CLASSIFICATION AND ALGORITHMS OF RISK MANAGEMENT DECISIONS IN INDUSTRIAL ENTERPRISES

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Abstract. *This article examines the scientific and methodological approaches to the classification of risk management decisions and to the development of decision-making algorithms within the risk management system of industrial enterprises. Under conditions of economic instability, supply chain disruption and technological transformation, classical risk management methods require adaptation. The author systematises the risks specific to the industrial sector –production, technological, financial and environmental –and proposes step-by-step algorithms for their rapid identification, assessment and mitigation. The practical significance of the research lies in the development of applied tools that enable enterprise management to take informed strategic decisions, minimise losses and ensure the sustainable development of production.*

Keywords: *risk management; industrial enterprise; risk classification; decision-making algorithm; enterprise risk management; production resilience; crisis management.*

INTRODUCTION

The contemporary industrial enterprise operates in an environment marked by a high level of uncertainty. Volatile commodity and currency markets, the accelerating pace of digital transformation, the propagation of disruption along multi-tier supply networks and the intensification of external challenges have made isolated, reactive responses to individual hazards increasingly inadequate. International practice has consequently moved towards integrated frameworks in which risk is treated as an attribute of strategy rather than as an operational by-product (International Organization for Standardization [ISO], 2018; Committee of Sponsoring Organizations of the Treadway Commission [COSO], 2017). Empirical work supports this shift: firms that implement enterprise risk management systematically are associated with a measurable premium in firm value (Hoyt & Liebenberg, 2011).

For industrial enterprises in particular, the analysis of disruption propagation –the so-called ripple effect –has shown that the consequences of a single localised failure are amplified as they travel through the production and supply network, and that digital technologies of Industry 4.0 substantially change the analytical toolkit available to management (Ivanov, Dolgui, & Sokolov, 2019). The viability of intertwined supply networks has therefore become a criterion of risk management quality in its own right (Ivanov & Dolgui, 2020).

The theoretical foundation of the present study is the approach according to which decision-making constitutes the central link of any management process, so that the classification of risk management decisions is not a taxonomic exercise but an instrument for revealing the specific properties of each class of decision and for reducing risk during the decision-making process itself (Glushchenko, 1999). The purpose of the article is, first, to systematise the classification of risk management decisions in industrial enterprises, and second, to formalise decision-making algorithms corresponding to the principal types of management.

MAIN PART

1. Risk management as a component of the general management process

As the vulnerability of business to risk increases, many companies recognise that solutions to risk problems must be placed on a professional basis. A manager is required to protect all corporate assets and profits from losses caused by changes and fluctuations in interest rates and exchange rates, and at the same time to manage interest expenditure. Only a sufficiently experienced and qualified manager is able to handle this task. Risk management affects the efficiency of operations and systems to the same extent as the management of target outcomes or the management of resources, which allows risk management to be regarded as an integral component of the general organisational management process (Glushchenko, 1999).

Since decision-making is the central link of management, the classification of risk management decisions makes it possible to highlight their specific characteristics and creates opportunities to reduce risk in the course of the decision-making process (Glushchenko, 1999). Three classification criteria are of particular importance for industrial enterprises: the domain of application, the position of the decision within the risk management process, and the predicted efficiency of the decision.

2. Classification by domain of application

Taking an investment decision, like any other type of managerial activity, rests on the use of both formalised and non-formalised methods. According to the domain of application, risk-related decisions may be classified as geopolitical, foreign policy, domestic policy, economic, financial, technological, design and operational decisions. These types of decision are systemically interconnected and are capable of influencing one another (Glushchenko, 1999).

3. Classification by position within the risk management process

According to their position within the risk management process, decisions may be grouped into three categories (Glushchenko, 1999):

– risk-goal-setting decisions, which concern the selection of risk management objectives. These are the least amenable to study and formalisation, since formal methods for the synthesis of goals have not yet been developed;

– risk-marketing decisions, which involve the choice of methods (prevention, reduction, insurance, absorption) or instruments (structural, technological, financial and others) of risk management. These decisions do admit formalisation, in particular through functional-logical methods;

– risk-management decisions, aimed at maintaining a balance within the 'people – resources – goals' triangle while the established risk objectives are achieved by means of the instruments selected at the risk-marketing stage.

