ISSN- 2350-0530(O), ISSN- 2394-3629(P)
Index Copernicus Value (ICV 2018): 86.20
DOI: https://doi.org/10.29121/granthaalayah.v7.i10.2019.416

INTERNATIONAL JOURNAL OF RESEARCH – GRANTHAALAYAH
A knowledge Repository

Management

RISK MANAGEMENT WITH A FINANCIAL IMPACT

Olga Dobrovolschi [*1], Jan Lhota [2]
[*1, 2] Department of Management and Economics of the Enterprise, Faculty of Mechanical Engineering, CTU in Prague, Czech Republic

Abstract

Project risk management's aim is to afford vision of the risk profile of a project to support decision-makers to reduce the consequences of risks on project purposes such as time and budget. Risk evaluation and treatment of the whole project fronts the crises of developing irrelevant reactions. Despite every risk is by nature subjective, at the time of risk management progress many analytical models have been developed. Nowadays risk management tools are obtaining big attention, as it is a way to reduce costs, improve schedule and redevelop technical performance of new products. However, there is still a lack of researches directed on the investigation of the productive integration of risk management tools into an organization. Quantitative tools remain the best choice so this study broaches one of them named RFMEA. The research provides a basis for a quantitative approach to risk assessment in a project of an engineering company. Because of changes coming to the traditional risk management process caused by implementing Industry 4.0 in the automotive industry, there is considered management of Innovation. The outline is made of risk management trends.

Keywords: Risk Management; R&D; Innovation Risk; Risk Impact.

Cite This Article: Olga Dobrovolschi, and Jan Lhota. (2019). "RISK MANAGEMENT WITH A FINANCIAL IMPACT." *International Journal of Research - Granthaalayah*, 7(10), 418-428. https://doi.org/10.29121/granthaalayah.v7.i10.2019.416.

1. Introduction

In a competitive marketplace, technological innovations make one of the important keys for organizations to survive and reach goals. However, different types of innovations involving uncertainties of technologies cause failures of R&D projects. This is one of the reasons, why it is very important to manage risk for innovative projects through all the development stages.

National investments are supporting key enabling technologies, as additive manufacturing, to uphold innovation beyond a large spectrum of resources and products. Coming up technologies, by their nature, carry uncertainties, including potential risks and ways how to manage them. Managing risks is a big part of everyday life and especially initial to businesses working with

ISSN- 2350-0530(O), ISSN- 2394-3629(P) Index Copernicus Value (ICV 2018): 86.20
DOI: 10.5281/zenodo.3542065

innovative technologies. The main reason is in the need for security that thing is being done correct, safely and within the law to minimalize the obstacles to market success. Additionally, it helps companies secure investors, customer trust and protects against future liabilities. Financing the innovative R&D projects helps to revitalize the manufacturing industry and stimulates new concepts to be developed by supporting the collaboration of various sectors to innovate and develop new products, products at the same time as recognizing and reducing risks.

This research considers risks as a negative impact on the project's budget and develops a background for risk management to increase success rates of R&D projects in engineering. The proposed framework is widely used in the industry and helps in organizing risk management activities. This paper enables a project manager to define specific categories of risk factors and suggests one of the techniques for detailed analysis of the risk impact. An experienced project manager is acquainted with the basic concepts of reducing costs. In order to control the project budget and schedule team should be aware of potential risks and their impacts. Nowadays is it impossible to figure out with risks without its detailed quantitative evaluation.

While planning a new product development or implementing additive technologies in the automotive industry project managers are facing new unexplored outcomes caused by innovations. In order to be prepared for any scenario, team members must be familiar with the management of innovation and levels of innovation. [1] All this aspect and a small sight of the trends in risk management are covered briefly in this study. Existing definitions of risk are different due to its application. In economic theory, the risk arises when the decision-maker can define probabilities to possible outcomes. A well-known definition of risk is given in a project management body of knowledge where risk is considered as “an uncertain event or condition that, if it occurs, has a positive (opportunity) or negative (threat) impact on project objectives”. [2] The main task of every designed risk management approach is to identify and manage threats.

