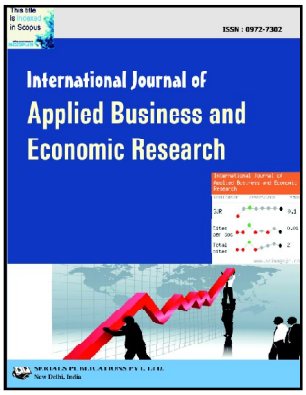

International Journal of Applied Business and Economic Research

ISSN : 0972-7302

available at http: www.serialsjournal.com

Volume 15 • Number 19 • 2017

Risk Management in Czech Manufacturing Company: Case Study

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Abstract: Project risk management is an important aspect of project management. The aim of presented paper is to demonstrate how to use RIPRAN, Czech project risk analyse, as a main part of feasibility study of the new product project in the manufacturing company. To fulfil the primary aim of presented paper we decided to use the case study method.

Keywords: RIPRAN, project management, project risk management.

INTRODUCTION

Project risk management is an important aspect of project management. According to the PMBoK [1, p.126], risk management is one of the ten knowledge areas in which a project manager must be competent.

Project risk management remains a relatively undeveloped discipline, distinct from the risk management used by Operational, Financial and Underwriters' risk management. This gulf is due to several factors: Risk Aversion, especially public understanding and risk in social activities, confusion in the application of risk management to projects, and the additional sophistication of probability mechanics above those of accounting, finance and engineering. With the above disciplines of operational, financial and underwriting risk management, the concepts of risk, risk management and individual risks are nearly interchangeable; being either personnel or monetary impacts respectively. Impacts in project risk management are more diverse, overlapping monetary, schedule, capability, quality and engineering disciplines. For this reason, in project risk management, it is necessary to specify the differences as it is cited in [6]:

Risk Management

Organizational policy for optimizing investments and (individual) risks to minimize the possibility of failure.

Risk

The likelihood that a project will fail to meet its objectives.

A Risk

A single action, event or hardware component that contributes to an effort's "Risk."

According to ISO 31 000:2009 [2, p. 10] term risk is defined as

"effect of uncertainty on objectives. An effect is a deviation from the expected – positive and/or negative. Objectives can have different aspects (such as financial, health and safety, and environmental goals), and can apply at different levels (such as strategic, organization-wide, project, product or process)" By definition of risk by ISO 31000:2009 risks are possible to divide into categories positive risks–opportunities and negative risks–threats.

Risk management is then defined by PMBoK [1, p. 126] as

"the systematic process of identifying, analysing, and responding to project risk. It includes maximizing the probability and consequences of positive events and minimalizing the probability and consequences of adverse events to project objectives."

An improvement on the PMBOK definition of risk management is to add a future date to the definition of a risk. Mathematically, this is expressed as a probability multiplied by an impact, with the inclusion of a future impact date and critical dates. This addition of future dates allows predictive approaches.

Good Project Risk Management depends on supporting organizational factors, having clear roles and responsibilities, and technical analysis.

Chronologically, Project Risk Management may begin in recognizing a threat, or by examining an opportunity. For example, these may be competitor developments or novel products. Due to lack of definition, this is frequently performed qualitatively, or semi-quantitatively, using product or averaging models. This approach is used to prioritize possible solutions, where necessary. In some instances it is possible to begin an analysis of alternatives, generating cost and development estimates for potential solutions.

Once an approach is selected, more familiar risk management tools and a general project risk management process may be used for the new projects:

- A Planning risk management.
- Risk identification and monetary identification.
- Performing qualitative risk analysis.
- Communicating the risk to stakeholders and the funders of the project.
- Refining or iterating the risk based on research and new information.
- Monitoring and controlling risks.

Finally, risks must be integrated to provide a complete picture, so projects should be integrated into enterprise wide risk management framework, to seize opportunities related to the achievement of their objectives.

Risk management framework is according to [2, s. 11] possible to define as

"set of components that provide the foundations and organizational arrangements for designing implementing, monitoring, reviewing and continually improving risk management through the organization."

