

METHODICAL PROCEDURES FOR DEVELOPMENT, SELF-ASSESSMENT AND IMPLEMENTATION OF RISK-CONTROLLING MECHANISM FOR ECONOMICS SUSTAINABILITY MANAGEMENT OF THE BUSINESS ENTERPRISE

Svilen V. Simeonov*

ABSTRACT— *In the current paper the development and implementation of the RCM for economic sustainability control of the business enterprise is presented. The main accent is given on the organizational and instrumental development of RCM subsystems. An algorithm exemplifying the implementation and interconnections of the RCM subsystems is presented. Based on the shown aspects for RCM development and implementation, an empirical study in Bulgarian enterprise is realized and some main results of the archived management efficiency of RCM application in the management of the economical sustainability are presented.*

Keywords: organizational construction, instrumental construction, application algorithm, efficiency, risk-controlling, economic sustainability

1. INTRODUCTUON

Risk is an integral part of any management decision and taking it into account in managing economic sustainability is imperative. This places Bulgarian manufacturing companies in serious difficulties, considering their low readiness to introduce risk-management (Богданова, 2012). Under this circumstance, the introduction of a risk-controlling mechanism may be considered to increase the effectiveness of economic sustainability management - in the absence of integrated risk management systems in the enterprise. The introduction of a risk-controlling mechanism can give the necessary orientation to the risk of managing economic sustainability. Risk-oriented management of economic sustainability should be based on the proactive approach and risk management principles set out in the risk management standard ГОСТ Р ИСО 31000-2010 and ГОСТ Р ИСО/МЭК 31010-2011. In such management, risk controlling can successfully perform a consultative function to assist management in making management decisions related to the achievement of the target parameter values characterizing the economic sustainability of the production enterprise. In view of this function, the risk-controlling mechanism will be considered as:

A comprehensive management mechanism that ensures the transformation of data into information resource and methodological support for decision-making to manage the economic sustainability of manufacturing enterprises in an undefined environment.

This complexity is expressed in two directions - while the first one connects it to a complex of internal functions (executed by the subsystems of the mechanism) who are to be implemented by the mechanism, the second one is related to the need to combine and adapt appropriate methods applicable to risk management.

*Corresponding author at the Department of Industrial Management, Technical University of Varna, 9010, Bulgaria, e-mail: svilenvs@gmail.com

Prof. Kachalov (Качалов, 2002) presents the risk management methods by categorizing them from the point of view of their applicability depending on the level of uncertainty. According to this categorization, the "Monte Carlo" method has a leading position in high uncertainty.

The name "Monte Carlo" summarizes a class of algorithms for which the following properties are valid (Манджуков, 2017):

- They use pseudo random numbers generators;
- An approximate solution is created, which may be very close to the exact one, but does not overlap with it;
- There is a level of accuracy that can be controlled by the calculation time (computer processing) or set as a parameter to achieve.

Some authors view modeling using the "Monte Carlo" method as a new era in its application (Первов, 2017). In this respect, there is development of software products (based on the "Monte Carlo" method) by some software companies, such as – Crystal Ball (Oracle), Risk Solver (Frontline Systems Inc), Risk Analyzer (Aon Hewitt), and others. It can be said that these products are capable of delivering impressive results from a Monte Carlo analysis, but the algorithms used for that purpose remain their confidential information. This practically transforms their application into black boxes, with which operate the analysts. The development of author models and software applications based on the Monte Carlo method would provide greater clarity with regard to the analytical actions performed and would provide confidence in the application of the method and the analytical information provided by it for the management of the economic sustainability.

The use of the Monte Carlo method can provide a risk assessment, but it would be difficult to assess its impact on manufacturing companies. For this purpose, it is appropriate to combine it with logic-deductive systems, such as the Du Pont model. It was developed in the 1930s by an employee of the company Du Pont (Хан, 1997). To date, the model has gained a broad continuity in business - it is applied in both classical financial management and in the value approach of financial management (Тодоров, 2014).

It has a basic character and on its basis each organization selects and includes in the model indicators that match their individual and industrial specifics. It is assumed that its main positives include the ability to provide information for the planning of values of individual indicators involved in the formation of the top benchmark. The planning process in the model under consideration is carried out following the deductive line from the highest hierarchical level to the lowest one. Analyzing the information in the reverse model (from the lowest hierarchical levels to the top) allows the conducting of an analysis of the impact of each indicator to be considered as a factor in achieving the top benchmark. The model under consideration is mainly used to analyze the ability of an enterprise to generate profits by basically developing target parameters such as ROE and ROI (Павлова, 2011), (Хан, 1997).