Research and Development Projects are naturally linked to take and manage risks, as most activities can be analyzed as a reduction of uncertainty. Towards managers are aware of customer needs and market trends there comes a possibility to develop a new product, which in turn will correspond requirements based on the latest technology development, capability and cost of new technologies, improvement, and standardization of new business processes. Eliminating risks in R&D projects can increase customer value and be used as a background to analyze and optimize product development processes.

There were many attempts over the last 30 years to discover the fundamental risks that can indicate the success or failure of R&D projects. [3] A predecessor to a new product is the Research and Development project needed to produce it. Frequently it is hard to predict the rate of success for commercial projects. As evidence, that project suffers from risk and weak risk management framework, are serious cost and schedule overruns, as well as problems in achieving the targeted technical performance of the product. [4] Risk is defined as undesired project outcomes in the major part of the literature. Regarding this paper, the risk is considered as an event having a negative financial impact on the project. Recognizing, evaluating, planning and controlling risk and uncertainty, efficiently and effectively, are significant challenges in the management of R&D. [5] R&D projects are influenced by numerous factors, which are divided into different levels and types depending on the major of risk. The main problem why project managers do not follow risk

ISSN- 2350-0530(O), ISSN- 2394-3629(P) Index Copernicus Value (ICV 2018): 86.20
DOI: 10.5281/zenodo.3542065

management approaches is extended by the lack of proficiency about the additional uncertainty and risks in projects that sustain innovations in organizations. [6]

2. Methodology

The risk management framework to follow for every organization nowadays is more informal and is not specifically defined. Even the fact, that it is a crucial part of whole project management does not convince managers in the major cases to arrange it and apply for every project. Considering new additive manufacturing spreading through the automotive sector a well-defined risk management approach does not exist yet, so this research is combining some most commonly used. Noticed should be factors as the necessity of risk register, identified risks were documented considering their risk impacts. Definition of the risk priority depend on the impact and then risk management activities are planned.

Risk management is a described as methodological tool to conduct uncertainty through a sequence of activities: risk identification, risk assessment, risk response planning, and risk monitoring and control. The purpose of risk identification is to recognize and qualify risks that may affect project outcomes. Risk assessment estimates the probability of an identified risk contributing to plan actions for reacting to specific risks to reduce threats to project success. This research proposes a quantitative-oriented risk management framework that integrates analysis of the financial impact of the technical risks.

The dissemination of for example 3D printing leads to the transformation of not only the production process but also the project management process. The biggest profit that additive manufacturing brings is in reducing the costs of prototyping and reducing overall time from generating an idea to finished products. The technology of 3D printing allows minimalizing costs related to transportation or energy. The idea to create a risk assessment methodology is to contribute companies which will introduce risk management technique into the proper project management process.

Before launching up a project or processing an order from the customer it is necessary to make a qualified decision under what conditions and whether to enter the project at all. During planning the R&D project workers should continuously refine the estimation of the risk impacts on costs and schedule. Suggested project risk analysis can enable companies to make necessary changes in time. The ability to prevent a company from big losses and the project to be successful is closely connected with the ability to conduct a risk analysis.

An effective risk management strategy allows for identifying the project's strengths, weaknesses, opportunities, and threats. Respective organizations would profit in the different ways by implementing a new and more structured risk management tool. As the process should be improved and periodically reviewed from time to time risk management is cyclic and is shown in Fig. 1.

ISSN- 2350-0530(O), ISSN- 2394-3629(P) Index Copernicus Value (ICV 2018): 86.20
DOI: 10.5281/zenodo.3542065

