Risks of IT technology adoption

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Abstract. Automation of technological processes and digitalisation of various spheres of the economy are among the key management tasks. The main threats and risks to development include cross-border threats and illegal use of information and telecommunication technologies, including computer attacks on the information infrastructure and means of communication. The primary task in solving problems of cyber security is introduction of domestic technologies and software products. In this article, we consider the risks of adopting new IT-technologies. Initially, the risks at each stage of project implementation and introduction of IT-technologies were identified, then the methodology of risk assessment was applied based on the determination of risk probability and degree of negative consequences realization (losses for the organization). Each risk was assessed taking into account two items. The first is the probability of risk occurrence. The second is the danger of risk or adverse consequences (losses) which arise at the organisation in case of its realisation. To determine the degree of risk of risks, 4 priority groups were allocated, the weighting values of the groups, and the risks were calculated. Subsequently, each risk was assessed and the risks of implementing new IT technologies were ranked. The research showed that the main risks of IT implementation include innovation risks, information security risks, risks connected with decrease of productivity and capacity of information systems, with changes in the project budget, miscalculations in selection of techniques, equipment, its installation, insufficient qualification of executors. The grouping of risks by stage of their occurrence showed that the risks increase and have the highest aggregate assessment at the stage of operation. Risks are managed throughout the life of the project, but the ability to manage risk decreases as the project progresses towards completion. Identifying, assessing and ranking risks is the basis for developing an effective risk management system

1 Introduction

Mass introduction of information technologies, automation and the use of artificial intelligence allow optimizing business processes and improving the performance of companies. Therefore, many authors' work is based on the advantages of implementing IT technologies and is devoted to justifying the use of a particular technology to reduce company risks and increase production efficiency [4]. Projects implemented in the area of information and computer systems involve the use of a large number of technologies,

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technically complex devices, and means of communication, and consequently, during their implementation, a large number of risks arise that have a significant impact on the results of implementation. Therefore, project risk analysis and assessment are quite relevant and debated issues. For example, some scholars consider industry 4.0 implementation risks [3] and analyse and develop risk management measures [9]. Some scientists and economists investigate risk factors [1,10] and study individual risks of technology firms [2].

When assessing the risks of introducing new IT technologies, a comprehensive approach based on the identification, systematisation, and ranking of all the risks of the project should be used. It is necessary to quantify the totality of risks, examine external and internal factors, and divide them into manageable and unmanageable.

The aim of the study is to comprehensively assess the risks of implementing new IT technologies, taking into account the likelihood of their implementation and the occurrence of adverse time, technological, and cost consequences and losses.

Based on the objective, the following research objectives were formulated:

- to identify the risks of adopting IT-technologies,
- to conduct a risk assessment using expert method based on the probability of each risk and its priority group
- to carry out risk ranking, to identify the most significant of them.

2 Materials and methods

The methodological basis of the study is the systematic approach, which allows to consider the IT project as a holistic system consisting of many elements and subsystems, interconnected with each other. The functioning of these elements and subsystems leads to the emergence of risks, which can be investigated using a point estimate. Each risk can be assessed using a probabilistic approach and prioritising groups (group and risk weights). Formal and abstract-logical (deduction, induction, abstraction), empirical, economic-statistical methods were used in the work. The data was processed using the Microsoft Office application software package.

3 Results

We will consider the risks of the adoption of new IT technologies and evaluate them. By implementation risks of information technologies, we will understand adverse events that may affect the timing of information technology implementation (time risks), or the functional completeness of the implemented technologies (technology risks), or the cost of implementation (cost risks). Let us distinguish four stages of information technology implementation and operation and identify the risks that may arise at each stage (Table 1).

Table 1. Risks of adopting IT technology. Source: complied by the authors.

Stages	Risks of adopting IT technology
Project (pre-setting)	1. Adoption planning errors (R_1)
	2. Risks related to changes in project budget (R_2)
Installation stage	3. Miscalculations in the choice of machinery, equipment, its installation (R_3)
	4. Poor integration with existing technology (R_4)
	5. Risk of failing to complete the project on time (R_5)
Initial operation stage	6. Delay in technology start-up after implementation (R_6)
	7. Unpreparedness of employees to use new IT technologies (R_7)
	8. Insufficient qualification of performers (R_8)

	9. Functional inconsistency in actions of different structural units (R_9)
	10. Failure to meet the expectations of managers (R_{10})
Operational stage	11. Risk of reduced information security (R_{11})
	12. Risk of reduced productivity and capacity of the information system (R_{12})
	13. Organisational risks (changes in organisational structure or management system) (R_{13})
	14. Innovation risks (related to the rapid emergence of more advanced IT technologies) (R_{14})

All risks in terms of their impact on the organisation can be divided into tolerable, material, critical and catastrophic risks, and by the nature of the impact - temporary, technological and cost risks. By the possibility of management risks are divided into manageable and unmanageable, by the causes of occurrence - on external and internal. As shown in Table 1, most risks are internal manageable, so they are well controlled and managed by the organization. Each risk of implementing new IT technology can be assessed from two perspectives. The first is the probability of occurrence of the given risk (in percentage out of 100), the second is adverse consequences which arise at the organization in case of realization of risk. Let's carry out an assessment of risks of introduction of new computer technologies in the organization taking into account these two components.