Joint application of the "Monte Carlo" method and the Du Pont model (Köppen, etc. 2005), (Köppen, Lenz, 2008) turns them into a successful integrated tool that is capable of implementing an informational and analytical function to support decision-making of the management in an undefined environment. Their joint use gives some authors reason to consider the parameters that form the Du Pont model as internal and external while designing ROI. Grouped in this way, the parameters allow to formalize the ambiguity of the external and internal environment as far as it is covered by the parameters and the application of the Monte Carlo method.

The probability value of the parameter at the highest hierarchical level is based on the projected values of the lowest hierarchical level. After projecting them, they are included in the

Du Pont model. The joint application of Monte Carlo and Du Pont is able to provide better management awareness than the proposed Monte Carlo, ROI value proposition of some authors (Bamikole etc., 2011).

Other authors find successful joint use of the Monte Carlo and the Du Pont model as an instrument for introducing economic uncertainty into an overall model for the RFS regarding the eligibility for space programs (Maris, Bandte, 2017). To achieve this assessment, designing ROI value is proposed. On the basis of this projection is the use of empirical data to form an empirical distribution that is subjected to a subsequent transformation followed by a normal distribution by the Metropolis-Hastings method (Köppen, etc. 2005). This transformation is widely used and provides significant ease in the constant use of empirical distributions.

From the above-mentioned it becomes clear that the joint use of Du Pont and the Monte Carlo method has its advantages, allowing it to increase their information usefulness compared to their use individually. It is clear that the authors surveyed rely on the use of empirical distributions to avoid the drawbacks of applying purely theoretical distributions of probability values. In the design of economic values using the Monte Carlo method, use of interval values of economic parameters positioned at the lowest hierarchical level in the Du Pont system was not found. Using interval values would allow a more accurate reading of the uncertainty dynamics and its impact on the formation of the indicators included in the Du Pont model. It is also possible to apply the Box-Muller transformation, instead of Metropolis-Hastings.

In this article, economic sustainability management will be considered as management ensuring the achievement of the specified values of the parameters characterizing the economic viability of the enterprise - with tolerances. To support this management, the author presents the methodical construction and application of a risk-controlling mechanism based on the joint application of the Monte Carlo method and the Du Pont model using interval values and the Box-Muller transformation. For this purpose the gradual construction of risk-controlling mechanism is presented - with emphasis on organizational and instrumental construction. To facilitate computational operations related to the Monte Carlo method, a software application developed by the author is presented.

2. METHODOLOGICAL PROCEDURES

Prior to taking action to build a risk-controlling mechanism to manage economic sustainability, it should be determined to what extent its introduction is justified. For this purpose it is necessary to form a team (figure 2.2) which is to evaluate and compare the expected benefits and costs.

The information gathered should also ensure the application of formula 1.

$$R = \frac{ER}{EC} \quad (1)$$

- R – rationality of the imminent risk-controlling mechanism;
- ER – expected benefits of introducing a risk-controlling mechanism – economy of managerial work;
- EC – Expected total costs and disadvantages related to the introduction of a risk-controlling mechanism.

Findings that expected earnings exceed the respective expected costs will indicate existence of justification to introduce the risk- controlling mechanism for managing economic sustainability. An empirical study conducted by the author revealed the production of a coefficient of 10.6 - formula 1.

Taking action to implement the RCM should happen after the relevant management decision has been taken in formal form. This decision leads to the expanding of the initial team, which should take as its task the realization of the steps of figure 2.1.

Diagnostics	<ul style="list-style-type: none"> Analyzing the information resource necessity Analysis of the existing managing system Analysis of the existing information system
Planning	<ul style="list-style-type: none"> Compiling a time schedule Budget for test introducing of Risk-controlling mechanism Budget for implementation of Risk-controlling mechanism
Formation	<ul style="list-style-type: none"> Organizational development Instrumental development
Pilot implementation	<ul style="list-style-type: none"> Data collection for operation of the risk-controlling mechanism.
Efficiency assessment	<ul style="list-style-type: none"> Applying methodological procedures for assessing effectiveness; Reporting.
Improvement	<ul style="list-style-type: none"> Planning for Improvements; Effective development of the Risk-controlling mechanism.

Figure 2.1 Stages of development a risk-controlling mechanism for management of economic sustainability.

The implementation of the main stages related to the organizational and instrumental construction of the RCM are presented in figure 2.2.