4. Strategies of risk management and stages of risk reduction

Risk management as practised in industrial enterprises comprises six strategies (Glushchenko, 1999):

– risk avoidance, through abstention from activities that carry a specific risk;

– risk assumption, with a guarantee of full compensation covered by the internal funds of the organisation, that is, the establishment of an insurance fund;

– risk distribution among the direct participants in the business;

– the establishment of a network of independent limited-liability venture firms functioning as subsidiaries of the parent organisation;

– the transfer and sale of risk liability to a third party, for example an insurer;

– risk reduction and mitigation, through the minimisation of potential negative consequences by precautionary measures such as the installation of fire-suppression systems, the maintenance of a strategic stockpile of raw materials, or the creation of a diversified stock portfolio.

Every organisation must employ all six strategies to varying degrees. Among them, corporate risk insurance has become the most widely adopted method. Risk reduction proper can be achieved at three distinct stages (Glushchenko, 1999):

1) at the operation planning or prototype design stage, by introducing additional elements and protective measures;

2) at the decision-making stage, by applying appropriate criteria for evaluating the efficiency of a decision –for instance the Wald maximin criterion, which orients the decision-maker towards the worst possible state of nature (Wald, 1950), the Savage minimax-regret criterion, which minimises the maximum opportunity loss relative to the best action available in each state (Savage, 1951:55-67), or a criterion under which the risk indicator is capped at a fixed value, so that alternatives failing to satisfy the risk constraint are excluded from consideration;

3) at the operation and technical-systems deployment stage, through strict observance of and monitoring over operational regimes.

Within each of these areas the measures implemented differ in their cost-effectiveness ratio, understood as the ratio between the reduction in the probability of unacceptable damage and the cost of achieving that reduction. Such measures entail expenditure and require increasing funding as the complexity of the system grows. Under certain conditions it may therefore prove economically more viable to allocate funds to the compensation of potential damage rather than to its prevention or reduction; in the latter case the mechanism of insurance is employed (Glushchenko, 1999).

5. Classification by management approach and by predicted efficiency

In accordance with the management approach adopted, risk-related decisions may be categorised as traditional, systemic, situational and socio-ethical. According to predicted efficiency in risk management, decision options and systems may be classified as ordinary, synergistic and asynergistic variants (Glushchenko, 1999).

Ordinary risk-related decision options are those in which the efficiency of resource expenditure per unit of achieved effect complies with the standards and regulations established for the respective industry or type of activity. Synergistic options are those in which the efficiency of resource expenditure rises sharply, so that the achieved effect displays a disproportionately growing, non-linear character. Systems of this kind operate in real time: decisions are taken and implemented rapidly enough to monitor and control the managed entity even during emergencies or crisis management situations. This dynamic is highly characteristic of production systems with disproportionately increasing scaling effects (Glushchenko, 1999).

Asynergistic decision options, by contrast, are those that fail to yield the standard or expected effect from the funds invested in risk management. Among the most frequent causes of such decisions are execution delays, the absence of the necessary resources, deficiencies in organisation and motivation, and conflicts generated by the decisions themselves. Within the class of real-time decisions it is possible to distinguish crisis decisions; the etymology of the word ‘crisis’ itself points to the moment of decision-making. A crisis decision is a decision taken at the point in time corresponding to the transition of the managed entity into an uncontrollable or otherwise unacceptable state (Glushchenko, 1999).

6. Diversification and the optimisation of investment allocation

For risk management in investment activity, diversification is frequently employed. It consists in allocating investments –and consequently risks –among several assets characterised by risks that differ both in their physical nature and in the time of their manifestation. Both spatial and temporal optimisation of investment allocation are possible (Kovalev, 2007:659-662).

Spatial optimisation of investment allocation refers to an approach in which the total volume of financial resources available for a given period is capped from above, while several mutually independent investment projects are available, each characterised by risks that differ in nature, intensity and time of manifestation (Kovalev, 2007:659).

Temporal optimisation of investment allocation is an approach in which the total volume of financial resources available for funding in the planning year is capped from above. Several independent investment projects are available that cannot all be implemented simultaneously within the planning year; in the following year, however, the remaining projects or parts of them may be executed. The task is to allocate the projects across years optimally, taking into account investment efficiency, the resources available and time-averaged risks (Kovalev, 2007:662).