The five main steps which usually create risk management framework are:

- **Risk identification**–a process of recognizing, finding and describing risks.
- **Risk analysis**–a very important process. Team has to assess probability and impact of risks, which will be identified in the process of risk identification.
- **Risk evaluation**–In this phase a manager must to compare results of risk analysis, with risk criteria, which will be established. Manager must to determine each risk and find out if its magnitude is acceptable or unacceptable.
- **Risk treatment**–This process is possible to define as the process to modify risk.
- **Monitoring, review, communication, and control**–Monitoring is a continual checking, determining and observing the status of a risk.

Risk management components allow planners to explicitly address uncertainty by identifying and generating metrics, parameterizing, prioritizing, and developing responses, and tracking risk. These activities may be difficult to track without techniques, documentation, information systems and various tools.

There are two distinct types of risk tools: Two are identified by their approach, Capital asset pricing model (CAP-M) and Probabilistic risk assessment (PRA), is the mainstay of project risk management. These are classified by the quality and fidelity of information required for their calculations. Market-Level tools use market forces to make risk decisions between securities. System-Level tools use project constraints to make risk decisions between projects. Component-Level tools use the functions of probability and impact of individual risks to make decisions between resource allocations.

Presented paper presents in the theoretical and practical viewpoint one of the best risk management analysis of Czech origin, RIPRAN, that can be used not only in Czech business environment, but worldwide.

METHODOLOGY

The aim of presented paper is to demonstrate how to use RIPRAN, Czech project risk analyse, as a main part of feasibility study of the new product project in the manufacturing company. To fulfil this primary aim we formulated these secondary aims:

- To provide critical analyse of available information sources dealing with risk management in new product project in manufacturing companies.
- To study and profoundly understand the RIPRAN, project risk analyse, its history, application, principles, rules, exceptions.
- To make discussion with the author of RIPRAN about the RIPRAN application in new product projects in manufacturing companies of non-Czech origin.
- To compile the feasibility study of the new product project.

All these high cited secondary aims were fulfilled. The short overview of the risk management topic as well as RIPRAN characteristics and definition are part of presented paper. To process this theoretical part of paper we used mostly analyse, synthesis, comparison and deduction. We studied monographs, journals and internet links with the impact of source´s topicality. The used sources are cited in the List of references.

During the process of the feasibility study of new product project provided through the analyse of own experience we discussed the application of RIPRAN method to the new product project with the author of this method. We realised the e-mail correspondence, the phone discussions and finally the personal meeting to control the whole RIPRAN analyse document and to discuss the method application in the non-Czech origin business environment.

To fulfil the primary aim of presented paper we decided to use the case study method.

RISK MANAGEMENT

As it is cited in [12], the issue of risk management is very current today. It's not just because of the fact that the market economy is risk-based. There are other reasons why today there is often a risk. The current global marketplace presents many threats for every company that must be identified by the company's personnel, whether they come from any area (technical, economic, financial or personnel), and they must prepare appropriate measures to reduce them. The current turbulent environment full of changes those result mainly from the rapid scientific and technological development and those are the consequence of solving many of our society's problems and changes in nature, present a source of many potential threats to the economy of every company.

Recently, a number of legislative measures have been issued requiring risk analysis at a professional level (*e.g.* the new Labor Code - Occupational Safety Risks, a new Safety Machine Approval Regulation, the risk of data leakage that is subject to the Privacy Act, etc.) or in other contexts (*e.g.* IS risks - theft of new product data, etc.). For many Czech companies, especially recently established companies, this issue is new. In addition, there is a lack of the necessary Czech publications on risk engineering and the application of risk engineering in selected areas that would reflect current progress and demands in this area. A contribution in this direction is professor Tichy's publication [18] or [19], which present a very good overview of the issue of risk management for those who need to get acquainted with this issue in detail.

Project management must necessarily consider potential threats to the project, so risk analysis is a necessary part of it, as it is presented in [15]. Of course, this also applies to the design and management of information technology projects, as highlighted in [9, p. 82], because risk management is a part of the project manager's work (see [20]).

Other available relevant to Czech environment publications to the topic are [4], [8] or [13].

Requirements for quality risk analysis are increasing in such projects as project of complex engineering and of other complexes (*e.g.* mechatronic systems, automation systems, robotic systems). Given the high financial budgets of such projects, there is a need to look into ensuring of a high probability of successful completion of such projects [12].