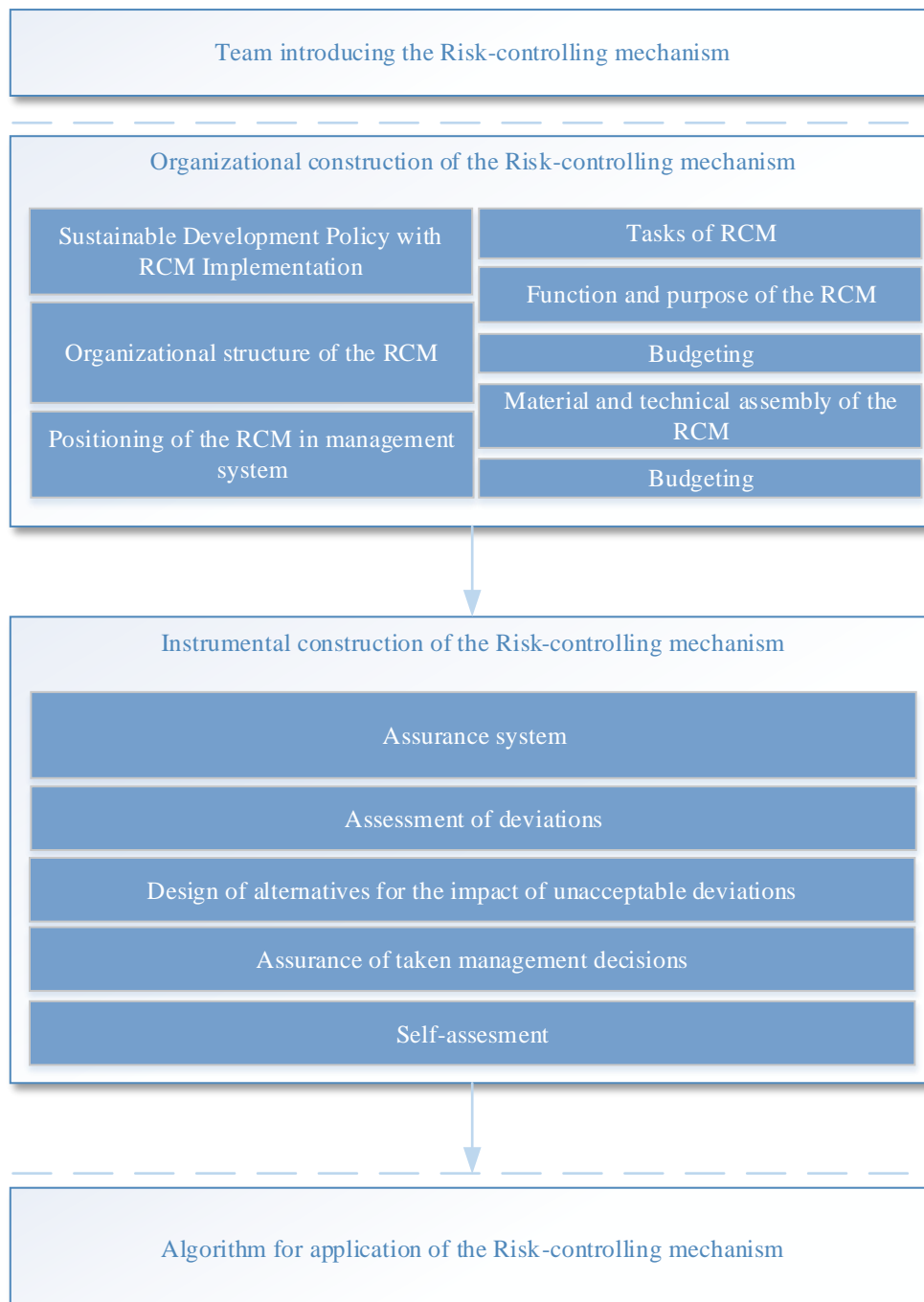


Figure 2.2 Organizational and instrumental construction of risk-controlling mechanism

Organizational build-up of risk-controlling mechanism

- (1) Sustainable development policy of the manufacturing plant and the location of the RCM in it

The application of risk control as a mechanism in the management of economic sustainability determines the need for its role to be subordinated to the policy of joint sustainable development of business enterprises. Notwithstanding this subordination, the construction and implementation of RCM should retain its advisory role in the management of economic sustainability and the provision of sustainable economic development of production enterprises.

(2) Organizational structure of RCM

The structural organizational model of the RCM consists of five subsystems:

- Providing
- Assessment of deviations
- Designing alternatives to impact on unacceptable deviations
- Ensuring the management decisions
- Self-assessment

(3) Positioning of the RCM in the organizational and management structure of PE

The central character of the RCM places emphasis on its participation in linear-staffing, organizational-management structures (figure 2.3). According to the specifics of the organizational structure of the enterprise, the MCC may also be a head of unit to the chief accountant - in the absence of a financial manager.