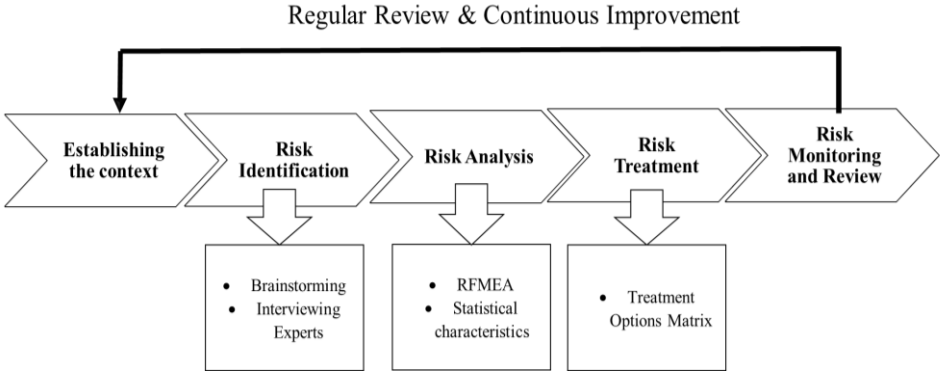

Figure 1: Risk Management Process Framework

Proficient risk analysis helps company to indicate the purpose of risk management, make measurements propose risk mitigation tools, monitor and control risk and create a homogenous system of risk management. In a few words, risk management is an effective and efficient way that supports the implementation of strategy. When designing the risk management process, it is necessary to decide on which techniques to include in the process and how to create a decision environment where those responsible to implement these techniques can do so easily and effectively. Giving the importance of the risk origin model for risk assessments should be changed. Based on the analysis there are proposed the highlighted limitations which cause financial uncertainties. Usually there three major groups of variables for successful R&D projects: innovation, market, technology. [3]

3. Findings

The level of modernity in product innovation for Industry 4.0 can vary broadly and larges a wide spectrum. Firstly, there are considered two levels of innovation – incremental and radical. Mentioned as a first level, called incremental innovations, are based on the point of intersection of technology and product structure. [7] Radical innovations defers in technology specifications from the earlier product at a considerable level. Every innovation depending on its nature effects differently markets and companies, and R&D projects in next step. Radical innovations are difficult to be analyzed due to the lack of experience, when in the case of incremental innovations we can use existing market to perform the forecasts. [3] Technological innovations during implementing principles of Industry 4.0 require big attention even when an organization does not deal with long lasting and expensive projects. The main task is to minimize the innovation risk with an adequate time and developing decision models to evaluate a risk management. Conditions are relevant and reliable information from the experts, correctly defined variables for calculations and in conclusion reduction of unintended outcomes. [8]

After identification of the risk factor, it is useful to divide them into groups and create a list of risks. Considering known methods of risk categorization an overview of the main groups of risks is made. The decision to distribute risks into groups is that most of the proposed factors can be allocated to the corresponding departments existing in the company. Into consideration was taken correlation of risk factors among themselves in the group and their attribution to business processes. The following Table 1. shows risk categorization for an R&D project using 3D printing containing groups and risk factors.

ISSN- 2350-0530(O), ISSN- 2394-3629(P) Index Copernicus Value (ICV 2018): 86.20
DOI: 10.5281/zenodo.3542065

The table is presented with risks with the biggest probability of occurrence during the implementation of 3D printing in companies. The largest number of factors occur in the technical risk group. The next step is to analyze risks by quantitative approach. Semi-quantitative evaluation can be also used to quantify the significance of individual risks. It is necessary to assign a numerical evaluation to the individual stages of the probability scale of risk occurrence and to the intensity of their negative impacts. During the risk analysis, the understanding of the risks is further deepened. This should involve qualifying or quantifying risk levels, such as probability distributions of objective achievements (e.g. finishing date of the project) or likelihood and consequences of specific risks. [9] It includes analyzing the root motive that determine the level of risk and understanding how different risks are related to each other.

Table 1: Risk Categorisation

Risk Category	**Risk Factor**
FINANCIAL Risk 1	Increase of material cost
FINANCIAL Risk 2	Insufficient own resources
FINANCIAL Risk 3	High energy consumption
FINANCIAL Risk 4	Increase workplace costs
FINANCIAL Risk 5	The probability of loss of revenue
FINANCIAL Risk 6	Increased machine maintenance costs
TECHNICAL Risk 1	Unverified manufacturing process
TECHNICAL Risk 2	Incomplete technical specification
TECHNICAL Risk 3	Environmental influence
TECHNICAL Risk 4	Defective design
TECHNICAL Risk 5	HW equipment of the machine
TECHNICAL Risk 6	Transport and handling
TECHNICAL Risk 7	CAD model quality
PURCHASE Risk 1	Unsuitable material quality
PURCHASE Risk 2	Changes in the project assignment
PURCHASE Risk 3	A dominant supplier can terminate business
PURCHASE Risk 4	Delivery time of material
BUSINESS Risk 1	Short time for project implementation
BUSINESS Risk 2	Changes in business processes
BUSINESS Risk 3	Internal communication within the team
BUSINESS Risk 4	Low production speed
BUSINESS Risk 5	Unsatisfactory delivery date