The underestimation of project risks in some of our firms and projects often comes from the ignorance of risk engineering issues or from overlooking the issue of risk management, as is reported in

[21, p. 28-31]. Professional risk management requires not only the necessary knowledge of risks [18], [1] but also knowledge of methods those allow qualified risk analysis. A good project risk analysis is part of the quality management of the project [1], [2], [3] or [10]. Therefore, this knowledge should be a part of the required knowledge of the project manager [14]. Only a formal statement of the type:

> "The project could endanger the lack of awareness of possible educational events, so it is necessary to devote sufficient publication of courses in the regional press." or "The project could significantly endanger the delayed delivery of program modules by external firms" is necessary to consider as an insufficient output from the project risk analysis (note the generality and absence of any quantified facts)!

The RIPRAN method, which is the subject of the presented paper, complements a set of methods as UMRA or Risk Matrix Scoring Method, those can be used for a high quality project risk analysis [16], [18].

Many Czech projects failure, as confirmed by a number of studies and surveys (*e.g.* [3] or [7]). Despite the warnings of many authors [11, p. 109-116], [17, p. 1-8] or [21, p. 25-38], the attention on risk issues or risk analysis is performed poorly, unprofessional and is still very low

RIPRAN enables project teams to carry out risk analysis on a quality and professional level.

RIPRAN

The RIPRAN™ method (RIsk PRoject ANalysis), represents an empiric method for project risk analysis. The author of the method is Branislav Lacko.

It issues from the process notion of the risk analysis, understanding risk analysis as a process (inputs in the process–outputs from the process–activities transforming inputs to outputs with certain goals).

The method accepts quality philosophy (TQM) and therefore covers activities that provide for the quality of the risk analysis as required by the standard ISO 10 006.

The method is designed in order to respect the principles of Risk Project Management, as described in the PMI and IPMA materials.

It focuses especially on the processing of analysis or the project risks that must be done prior to its implementation.

However, it does not mean that we should not be working with threats in other phases. In each phase of the project's life cycle we should carry out activities (this relates mainly to pre-project phases–Opportunity Studies and Feasibility Studies), which lead to gathering of data for the project risk analysis for the project implementation phase, and which evaluate the potential risks of success of the particular phases we are actually working on. The captured risks are then used for the overall analysis of the project risks. The RIPRAN method may be used in all the phases of the project.

The whole process of risk analysis following the RIPRAN method consists of the following phases:

- Preparation of the risk analysis.
- Identification of the risk.
- Quantification of the risk.
- Response to risk.
- General assessment of risk.

Activities in the individual phases are designed as a consequent series of processes.

The method does not deal with the process of monitoring of risks in a project. Whenever some new danger is identified, or the situation changes and requires the re-evaluation of a certain risk, it is possible to use the RIPRAN method again also during the monitoring of the project risks.

A CASE STUDY OF A PROJECT RISK MANAGEMENT

Timeline of a Risk Analysis

This documentation of a risk analysis is provided as a main part of Feasibility study of the project PRJ 001325 PFC, which covers a patent of a new product in a manufacturing company. Timeline of this risk analysis is from 08/March/2017-16/March/2018. This time frame is sufficient to assess main risks, which can affect the project.

Creating a Team for the Risk Analysis

For this risk analysis were chosen professionals, those have already a lot of skills with similar projects:

- Project manager.
- Electrical design Engineer.
- Manager of Electrical design department.
- Global Project manager

Risk Management Context

The core team, which was established for risk assessment, chose next scales of likelihood, impact, and risk level (see Table 1, Table 2, Table 3 and Table 4):

Table 1
Table of probability scale

Item Description	*Scale*
Very high probability–VVP	over 0,8
High probability–VP	from 0,6 to 0,8 (include)
Middle probability–SP	from 0,4 to 0,6 (include)
Low probability–NP	from 0,2 to 0,4 (include)
Very low probability–VNP	below 0,02 (include)

Source: RIPRAN©2017, own solution.