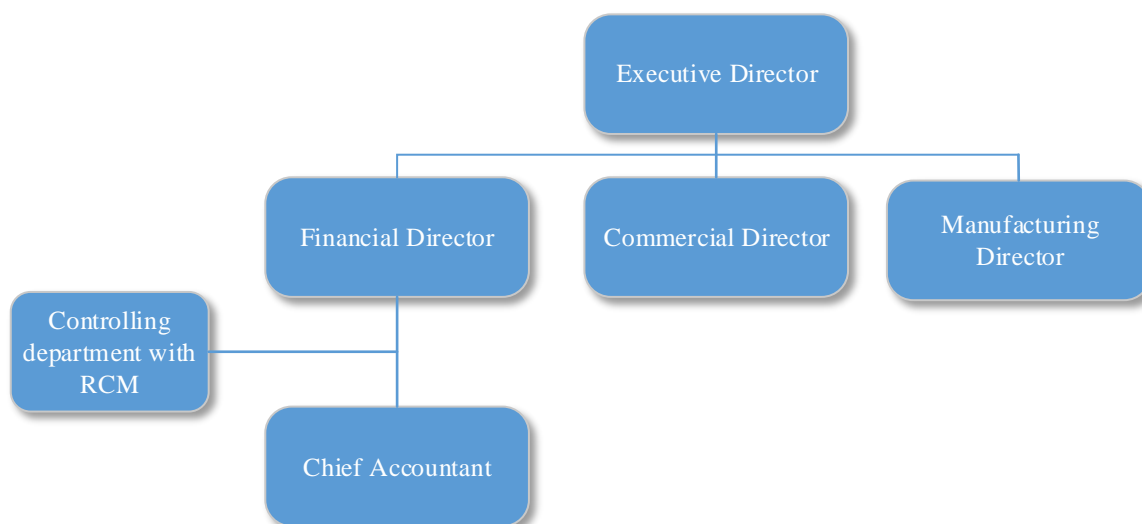


Figure 2.3 Modification of Risk-Controlling Mechanism in Linear Head of Organizational-Managerial Structure

(4) Material and technical assembly of RCM

Consideration of a management mechanism rather than an overall system determines significantly less material costs. Taking this fact into account, the minimum necessary for the functioning of the risk- controlling mechanism may be indicated as follows:

- Work station;
- Installment of an operating system (Windows) and MS Office;
- Installment of software application of the risk-controlling mechanism;
- Connection with the information system of the enterprise.

(5) Establishing a budget

On the basis of the result of the attached formula 1 and the defined pilot injection period for the RCM, the expected costs of its implementation can be determined. They should be allocated a cost budget for pilot implementation of the risk-controlling mechanism. When making a

management decision for the permanent introduction of the mechanism, a budget should be allocated for its permanent functioning.

Instrumental construction of risk- controlling mechanism

The instrumental construction of the risk-controlling mechanism for IT management consists of the formation of its five subsystems and their tools. These subsystems are built and function in close relationship with the information system PP or ERP system - if the enterprise has introduced such (figure 2.4)