The process of risk management is requiring certain scientific approaches in the phase of risk analysis to be done supported by qualitative and quantitative method. To specify the priorities and affect level of risks are used qualitative techniques based on numerical solutions, evaluating the rate of risk occurrence and impact on the project aims. For a detailed understanding of potential financial problems in the project course are used quantitative approaches e.g. Sensitivity analysis

ISSN- 2350-0530(O), ISSN- 2394-3629(P) Index Copernicus Value (ICV 2018): 86.20
DOI: 10.5281/zenodo.3542065

method, PERT, Probability analysis method, Monte Carlo, Decision tree and RFMEA. Mentioned techniques assure effective assessments for every identified and classified project risk. [10]

The outcome of each quantitative risk evaluation has a possibility to be presented in the way of risk groups not beyond limits of cost and schedule risks, technical and managerial risks analyzed by involved statistical tools. A risk manager has an opportunity to select between quantitative and qualitative measurements to apply for risk estimation. Quantitative measurements benefit from numerical indicators in their precision, when qualitative analysis inspects general sense of the risk factors. A number of different methodologies can be combined to design the priority of risk varieties depending.

There are fundamental methods based on factors quality as probability and consequences of the appearance of a factor to rank the level of risks as Impact Matrix. [10] In cost risk analysis the most common technique is Monte Carlo simulation there ranking includes the percentage of risk cost, while results from Decision Tree analysis include expected value. Methods of quantitative risk analysis are used on projects to develop numerical and statistical models, combine outputs prepare and update priority lists of risks, and are continuously enriched with new knowledge. The features of techniques of quantitative risk analysis include a comprehensive presentation of risk factors and budget loss related to the impact of risk. [10]

The use of technological innovation through R&D projects bring some challenges to managers. The new R&D projects are overflowing with risks that occur at every stage of the project lifecycle. [11] With the desire to increase the success rates of the projects, project managers apply specific methods and techniques that allows identification and management of the risks as effectively as possible. [12] A useful tool that helps to find possible flaws in a system or process is Failure Modes and Effects Analysis (FMEA). [13] Recently has acknowledged the extended version of FMEA, named Project Risk FMEA known as Risk Failure Modes and Effects Analysis (RFMEA).

This simple RFMEA method of classifying and prioritizing risks helps the organization mature its risk management process. Comparing some of the existing tools to set the priorities of risks the RFMEA wins because of its quality to identify effective possible plans to reduce major risks. [14] The technical aspects of the R&D project are being analyzed by FMEA tool, in design and planning phases, when RFMEA quantifies and analyses risks in the project environment. [15] The process of RFMEA is presented on Fig. 2. Two techniques are different due to the way we define detection of the risk. In Risk Failure Modes and Effects Analysis detection factor describes a measure of the ability to forecast risk chance with sufficient time and plan a strategy of its mitigation.

Concerning the use of the RFMEA process, every risk is assessed by its severity value, probability value, and detection method value. Determining those values is based on the secondary data and interviews with the experts. Various rating scales are being used, such as a scale of 1–5, 1–10, or 1–100%.

ISSN- 2350-0530(O), ISSN- 2394-3629(P) Index Copernicus Value (ICV 2018): 86.20
DOI: 10.5281/zenodo.3542065

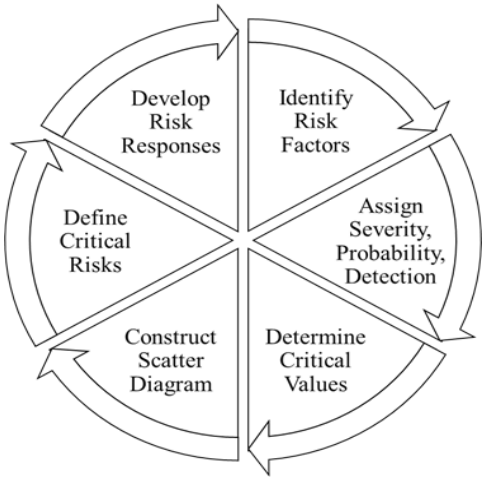

Figure 2: Risk Failure Mode & Effect Analysis Process

The severity (S) measures the impact on the project should it develop, mostly defined by time and cost impact. The probability (P) is the measure of the likelihood that this risk factor will occur. Determination is made of the probable occurrence of a cause, not of the failure mode - the probability that the cause will lead to failure. The third-factor detection method (D) for each risk in the risk register reflects the project team's ability to foresee that a risk will occur and plan for it. After determining the probability of occurrence, severity, and detection method values of risk, the Risk Priority Number (RPN) and Risk Score Value (RSV) can is calculated by using equations (1) and (2), respectively.