Risks Identification

According to the RIPRAN methodology, the team identifies the threats, which may mostly affect the project. The team has to create a scenario for each risk. For the risk identification, the team used the brainstorming method (see Table 5).

Table 2
Table of impact scale

Item Description	*Scale*
Very High impact–VVD	over 3 800 €
High impact–VD	from2 500 € to 3 800 € (include)
Middle impact–SD	from 1 500 € to 2 500 € (include)
Low impact–MD	from 750 € to 1 500 € (include)
Very low impact–VMD	below 750 € (include)

Source: RIPRAN©2017, own solution.

Table
Table of Risk level

Item Description
Very high risk – VVHR
High risk – VHR
Middle risk – SHR
Low risk – NHR
Very low risk – VNHR

Source: RIPRAN©2017, own solution.

Table 4
Table of acceptable/unacceptable risk level

	VVD	*VD*	*SD*	*MD*	*VMD*
VVP	VVHR	VVHR	VHR	VHR	SHR
VP	VVHR	VVHR	VHR	SHR	NHR
SP	VHR	VHR	SHR	NHR	NHR
NP	VHR	SHR	NHR	VNHR	VNHR
VNP	SHR	NHR	NHR	VNHR	VNHR

Source: RIPRAN©2017, own solution.

Risks Quantification

In this phase, the team has to assess the risk probability and impact, calculate the risk value and choose proper risk level. Risks were quantified by a brainstorming method (see Table 6 and Figure 1).

Table 5
Identification of the risks

Risk No.	*Threat*	*Scenario*	*Notes*
R1	Patent is impossible to sell	If research and development of the product take lot of time, and project will be delayed, the product may lose its features and characteristics, those are possible to patent.	
R2	Timeline, schedule, and budget are not in balance	If project obtains a timeline, schedule, budget and man power characteristics those do not respect each other it may cause a delay of the project or it can influence other project objectives.	
R3	Poorly defined project objectives	Unclearly defined project objectives of a product can cause a project delay or a project stop.	
R4	Impact of trend and market objectives on the project	The market is very dynamic and market forces influence the market. One of the market forces is the customer's expectation, which is very important and can affect project approval.	Regular market research
R5	Government and market restrictions	Government and market restrictions may affect the project, if they are changed on the go. For example a change of ISO standard, a new or a change in legislation, etc.	
R6	Patent infringement	The competitors may be faster in the research and development of a similar product. If they develop their new product earlier, they can patent it sooner, and later on our patent can cause an infringement of patent rights.	
R7	Prioritization of human resources	The company regularly research and develop new products and often uses similar combination of human resources within various teams. Since each project has different priority for the company, which can cause issues in delivery of the project on time.	
R8	High buyer's power	This type of product has a very characteristic and narrow group of customers. In the sector for which this product is targeted, the differences between competitors and substitute products are very small. There are also a lot of barriers in the market areas. Specifically for this product, there are very high technology protection parameters.	
R9	Threats of substitutive and new entrants	The costs and time for the entry in this sector are very low. Every entrant has to have a very well knowledge about product specifications, product options, and customer expectations.	
R10	Insufficient communication	Insufficient communication might have a negative impact on the project, project communication objectives and the communication between the core team and the stakeholders.	
R11	Refusal of the project	A project may be refused or stopped, because of its overtime or over cost.	

Contd. table 5

Risk No.	*Threat*	*Scenario*	*Notes*
R12	Insufficient team's knowledge and skills	The product is very new for the organization. Employees have insufficient knowledge and skills for the research and development, manufacture, and sale of the product.	
R13	In the past, the team worked together on many others projects.	The group of people which will establish the core team worked together efficiently on other similar projects in the past. This is a positive fact and it is an advantage of this project.	
R14	The product doesn't follow objectives those have to be met to obtain the CE certification.	If a company wants to sell a product on the EU market, it needs to have a CE certification. Objectives those have to be met to obtain the certification are very severe. A product without the CE certification is impossible to sell on the EU market.	

Source: RIPRAN©2017, own solution.