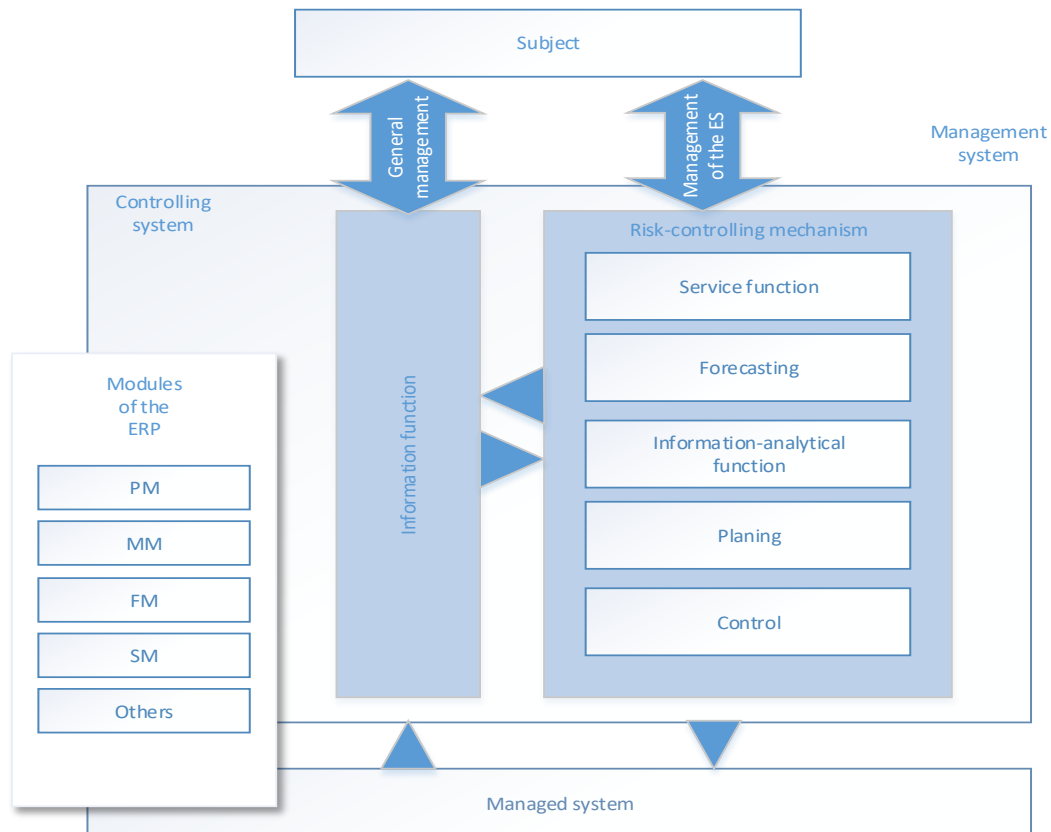


Figure 2.4 The interconnection of risk- controlling mechanism with an ERP system

(1) Construction of a providing subsystem

The construction of this subsystem should be in line with the agreed timetable for introducing the risk- controlling mechanism and the costing budget for its implementation. The team involved in the deployment of the mechanism shall perform the following actions to enable the tasks of the subsystem concerned to be effectively carried out:

- The implementing mechanisms should prepare and ensure the coordination and validation of instructions and procedures related to its operation;
- The implementation team should perform the setup of the existing information system;
- The implementation team should provide training to employees involved in managing economic sustainability through the Risk Controlling Mechanism;
- Another task of the implementation team is to regulate the alignment with the

management of the indicators defining the economic sustainability - target values of the ROI parameters and the overall liquidity ratio;

The implementation of the above actions should lead to the establishment of an organizational framework of the risk- controlling mechanism.

(2) Construction of a subsystem to estimate deviations.

In order to more flexibly implement the proposed risk-controlling mechanism and to create the possibility of real examination in an active production enterprise, a specialized software application has been developed. The application is built on the .NET platform using the C # programming language.

User Interface (Figure 2.5) of the software application allows:

- Manually entering and correcting input data;
- Loading data files;
- Selection of data to be used in the analysis;
- Selection of number of simulations and validation of the input data;
- Display of the data (Figure 2.6) and exporting it to .csv file format – this allows managers to perform specialized additional processing necessary for the specific needs of their PP in widespread software products such as MS Office Excel. With an ERP system available in the enterprise, this format can facilitate the migration of data between the mechanism and the ERP system.

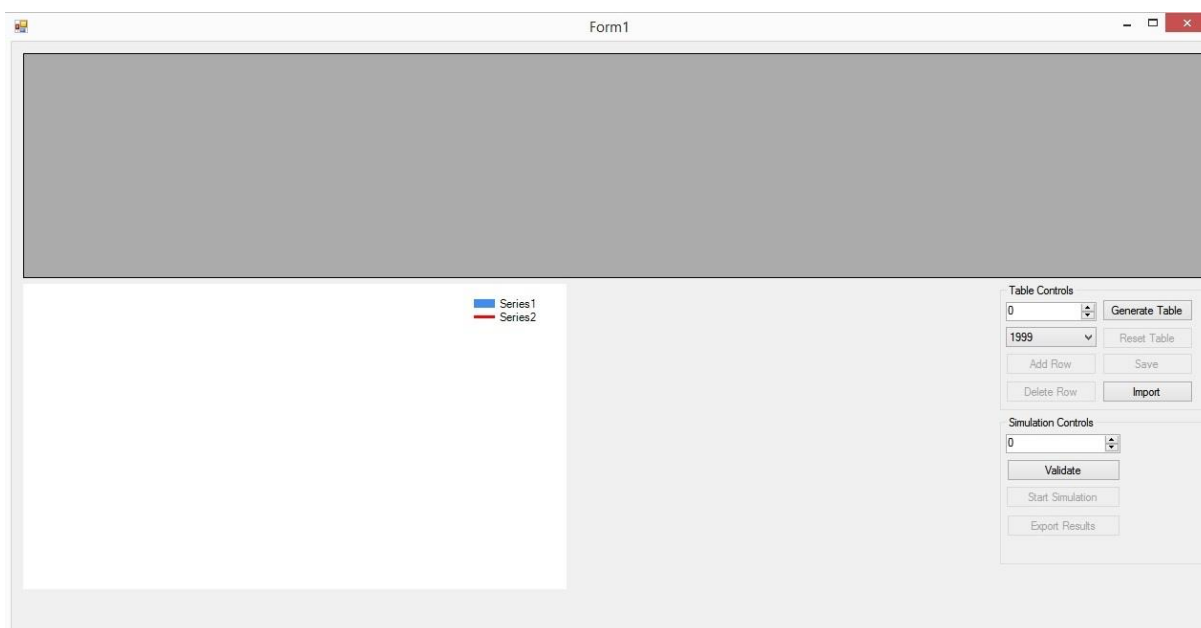


Figure 2.5 Software application for implementing the proposed risk- controlling mechanism

In order to realize the estimation of the probability deviations designed by the software application, they should be matched with certain tolerances for deviations - their values are provided by the procurement sub-system of the RCM. Because of the uncertainty dynamics, it is advisable to use expert judgment to form those limits.