Based on the method of expert assessments with the involvement of leading experts in the IT-sphere, the probability of occurrence of each risk in the above list was assessed. The expert assessments were checked for consistency. The next step was to prioritise each risk (from 1 to 4) and form risk groups. Priority 4 was assigned to acceptable risks, priority 3 to significant risks, priority 2 to critical risks, and priority 1 to catastrophic risks (the most dangerous risks causing high losses to the organisation). The weights of risk groups and each risk individually were then calculated and an assessment of each risk was given. The main results of the calculations are presented in Table 2.

Table 2. Risk assessment of IT adoption. Source: calculated by the authors.

Risks	**Average probability estimate, p_i, %**	**Priority**	**Group weight, W_i**	**Risk weight, w_{si}**	**Risk assessment, % $W_i \times w_{si}$**
R_{11}	31	1	0.375	0.188	5.83
R_3	25			0.188	4.69
R_2	50	2	0.292	0.097	4.85
R_{12}	55			0.097	5.34
R_4	25			0.097	2.43
R_{10}	33	3	0.208	0.069	2.26
R_{13}	34			0.069	2.33
R_8	60			0.069	4.17
R_{14}	85			0.069	5.9
R_1	28	4	0.125	0.031	0.86
R_6	30			0.031	0.94
R_7	60			0.031	1.88
R_9	30			0.031	0.94
R_5	60			0.031	1.88

The analysis of data in Table 2 shows that the main risks of the IT implementation include innovation risks (5.9), information security risks (5.83), risks associated with loss of productivity and capacity of information systems (5.34), with changes in the project budget (4.86), miscalculations in the choice of technology, equipment, its installation (4.69), lack of qualification of performers (4.17).

For clarity and determination of dependencies let's display risks on the diagram (Figure 1). We allocated 12 quadrants on the basis of definition of 4 ranges on axis OU (depending on an accessory of risk to priority group on size of losses) and 3 ranges on axis OX (depending on value of probability of risk occurrence). Particular attention should be paid to Quadrant 1 when analysing the risk map: it contains the most dangerous risks, as they are characterised by high potential losses (they belong to the first priority group) and a high probability of occurrence. There are no risks in quadrant 1 in our example. However, we should pay attention to risks in quadrants 2 and 5, because they represent potentially high losses for the organization (the first priority group). These risks are R_{11} (risk of reduced information security) and R_3 (miscalculation in the choice of techniques, equipment and its installation). The risks in quadrants 3 and 6 have a potentially high probability of occurrence. These risks are R_8 (insufficient qualification of performers) and R_{14} (innovation risks). Risks in quadrant 4 are also noteworthy as they belong to the second priority group of potential losses and the group of risks with medium probability of occurrence. These risks are R_2 (risks related to changes in the project budget) and R_{12} (risks of reduced performance and capacity of the information system).