Table 6
Quantification of the risks

Risk No.	*Threat*	*Probability*	*Impact*	*Risk value (Level)*
R1	Patent is impossible to sell	0,5–SP	37k€–VVD	VHR–N
R2	Timeline, schedule, and budget are not in balance	0,25–NP	1,2k€–MD	VNHR–A
R3	Poorly defined project objectives	0,2–NP	500€–VMD	VNHR–A
R4	Impact of trend and market objectives on the project	0,6–SP	20k€–VVD	VHR–N
R5	Government and market restrictions	0,25–NP	1,3k€–MD	VNHR–A
R6	Patent infringement	0,1–VNP	3k€–VD	NHR–A
R7	Prioritization of human resources	0,35–NP	700€–VMD	VNHR–A
R8	High buyer's power	0,3–NP	1,2k€–MD	VNHR–A
R9	Threats of substitutive and new entrants	0,4–SP	0,85k€–MD	NHR–A
R10	Insufficient communication	0,2–NP	1,2k€–MD	VNHR–A
R11	Refusal of the project	0,4–SP	1k€–MD	VNHR–A
R12	Insufficient team's knowledge and skills	0,3–NP	2,5k€–SD	NHR–A
R13	In the past, the team worked together on many others projects.	0,5–SP	0,5k€–VMD	NHR–A
R14	The product doesn't follow objectives those have to be met to obtain the CE certification.	0,35–NP	4k€–VVD	VHR–N
R15	Insufficient support	0,3–NP	2k€–SD	NHR–A

Source: RIPRAN©2017, own solution.

Response to Risks

In this phase the project team defines the ideas to reduce the risks. For better description of each risk, we used the Monte Carlo simulation to better describe risk characteristics.

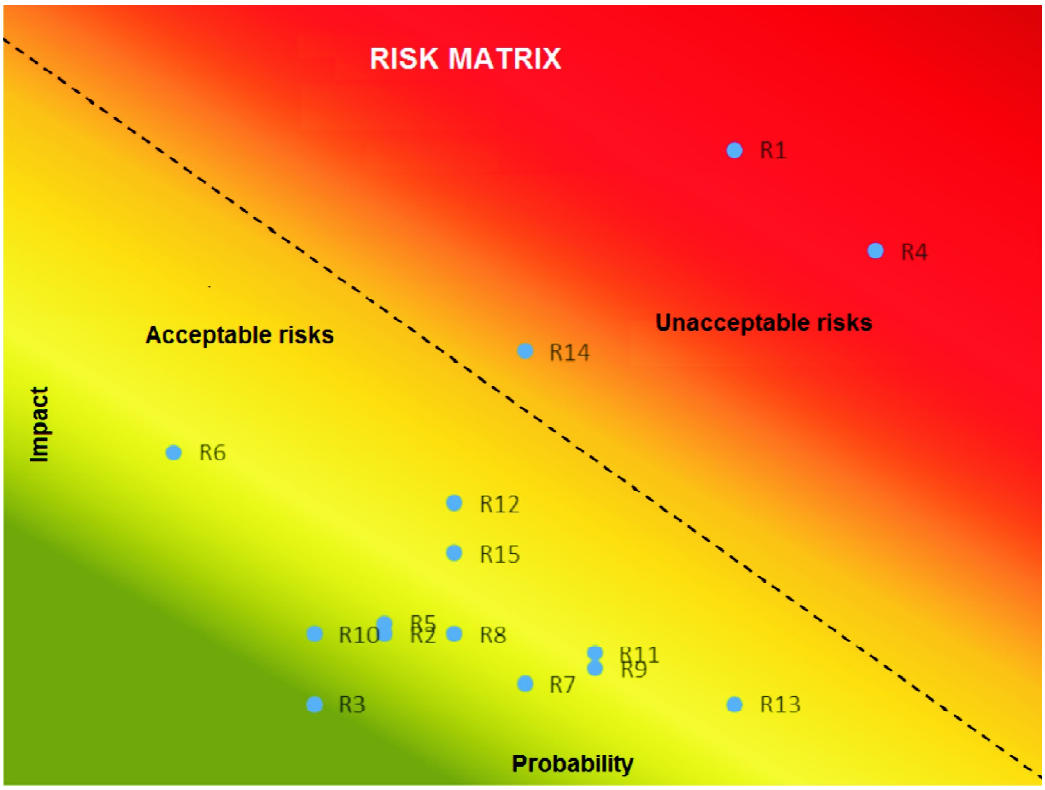

Figure 1: Risk matrix

Source: RIPRAN©2017, own solution.