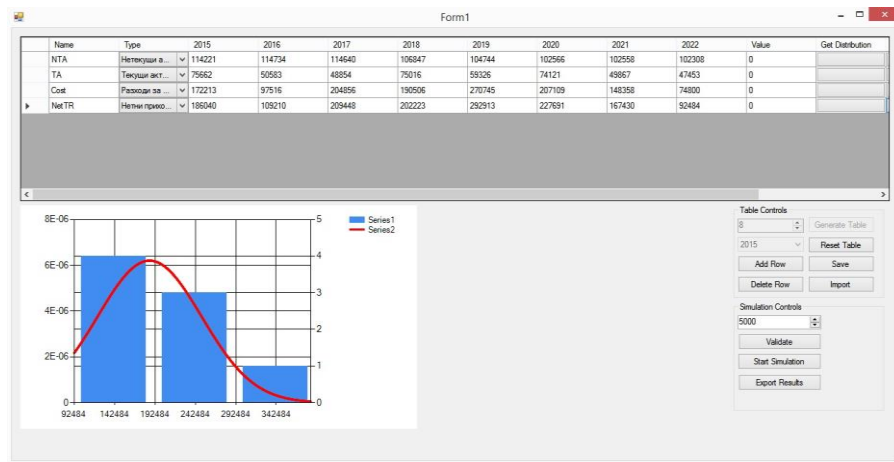


Figure 2.6 Software application for implementation of proposed RCM - input and display of data

(3) Construction of a Subsystem for Designing Alternatives to Impact on Ineligible Deviations

The construction of this subsystem provides for the implementation of the software application built into the Deviation Assessment subsystem. Its integration into the construction of this subsystem is presented in figure 2.7.

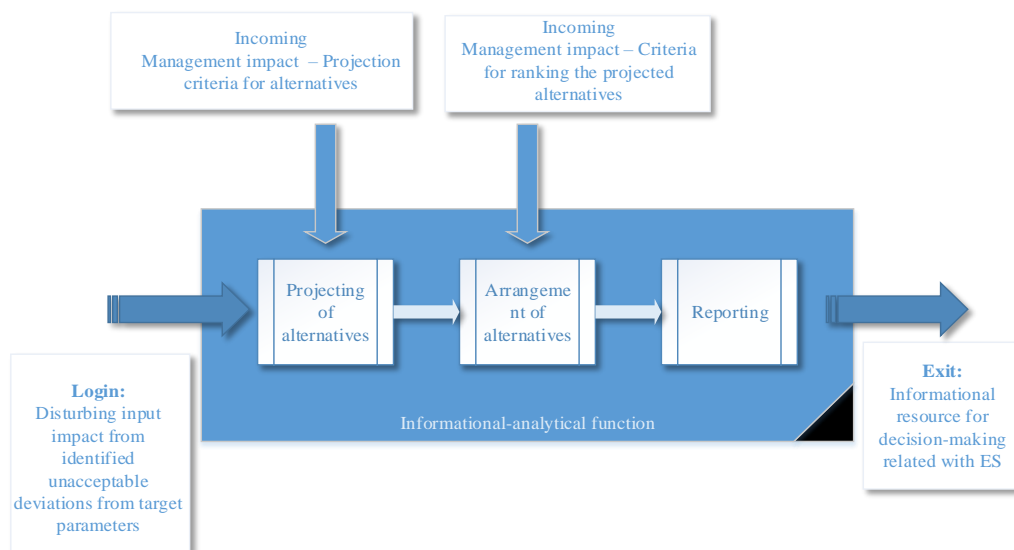


Figure 2.7 Process of implementation of information-analytical function

This integration allows the design of probabilistic alternatives based on input values of the parameters in the software application. The alternatives generated in this way should be ranked according to the criteria set by the managers charged with decision-making about the management of the IT. The results of the design and ranking are filed into a report to the managers responsible for the management of the IT.

(4) Construction of subsystem that ensures the management decisions that are taken

The essence of the construction of this subsystem is to ensure the fulfillment of its three main tasks as follows:

- ✓ Transforming the management decisions into plans

This transformation is required irrespective of whether the decision taken is the result of a developed alternative to the risk-controlling mechanism or is the result of a self-made management decision. Transforming a solution from developed alternatives to the mechanism is based on the ability of the developed software application to export data in *.csv format. IT management decisions made as stand-alone management decisions by managers should be manually transformed to a format appropriate to import into the existing enterprise information system.

After importing the decisions into the information system, the coordination of the transformation into planning values is assumed by the controllers or responsible employees in the financial and accounting department of the enterprise.

- ✓ Monitoring of the implementation of decisions regarding the management of economic sustainability

The monitoring carried out here is proactive. To perform this proactive monitoring, we rely on the developed software application (the Monte Carlo method). In it, reporting data from executed management decisions (business activity) are periodically imported on the basis of which probability deviations from the target values of the parameters for achieving the decisions are projected. The predicted deviations are analyzed from the point of view of their eligibility and reported to the management.