7. Algorithms of risk-related decision-making

If a problem is well structured on the basis of domain-specific and statistical information, the application of programmed decisions becomes feasible. In this case the methodological features of the different types of management are reflected in the development of algorithms for preparing and taking risk-related decisions. The development of specialised risk-decision algorithms can secure the required level of organisational decision quality, reduce the influence of subjective factors and, crucially, accelerate the risk management process. In principle a specific decision-making algorithm may be developed for each typical risk problem within an organisation; at the same time it appears feasible to design a risk-decision-making algorithm tailored to each type of management (Glushchenko, 1999).

The risk-decision-making algorithm in traditional management may include the following operations:

– detection of the risk problem;

– collection of data on the sources and characteristics of the harmful factors, on the vulnerability of the risk object, and on the consequences and damages generated by the impact of those factors;

– visualisation of the data, that is, their presentation in a form convenient for analysis;

– analysis of the risk data, focusing on information concerning the risks themselves, the vulnerability of the object and the potential severity of the damage.

The decision-making algorithm in systemic risk management may include the following operations:

– monitoring and detection of risk problems;

– collection of data;

– visualisation of the data in a form convenient for analysis;

– analysis of the risk data within the system as a whole.

One possible version of a specialised risk decision-making algorithm comprises the following steps:

– collecting information on the sources of risk, their physical nature and frequency of occurrence, the condition and vulnerability of the management object, the control measures available, and the parameters of the unacceptable states of the managed object;

– analysing the collected information;

– diagnosing the risk-related problem;

– defining the management objectives for addressing the identified risk problem;

– developing criteria for assessing catastrophic (unacceptable) conditions;

– developing criteria for evaluating the effectiveness of risk management;

– generating a list of possible risk control (risk response) measures;

– forecasting the consequences of each proposed risk control measure.

Since moral and ethical (Japanese-style) management is concerned primarily with the management of human resources, the risk decision-making algorithm associated with that approach is not examined in the present study.

The decision-making algorithm employed in stabilisation-oriented risk management may comprise the following stages:

– identifying the risk-related problem;

– collecting information on changes in the risk parameters;

– analysing the dynamics of change in the composition and magnitude of the risk parameters affecting the managed object;

– assessing the time available for risk management activity, that is, the period during which the managed object is expected to remain in a controllable state with a probability not lower than a predetermined threshold;

– allocating the available time among the stages of decision preparation, decision-making and implementation, so that the risk level of the managed object remains within an acceptable range with a probability not lower than the predetermined threshold.

Naturally, when specific managerial challenges are addressed by means of a particular management approach, these algorithms may be adapted to reflect the distinctive characteristics and requirements of the problem at hand.

CONCLUSION

The findings of this study indicate that the effectiveness of risk management systems in industrial enterprises depends largely on a scientifically grounded framework for risk classification and on a systematic algorithm of managerial decision-making. The contemporary industrial environment –characterised by a high level of uncertainty, rapid digital transformation, supply chain disruption, volatile market conditions and growing external challenges –necessitates a shift away from fragmented and reactive practice towards a comprehensive, integrated and proactive enterprise risk management approach (COSO, 2017; ISO, 2018).

The proposed risk management decision-making algorithm represents a structured sequence of interrelated stages: risk identification, classification, assessment, prioritisation, the selection of appropriate response strategies, the implementation of mitigation measures, continuous monitoring and the ongoing adjustment of management decisions. Unlike traditional approaches, the proposed algorithm emphasises the continuous improvement of the risk management process and the integration of risk management into the strategic and operational management system of the enterprise –an emphasis consistent with the principle-based logic of the international standards (Institute of Risk Management [IRM], AIRMIC, & Alarm, 2002; ISO, 2018).

The practical significance of the study lies in the applicability of the proposed classification framework and decision-making algorithm to the development of corporate risk management systems across industrial enterprises in a variety of sectors. Their implementation can improve the quality of managerial decision-making, reduce potential financial and operational losses, enhance the resilience of production processes, strengthen enterprise competitiveness and support the effective achievement of strategic objectives (Hoyt & Liebenberg, 2011).

Future research should focus on the development of digital decision-support models based on artificial intelligence, big data, machine learning and digital-twin technologies (Ivanov et al., 2019), as well as on adapting the proposed algorithm to the specific characteristics of different industrial sectors and to the requirements of international risk management standards, including ISO 31000, COSO ERM and the FERMA risk management standard.

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