Risk: R1–Patent is Impossible to Sell

Scenario

Patent may be impossible to sell, because of a delay in the phase of project research and development. Next reason is a fact, that the process to obtain a license for a patent takes a lot of time. Usually, the process to obtain a license for a patent takes in average about 4 years. If these delays occur, it may lead to increase in costs, change of customer's expectations or a change of conditions on the market (*i.e.* new entrants, substitutive products, etc.).

Probability: 0,5 SP

Impact: 36k€ VVD

Risk value: 17,6 VHR–N

Mitigation plan: Patent insurance by Industrial Property Office of the Slovak Republic

Risk owner: Project manager

Apply mitigation plan on: 08/April/2017

Costs to realize the mitigation plan: 5500€/year × 3 years = 16,5k€

New probability: 0,02 VNP

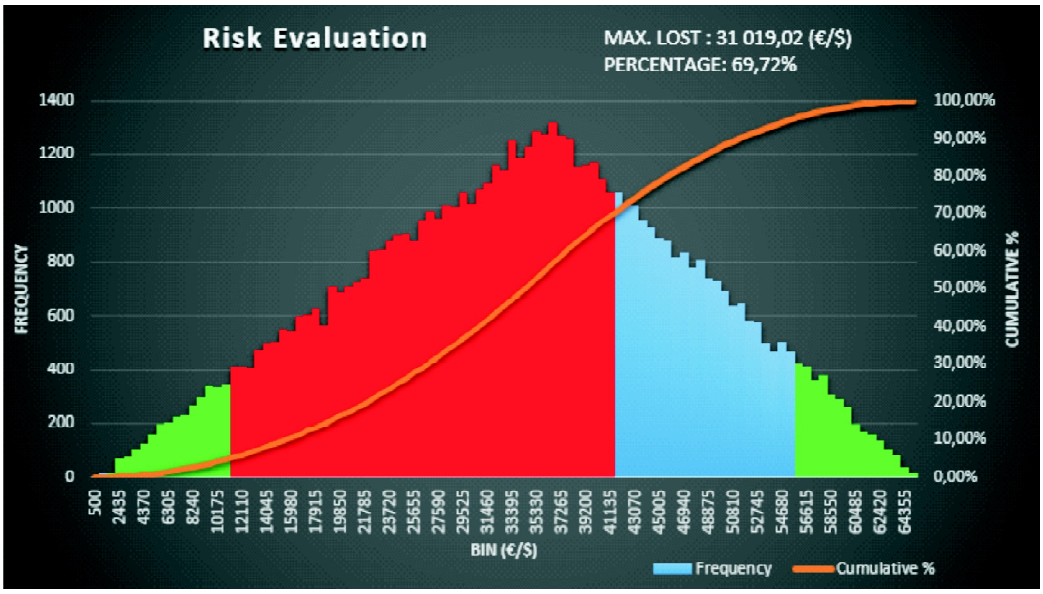

Figure 2: Simulation of the risk R1

Source: RIPRAN©2017, own solution.

New impact: 36k€ VVD

New risk value: 0,8 SHR–A

Effectiveness of the action: 1,02

Risk: R4–Impact of the Trend and Market Objectives on the Project

Scenario

The market is very dynamic and market variables influence the market. One of the market's variables is the customer's expectation, which is very important and can affect project approval.

Probability: 0,6 SP

Impact: 20k€ VVD

Risk value: 12 VHR–N

Mitigation plan

Regular monitoring of various aspects (one market research per three month), which can influence the market environment and following may affect the project objectives. The marketing department has to analyse new trends in the sector and new regulatory objectives every three months.