$$RSV = S * P,$$

The RPN merely ranks the failure in the system, giving an idea of the "risk" of the failure happening.

$$RPN = S * P * D$$

Firstly, a critical RPN value is necessary to identify the critical project risks. A certain RPN value on one project may be deemed moderate, whereas on another project it may be an essential risk to manage. As each project is unique, so are the risks and the corresponding RPN values. Critical values provide guidance for prioritizing risk and plan responses for it. For the selection of the critical values there is no specific rule. In some projects, the choice is obvious, and in other ones making decision is more difficult. Often, a critical step to determine the value to use further is the analysis of the Pareto.

4. Discussions

The increasing number of scientists highlights the importance of linking the technological capabilities of a company with its customers. The number of product destruction are appearing during last years because of customers desire to gain innovative products, what becomes a problem for companies.[3] The importance of organizing product development and product manufacturing for speed, both complemented with time-saving techniques. [7] The creation of innovation rests strongly in a firm's R&D capabilities and the ability to make technical changes. In doing so a firm

ISSN- 2350-0530(O), ISSN- 2394-3629(P) Index Copernicus Value (ICV 2018): 86.20
DOI: 10.5281/zenodo.3542065

must manage understanding all the complexities of innovation and its management in order to predict risks and eliminate them.

Technical innovations present challenges to enterprises that tend to achieve more market share or tends to grow. Executive directors convince managers to deal with innovative products or focus on offering innovative services, but not all the time these strategies meet success. Project managers run to meet problems such as finding an optimal tool for effectively managing innovation risk. Trends in the automotive industry request engineering companies to have a reliable risk management system focused on innovation risk also. In order to navigate successfully risks, businesses should combine proper innovation strategy in common. In detail, firstly firm must be able to clearly define innovation ambitions. Respecting different types of initiatives as basic, adjacent and transformational there comes a need to carry the right balance between them. The next part is the integrated implementation of the new tools and capabilities. [16]

For the project managers drawing up a new risk management approach as a guide for innovation risks there is a need to evaluate next factors:

1) **Industry risk** – The largest part of industries has similar innovation risk strategies. In the case of R&D projects in an engineering company prevail transformational innovations because on the market appears necessity of a new product.
2) **Competitive position risk** – The major point is to keep a balance of innovation risk or find a way to mitigate the risk.
3) **Development stage risk** – Usually start-up companies tend to respect disturbing product innovation, so they have a fundamental business to build on and then grow, therefore change the strategy to core initiatives.

Balancing the mix of core, adjacent, and transformational innovations are one of the keys to successfully managing risks associated with innovation in R&D projects. It is impossible to succeed if we undertake with transformational innovations, so we have approach risk management framework associated with innovations. One of the opportunities is to develop differently facing technological innovation by continuous communication of objectives and goals.

The biggest considerations in today`s business environment are security and risk management. An increasingly unpredictable change in automotive upcoming from Industry 4.0 demands the design of a clear risk management strategy. Firstly, of all the ownership of risk management is changing due to rediscovering the significant role in the initial risk identification and risk prevention. Nowadays the situation is changing, and managers are spending more time on creating a decision-making risk process rather than treating operational risks. In several past years, all industries are benefiting from integrated risk culture establishing it as a priority. The idea to make risk management as a cultural priority means more than a framework for identifying and control potential risks. The crucial step is to establish and in time promote tools for communication, report on and address risks throughout the business. In practice, it can be explained as a translation of a solid risk management strategy to achieve real business change. [17]

It is not a secret that we are living in a time when manufacturing and people are more connected than ever before. The reality is that modern companies are producing more data and outputs, handling different communicating platforms. The culture of constant conversation enables to

ISSN- 2350-0530(O), ISSN- 2394-3629(P) Index Copernicus Value (ICV 2018): 86.20
DOI: 10.5281/zenodo.3542065

develop faster risk management solutions and strategies. The process of managing risk is becoming more and more collective process and this trend will be positive. We are facing the transformation of risk management processes inside businesses and industries.