- ✓ Reporting

The results of the tasks performed in the subsystem concerned should be formalized and submitted to the managers involved in the management of the IT.

(5) Construction of the self-assessment subsystem

The construction of this subsystem is based on an integrated methodology for assessing the effectiveness of managing of the economic viability of the production entity using the risk-controlling mechanism. This methodology is based on quantitative and qualitative assessments. Its application algorithm is presented in figure 2.8.

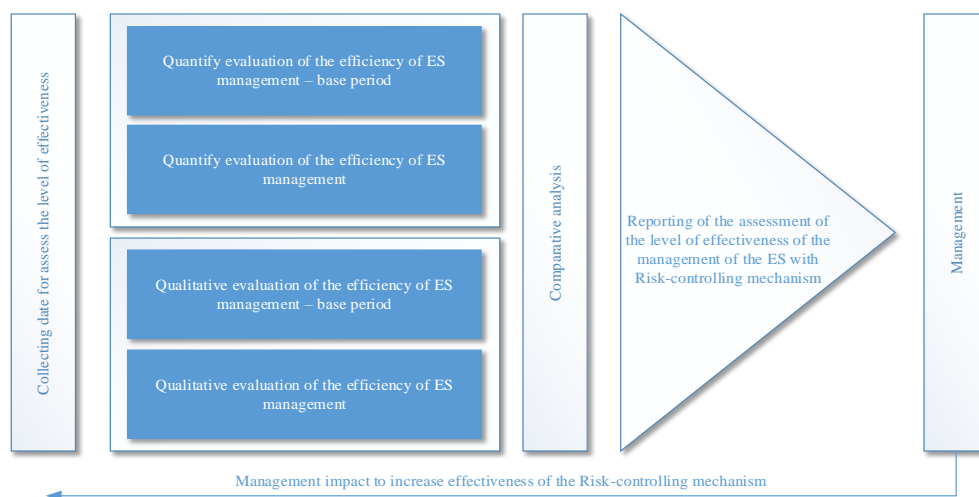


Figure 2.8 Algorithm for self-assessment of the operation of the risk- controlling mechanism

Algorithm for application of the risk- controlling mechanism

The presented algorithm (figure 2.9) reveals the relationship between the sub-systems of the PKM, the subject and the supported database. The specific figure is represented by the ERP system, but in cases where the enterprise does not have it, its function should be taken over by the

enterprise's existing information system.