Risk owner: Project manager, marketing department

Apply mitigation plan on: 01/May/2017

Estimated costs to realize the mitigation plan: 5,2k€

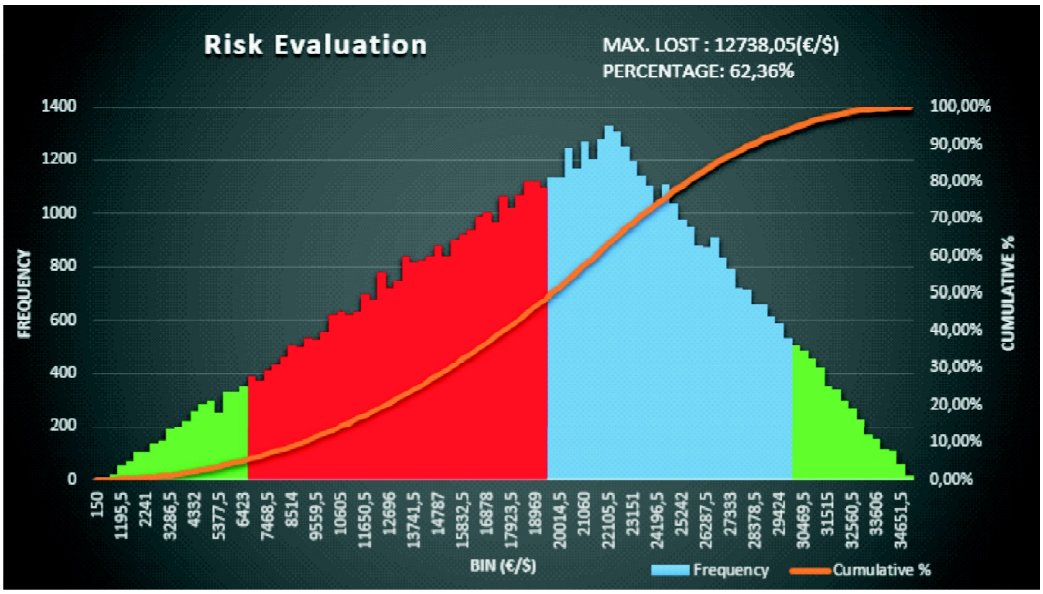

Figure 3: Simulation of Risk R4

Source: RIPRAN©2017, own solution.

New probability: 0,02 VNP

New impact: 20k€ VVD

New risk value: 0,4 SHR–A

Effectiveness of the action: 0,58

Risk: R14–The product doesn't follow objectives those have to be met to obtain the CE certification.

Scenario

If a company wants to sell a product on the EU market, it needs to have a CE certification. Objectives those have to be met to obtain the certification are very severe. A product without the CE certification is impossible to sell on the EU market.

Probability: 0,35 NP

Impact: 4k€ VVD

Risk value: 1,4 VHR–N

Mitigation plan

The research and development of the product is in accordance with standards of the CE certification. Changes in the standards are very dynamic. During the research and development phase, it is mandatory to meet recommended values, those are established in standards of the certification.