The upgrade in cognitive technologies, artificial intelligence and data analytics helps do past the old ways of risk maintenance by sharing data between collaborates and departments. In order to conduct the entire process of risk management, there are still appearing specialized tools in the market. By its way it enables uniformity in the management of the project and risks and application of risk management frameworks among all business processes. [18]

The ability to remain viable in today's business depends greatly on the effectiveness of risk management and compliance programs. The evaluation of the success of risk management is understood in the area of project risk management as a continuous review and evaluation of the analysis. The key process is continuous communication and consultation inside project teams, which runs R&D project from the first to the last phase. Each risk event described in the project is a threat to the project and is represented by a loss that may occur. Since the project manager is obliged to assess the risks of the project, it is necessary to ensure a quality risk analysis. A part of the output of quantitative risk assessment makes determination of the overall project risk. The expected risk value is used to quantify risk events for a better estimation of the uncertainty level. By numerical expressions we can identify overall financial impact of project risk and potential cost increase in manufacturing projects.

Risk management is based on a systematic approach to work with risk and uncertainty to improve the quality of project preparation and evaluation. Risk management can be supported by the use of certain risk decision tools, which leads to deepening and increasing its effectiveness. Risk quantification connects the project manager with the mathematical discipline that is necessary to avoid erroneous assessments and achieve demonstrably complete analysis. Once numbers have to be used, the manager realizes that his calculations can be examined and questioned. A good risk analysis must include a control that not only justifies the original results, but also allows sharp thought about alternative hypotheses or project changes.

On the phase of implementation, a new designed risk management process in an organization, it is necessary to assign a numerical measurement of financial impact to the individual grades of prepared evaluation. These grades will vary depending on the size and financial strength of the company to which identified risks affecting its success rate of development projects. The overall expected financial risk assessment is very important information for the management of the firm in order to be able to estimate in time the needs for additional reserves created in the company outside the project in case of extraordinary failures. In addition, we should take into account aspects as prepared teams and motivation level or project managers. The implementation of the methodology must be gradual and, depending on the complexity of the projects, may take months to a year. It is recommended to start with a pilot project, in which the individual steps are first debugged and then extended to the entire enterprise. The reasons include, for example, the ease of the problem solved within the project and its foundation based on the necessary knowledge and skills. When planning implementation and further development of risk management, it is recommended to continuously improve formalized and less time-consuming risk management.

ISSN- 2350-0530(O), ISSN- 2394-3629(P) Index Copernicus Value (ICV 2018): 86.20
DOI: 10.5281/zenodo.3542065

5. Conclusions

Topics regarding the general concept of risk, risk assessment and risk analysis are and will continue to be relevant as they concern not only the manufacturing and engineering sectors but also the everyday life of each of us. It is important to recall that the risk assessment does not matter the size of the engineering order or the prototype functions. It must be assumed that risks may arise during project implementation. It is important for an engineering company to count on the occurrence of risks and not to refuse any attempt to manage it because usually the unexpected risks that will do the most harm.

Project risk management with methods for risk analysis create a crucial part of the entire risk management process. Project risks and his management is still underestimated, that is why the system must be more simplified and adjusted for easy use in companies. Only then, companies could use the risk analysis in wide project management areas and in a specific financial way as was mentioned in this paper.

The key step of the integrated risk management is identification of potential risks within the project as it can indicate to the project manager what risk mitigation measures, we can take and which ones we cannot. Moreover, correct identification will save a considerable amount of money. The contribution of this paper is in the identified risks for the R&D project in an engineering company and its categorization. Applying quantitative approach, we can determine expected value of the overall project risk and the value at risk.

Using various tools for risk evaluating project management teams estimate material elements of a project, defining and ranging the largest estimated loss to the probable maximum loss based on sufficient data. The main challenge in cost risk management is to effectively integrate the results of a quantitative risk assessment of what can be diverse set of results received from qualitative risk analysis. Taking into consideration particular qualitative and quantitative techniques there is no defined optimal system for implementation to every single project. The task and challenge for us on modern industry is to draw a structured method of risk analysis. Each category of approaches has its advantaged and disadvantages at the same time. Considering quantitative tools, we face to the complicatedness of mathematical means for team members, while qualitative tools suffer from the lack of exactness. A combination of methodologies should preferably be used because it can simultaneously lead to a sensitive and practical risk assessment.