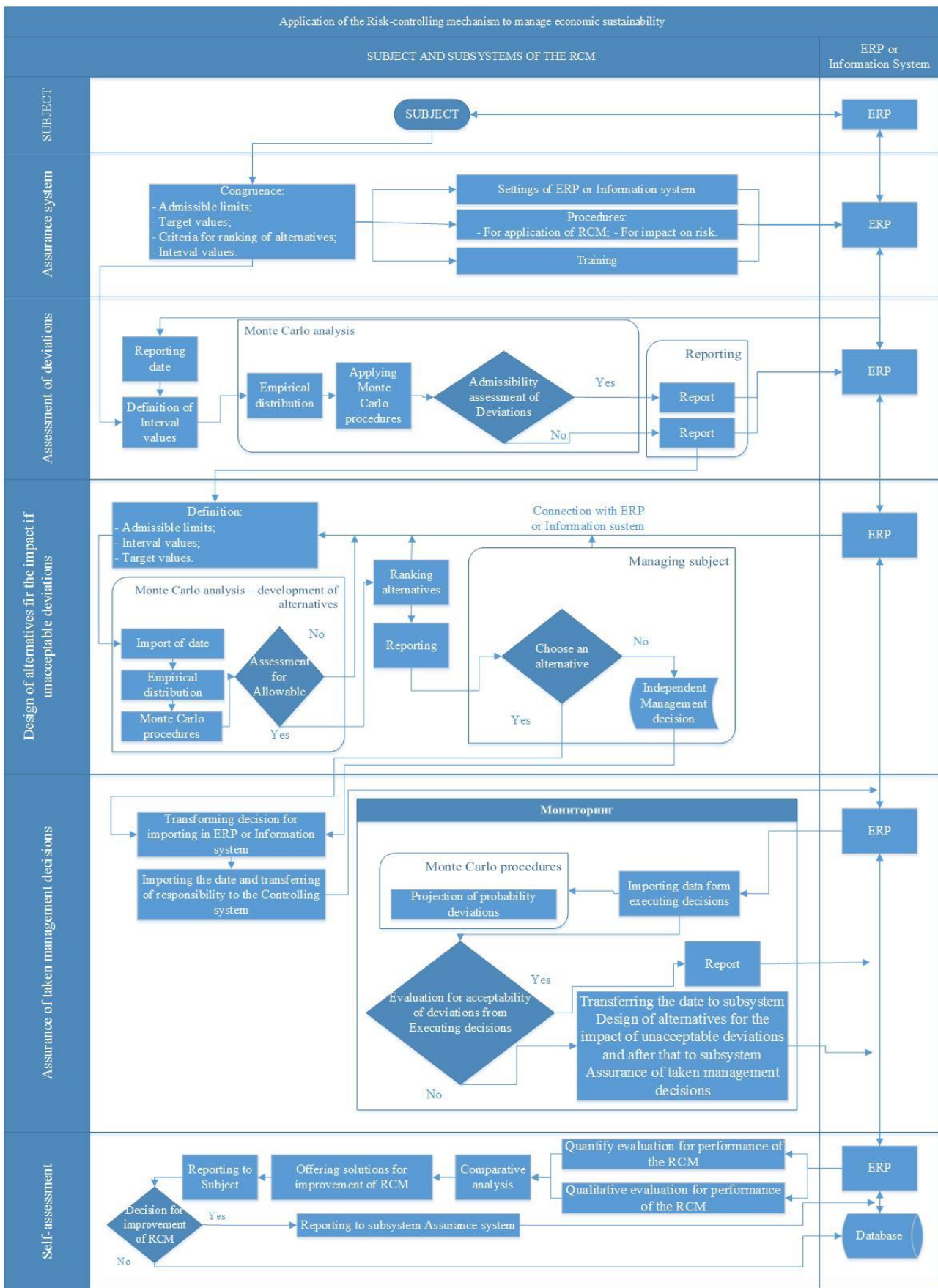


Figure 2.9 Algorithm for application of the Risk-controlling mechanism

3. RESULTS AND DISCUSSION

The presented methodical construction of the risk-control mechanism was implemented in a Bulgarian production enterprise. A risk-control mechanism for managing economic sustainability was introduced. The application of the risk-controlling mechanism for management of economic sustainability was realized according to the presented algorithm for its application (figure 2.9).

The application of the self-assessment system showed an effective application of the risk-control mechanism to manage economic sustainability, taking into account:

- Decrease of deviations from the target values of parameters that characterize economic sustainability;
- Reducing the cost of managerial work related to decision-making to manage economic sustainability;
- Enhancing managerial satisfaction from managing economic sustainability.

4. ACKNOWLEDGEMENTS

The funding of this publication is entirely with the author's personal funds.

5. SUPPLEMENTAL DATA

ГОСТ Р ИСО 31000-2010 and ГОСТ Р ИСО/МЭК 31010-2011 are available in the PDFs of the following links:

<http://www.novsu.ru/file/1156050> accessed on [19-08-2017]

http://ivan-shamaev.ru/wp-content/uploads/2013/05/31010-2011_Russia.pdf accessed on [19-08-2017]

Манджуков, Й. video lecture, <https://www.youtube.com> [19-08-2017]

http://www.columbia.edu/~mh2078/MCS04/MCS_generate_rv.pdf [19-08-2017]

6. REFERENCES

Journal article

Köppen V., Hausmann A., H.-J. Lenz, (2005) A Simulation – A Support for Controllers Decision Process. *Challenges and Prospects*, Proceedings of ICTM, p. 1155-1170

Köppen V., H.-J. Lenz, (2008) Robustified MCMC Sampler – Metropolis Hastings Simulator with Trimming. *COMPST*. Proceedings in Computational Statistics. p. 759-767

Vamikole A., Pertrie D., J. Görgens, (2011) Economic risk assessment of advanced process technologies for bioethanol production in Sout Africa: Monte Carlo analysis., *Renewable Energy*, (36) 11, p. 3178-3186

Богданова, М. Парашкевова, Е. Павлова, К. (2012) Ефективно управление на оперативния риск в българските компании. *Диалог*, 2, 172-185.

E-journal article

Петров, Т. (2017) Метод Монте Карло и приложението му за оценка на надеждност и прогнозиране на рисковете за безопасност: <https://www.mgu.bg>. Accessed on [2017-3-9]

Marvis D., Bandte O., Economic uncertainty assessment using a combined design of experiments/Monte Carlo simulation approach with application to an HSCT. <https://smartech.gatech.edu> [2017-8-19]

Book

Качалов, Р. (2002) *Управление хозяйственным риском*. Москва: Наука

Хан, Д. (1997) *Планирование и контроль: концепция контролинга*. Москва: Финансы и статистика

Тодоров, Л. (2014) *Съвременни модели за оценка на бизнеса*. София: Нова звезда

Павлова, Д. (2011). *Разходи, приходи и резултати на индустриалното предприятие*. Варна: ТУ-Варна

7. GLOSSARY

ERP – Enterprise Resource Planning, integrated management system.

ROI – Return of Investment.

ROE – Return on equity.

RCM – Risk-controlling mechanism

ES – Economic Sustainability