Risk owner: Project manager, Electric design engineer

Apply mitigation plan on: 11/April/2017

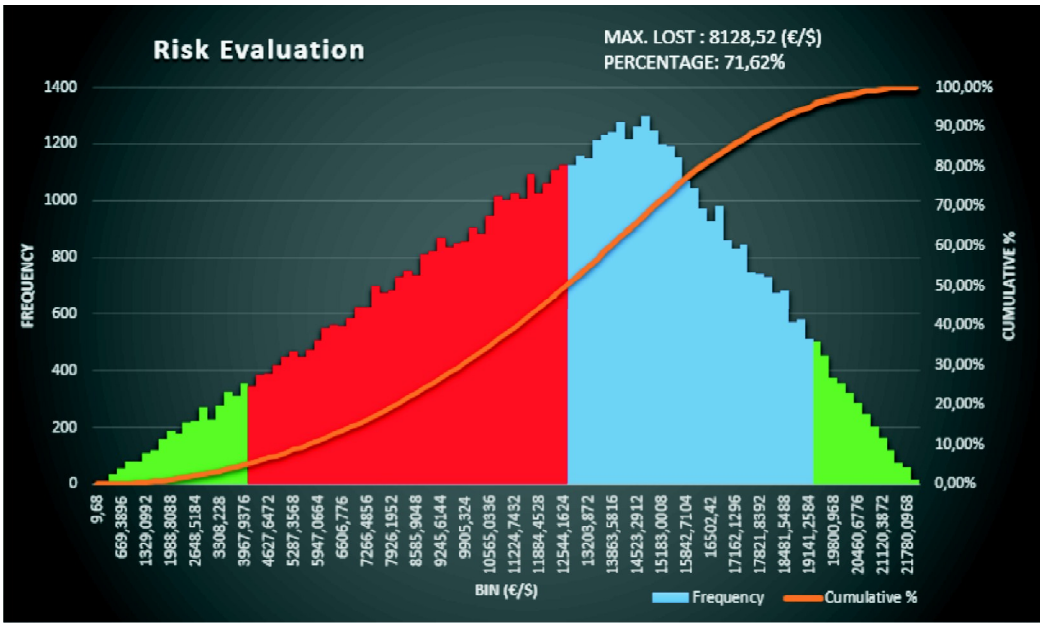

Figure 4: Simulation of Risk R14

Source: RIPRAN©2017, own solution.

Estimated costs to realize the mitigation plan: 3k€

Probability: 0,2 NP

Impact: 2k€ VVD

New risk value: 0,4 SHR–A

Effectiveness of the action: 0,33

General Risk Assessment

Using the RIPRAN analysis, we can conclude that the project has 15 main risks, those were identified and then evaluated by the Project Risk team. We can also conclude, that except three biggest unacceptable risks, all other evaluated risks are acceptable.

The team dealt with the three most impacting risks and developed mitigation plans to decrease their impact on the project. We want to regularly monitor and control these analysed risks, on monthly basis. The project risk team will provide analysis every 2 months.

CONSLUSION

Nowadays, the project management provides a lot of various high level project methodologies. Unfortunately, project managers do not always employ the wide options of offered methodologies. In general, the project risk assessment in the central Europe is usually performed in very simplified forms. The main goal of this paperwork was to apply the RIPRAN methodology on a specific case study and to show its advantages and disadvantages.

The used RIPRAN methodology is a very good method which is possible to apply to assess almost each project. Utilizing the RIPRAN methodology, the core team analysed 15 main risks, those can influence the project. These risks were analysed by a company without a risk culture. 3 out of 15 analysed risks were identified as unacceptable risks. To lower the risks and decrease the impact on the project, the project risk team developed mitigation plans. At the end of the RIPRAN methodology process, the team created communication, review and control objectives and a process.

We can state, that the used methodology can be applied on almost every type of project and almost in every lifecycle phase of a project. It is very easy to understand the methodology process, its input and output objectives and it is also easy to use this methodology in practice. It is possible to use this methodology even if the project team has less skills and knowledge of risk management characteristics. One of the advantages of this methodology is, that it can be extended by other objectives based on project nature.

Therefore, we recommend the following risk documentation principles during the use of the RIPRAN method:

- Each phase should be documented by a separate document that specifies for which project this risk analysis phase has been performed. The document should clearly indicate who and when the material elaborated, who approved it and other similar formalities.
- Suggestions of identification, quantification and analysis can be done either in the form of a spreadsheet or simply using a list of all the facts for each risk.
- A simple form of structured enrolment can be used for the first and last phase.
- Similarly, the final report may be worked in the form of a structured entry.
- If the tables and other materials used are not normally available in the company or do not arise from any other facts (guidelines, methodological guidelines, etc.), where they are important to understand the used process, it is necessary to attach such materials to the documentation as attachments, so that is clear, those auxiliary materials and sources were used.

At present, it is necessary to prefer the electronic form of all documents so that all output documents should be in electronic form and also archived in electronic form.

A current overview of risks should be supported by the "Risk Register" for the appropriate project. This can be solved as a simple table created by MS WORD or, respectively, MS EXCEL, both of which represent a simple option to support the work of the project team or as a database, using a sophisticated database system using SQL principles. The use of a client / server database system is the ideal solution for project risk management within corporate risk management and project management with the application of a corporate project office.

Based on our experience, we claim that the RIPRAN method is used to support the systematic implementation of risk analysis in a systematic way so that risk analysis is implemented in a high quality and is achieved an effective outcome in project risk management over time, possibly in other business processes.

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