chart confirms the dictates from Gagliodi, 2020 on the increase of costs for enterprise software. However, according to Statista (2021a), there will be no increase in the cost of IT services. Moreover, costs will continue the downward trend and decrease by another 2,2%.

5. Discussion

It is obvious that the spread of COVID-19 has negatively affected the increase of the IT market. Although the general trend of growth in IT spending remains positive, whether this is due to the surge in prices for IT goods remains an open question. Table 1 and Table 2 confirm that the IT market has been

negatively affected by the COVID-19 pandemic. After all, despite the fact that the information in some areas differ, the unanimous fact is that 2020 was not under the auspices of the spread of IT in economic life, which in the aggregate confirms H2.

Gutierrez (2021) highlights in his study that the COVID-19 pandemic has driven growth in IT, teleworking, cloud services and cybersecurity.

On the other hand, the pandemic has further confirmed the gravity of effective management of one's business by adoption the right and timely management decisions. For instance, Dineva, (2021) notes that the spread of COVID-19 has become a catalyst for many organisations towards increasing the use of digital tools in their activities in order to survive. However, a significant part of them were not ready for this, forasmuch as most companies still resist to change and are sceptical towards the introduction of technologies.

Moreover, even the solution to use IT technologies in their practice should be reached critically and responsibly by managers. After all, individuals thoughtlessly buying technology are found in many organizations, and they can blow up the ability of managers to make wise and timely technology choices. This, in turn, will affect the efficacy of the chosen technology specifically for one's business (Sacolick, 2021).

The role of timely management decision-making in nowadays conditions is also confirmed by Tutuk, (2021), who argues that in the digital age, solutions should be made in real time mode. IT allows doing this by certain that all the needed information is processed here and now. A prime example of it is the data generated for discussion by the leadership on Forbidden Planet. Through the use of the Qlik platform, managers have been capable to process and evaluate more important business processes and data volumes in just 15 minutes instead of wasting time in meetings, appointments,

reloading reams of papers or computer files. This allows looking ahead and not in the past. Within conditions of such an unstable economic environment as it is observed nowadays, this is extremely important.

In addition, understanding the solutions that need to be made today and that can be made later, as well as the ability to focus on goals rather than analysis, frees up creative thoughts and generates new opportunities. This leads to growth flexibility and the formation of the capability to cope with future uncertainty. Of course, Shafer believes that there are instincts based on years of experience, Shafer (2021). However, using IT will improve your decision-making success.

Currently, the world is on the verge of a new one quarantine. Despite the fact that vaccination of the population is in full swing, the world has already been talking about new quarantine restrictions. Only time will reveal whether the forecasts for the development of the IT industry for 2022-2023 come true. The only fact is known for sure that effective management will make it eventual for many enterprises to survive the crisis period, and IT should become an integral assistant in this process. Thus, although analyst data indicate the planned development of IT in 2022-2023, the threat of new quarantine restrictions does not allow us to confirm H3 by 100%.

6. Conclusions

The research has analyzed the phases of managerial decision-making and determined the place and influence of IT on this process. It has been established that using IT makes it feasible to increase the quantity of data processed in less time. This creates the preconditions for greater awareness and responsibility in decision-making. It has also been found that while using IT, managers have the opportunity to better assess existing alternatives and make the most effective

decisions.

The extent of technology in business require on the extant of IT use within countries. The dynamics of growth of IT expenditures for 2016-2023, analysed in the academic paper, the dispensation of the IT industry in the regional context for 2019-2022, as well as forecasts of changes in IT expenditures in terms of components according to Gagliodi, 2020 and Statista (2021a) have provided the possibility to establish the following conclusions. Firstly, in 2022-2023, global IT spending will proceed to grow. Asia, North America and Europe are the regions with the highest use of IT. However, taking into account the events of recent years related to the COVID-19 pandemic, the pace of development of the IT market in the regions is slowing down. In particular, in Europe, North America and Africa, the share of IT in 2023 is not wait around to growth, while in Asia, on the contrary, it is wait around to decrease by 1%. Secondly, the pandemic has dealt the greatest blow to the direction of devices and central data processing systems, which is one of the technologies applied for simplifying the decision-making process. In

addition, the growth of information services (which also serve as aids in decision making) is not expected in the near future.

In general, the pandemic and the shifts in economic life caused by it once again have confirmed the need to take full responsibility for management decision-making. For many organizations, this is a matter of stable development or survival. According to investigations presented by scientists in our academic paper, for some, the pandemic has become an impetus for the introduction of IT into business practice. After all, this leads to increased flexibility and the formation of the ability to cope with future uncertainty. However, on the other hand, for the rest of the economy, IT remains something distant and unknown. It is difficult to predict how the information technology market will develop in the future. The possibility of repeated quarantine restrictions is already being announced at the level of heads of states. Only time will reveal whether economic entities will have the resources and implement IT in their activities. Eventually, the fact that it should be urgently done can't be denied.

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Dmytro Kabachenko

Dnipro University of Technology,
Dnipro,
Ukraine
ocenka_2000@i.ua
ORCID: 0000-0001-6126-4809

Olena Churikanova

Dnipro University of
Technology,
Dnipro,
Ukraine
Elenachurikanova@gmail.com
ORCID: 0000-0001-5703-2271

Svitlana Oneshko

Odessa National Maritime
University,
Odessa,
Ukraine
osvfox1@gmail.com

Ruslan Avhustyn

West Ukrainian National
University,
Ternopil,
Ukraine
avgustyn27@gmail.com
ORCID: 0000-0003-3101-7107

Valeria Slatvinska

International Humanitarian
University,
Odessa,
Ukraine
slatvinskaya_valeriya@ukr.net
ORCID: 0000-0002-6082-981X