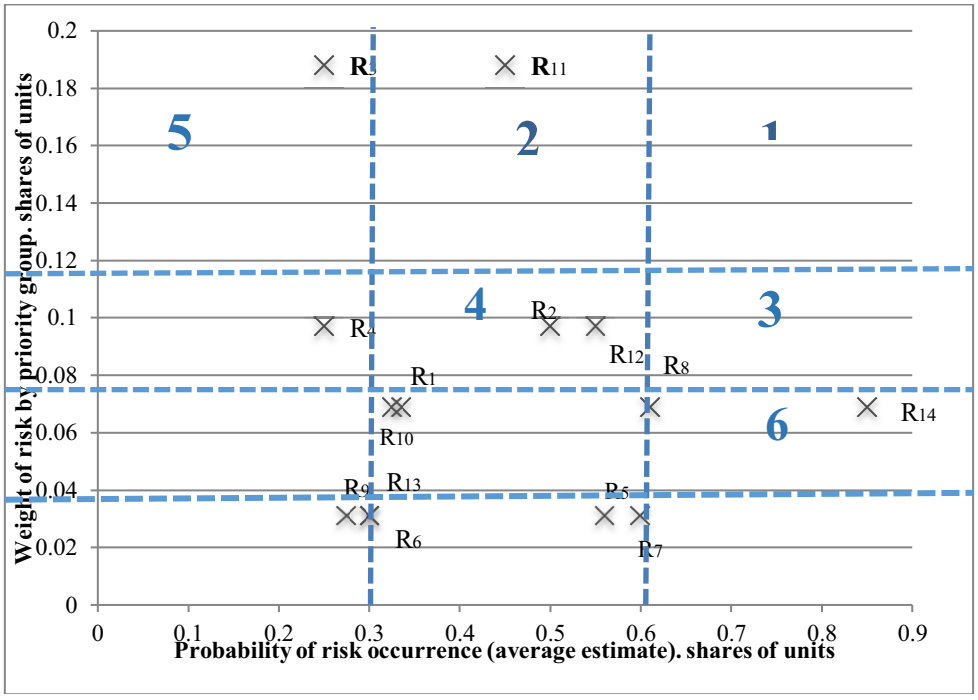

Fig. 1. Risk map. Source: complied by the authors.

Let us group the risks by stage of occurrence (Figure 2). As can be seen from the figure, risks increase as the IT project progresses and have the highest cumulative score during the operational phase. Risk management is conducted throughout the project implementation period, but the ability to manage risk decreases as the project progresses towards completion. In addition to this fact, the cumulative losses from risk increase as the project

progresses unless prompt risk management measures are taken. For example, failing to adequately respond to emerging risk in the early stages of a project may result in new risks and increased losses for the organisation as the project progresses.

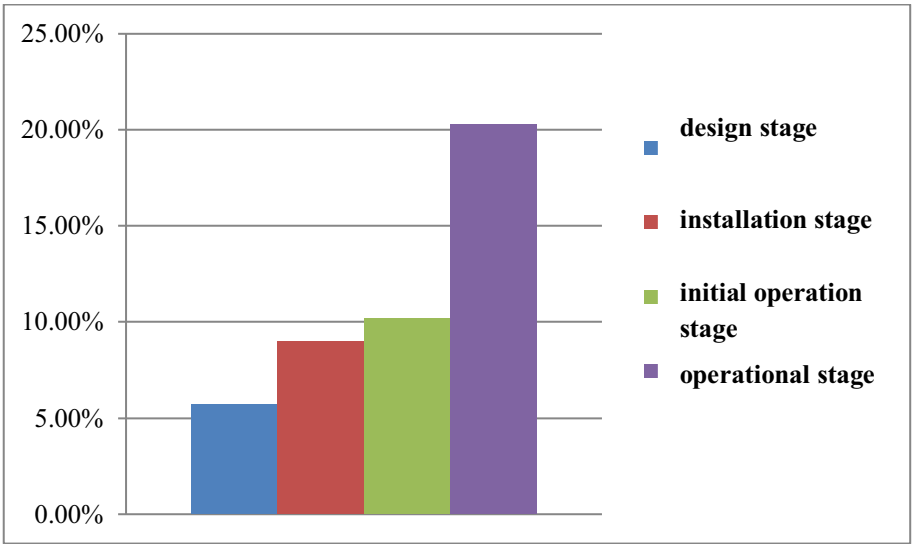

Fig. 2. Assessment of IT adoption risks by project implementation phase. Source: complied by the authors.

4 Discussion

A risk assessment performs risk ranking and determines the hazard level of each risk in the implementation of IT technologies. In practice, several risk assessment techniques are used. One of them is the sensitivity analysis [8]. It is based on identifying the most significant factors (risks). One of the disadvantages of this method is that the impact of each factor on the project is considered separately, the possibility of nonlevelling of their combined impact is not taken into account. In practise, risk modelling methods with risk mapping are actively used [5]. Simulation modelling is based on the use of a probabilistic approach using development scenarios [7]. The complexity of its application is associated with the complying an exhaustive list of options (scenarios). Economic-statistical methods based on the calculation of dispersion, covariance, and variation coefficients are actively used in risk assessment [6]. These methods require working with a large array of data, conducting a large number of calculations based on indicators obtained empirically. The method of expert assessments based on determining the probability of risks and the composition of priority groups, considered in this article, is relatively simple. The main drawback of this method is considered to be the subjective nature of expert evaluations. However, the application of the rules of this method and the comparison of expert assessments allows the latter to check for consistency and reduce the subjectivity of the results of the study.

5 Conclusion

The risk assessment of the adoption of new IT technologies enables risks to be ranked according to their degree of danger and impact on the organisation's activities. On the basis of quantitative assessment of risks the risk manager makes the decision on risk management, necessity of control and possibility of influence on each risk. The timely

identification of factors associated with the introduction of new technologies and optimal planning of measures to minimise the impact of these factors can reduce risks and improve the performance of the company. Therefore, risk assessment is one of the important stages of risk management. For example, for the most dangerous risks with a high probability of their realisation, it is necessary to develop measures of pre-event nature. For example, for manageable risks, measures to prevent their occurrence (or minimise them) should already be taken at the design stage. For unmanageable risks, various tools such as risk transfer (insurance), provisioning systems, risk containment, etc. must be used.

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