In this paper RFMEA method was presented as a suitable technique for risk assessment in Research and Development projects. In general, all quantitative methods can provide a more realistic cost and schedule estimates, but neither method can cover all the risks. Each requires a detailed knowledge of the process and an accurate record of the observed processes. Risk management process is not a non-repetitive task because risk changes over time. Risk assessment has its own financial weight and, consequently, adequate proportional benefit must exist. Nevertheless, risk analysis with financial impact should be carried out several times during the project development.

ISSN- 2350-0530(O), ISSN- 2394-3629(P) Index Copernicus Value (ICV 2018): 86.20
DOI: 10.5281/zenodo.3542065

Acknowledgements

This work was supported by the Grant Agency of the Czech Technical University in Prague, grant No. SGS17/178/OHK2/3T/12 - Modern cost management instruments.

References

[1] Ekman, S., Jackson, M. (2006). The Need for a New Innovative Product Development Approach. INTERNATIONAL DESIGN CONFERENCE - DESIGN 2006, Dubrovnik - Croatia, May 15 - 18, 2006
[2] A guide to the project management body of knowledge / Project Management Institute. Sixth edition. Newtown Square, PA: Project Management Institute, [2017]. ISBN isbn978-1-62825-390-0.
[3] Balachandra, R. and John H. Friar. Factors for success in R&D projects and new product innovation: a contextual framework. (1997).
[4] Kettl, Donald F. Managing Risk, Improving Results. Managing Risk., 40.
[5] Moehrle, Martin G. a Lothar Walter. Risk and uncertainty in R&D management: Editorial. R&D Management. 2008, 38(5), 449–451. ISSN 00336807: doi:10.1111/j.1467-9310.2008.00536.x
[6] Jalonen, Harri. The uncertainty of innovation: a systematic review of the literature. Journal of Management Research. 2011, 4(1). ISSN 1941-899X : doi:10.5296/jmr.v4i1.1039
[7] Ali, Abdul. Pioneering Versus Incremental Innovation: Review and Research Propositions.
[8] Innovation Risk: How to Make Smarter Decisions. Harvard Business Review. 2013, (April 2013). ISSN 0017-8012.
[9] Chapman, C. B. a Stephen Ward. Project risk management: processes, techniques, and insights. 2nd ed. Hoboken, NJ: Wiley, 2003. ISBN 978-0-470-85355-9.
[10] Mileusni, Mira. Project Risk Management: Comparative Analysis of Methods for Project Risks Assessment. Coll. Antropol. 2014, 10.
[11] Gassmann, Oliver a Zheng HAN. Motivations and barriers of foreign R&D activities in China. R and D Management. 2004, 34(4), 423–437. ISSN 0033-6807, 1467-9310 : doi:10.1111/j.1467-9310.2004.00350.x
[12] Hosseini, M.R., & Rameezdeen, R. Luppino, Ricky, Hosseini, M. Reza and Rameezdeen, Raufdeen 2014, Risk management in research and development (R&D) projects: the case of South Australia, Asian academy of management, 2017.
[13] Gilabert, Alvaro García and Eduardo. Mapping FMEA into Bayesian Networks, 2011.
[14] Carbone, Thomas A. a Donald D. Tippett. Project Risk Management Using the Project Risk FMEA. Engineering Management Journal. 2004, 16(4), 28–35. ISSN 1042-9247.
[15] Mastroianni, S.A. Risk Management among Research and Development Projects, 2011.
[16] Nagji, Bansi a Geoff Tuff. Managing Your Innovation Portfolio. Harvard Business Review. 2012, ISSN 0017-8012.
[17] 10 Ways to improve risk management. PRIMO. https://www.primo-europe.eu/10-ways-to-improve-risk-management/ [02.11.2019].
[18] How Artificial Intelligence Is Transforming Business. Business news daily. https://www.businessnewsdaily.com/9402-artificial-intelligence-business-trends.html [02.11.2019].

*Corresponding author.
E-mail address: olga.dobrovolschi@ fs.cvut.cz