
Attempted Development of a Methodology to Support Project Implementation Risk Management in a Manufacturing Enterprise

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Abstract:

Purpose: This paper attempts at the development of a methodology to support risk management in project implementation. The methodology refers to a manufacturing enterprise in the automotive sector as this is where the implemented projects are mutually comparable. Based thereon, it is possible to identify past risks during various project stage implementation which may contribute to more effective risk management relating to current and future projects.

Design / methodology / approach: Data gathering and analysis of a specific case to draw conclusions, understand mechanisms and indicate effective solutions.

Findings: The purpose of this work is to develop a methodology for gathering and analysis of data concerning the implemented projects in a way enabling their subsequent analysis in order to identify key project risks and provide valuable information.

Research limitations / implications: The developed methodology shall be used subsequently to create a tool supporting project implementation, taking the form of a spreadsheet. During continued work devoted to the topics covered herein, it is recommended that the developed methodology of data gathering and analysis be implemented into a computer application.

Practical implications: The information concerning those aspects may be useful for future risk management as the awareness of the past occurrence of certain threats or opportunities, combined with knowledge of the ways of coping in such circumstances, may contribute to a rapid implementation of an appropriate risk response and, consequently, improve the company's competitive advantage.

Originality / value: The holistic approach to the development of methodology allowing to gather data concerning any implemented projects and analyze it for future reference.

Keywords: Project risk management, methodology, optimized decisions, enterprise management.

JEL codes: D81, L23, M11, M21, C53.

Type of paper: Case study.

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1. Introduction

The automotive manufacturing enterprises operate based on implementing new projects. Expanded engineering centers which cooperate closely with manufacturing plants are responsible for the development of both existing and new product concepts until the developed solutions are implemented into production.

If the project entails cooperation with a key vendor for the company or is aimed at implementing highly important strategic assumptions of the company, the company's competitive advantage may be conditional on the success or failure rate of the project.

2. Literature Review

Irrespective of the market sector with which the company is connected, project implementation by it is accompanied by various challenges of different nature and complexity. Nonetheless, the emerging difficulties share one property, i.e., the fact that each of them is encumbered with risk.

It may be a threat for the project implementation or even result in its total failure. To prevent failure, such people as project managers, operational managers or operating team leaders employ methods to support management of a broadly-taken risk.

The objective of such activities is to prepare for the risk occurrence (when it is negative, it is called a hazard (Korcowski, 2010; PMBOK Guide, 2012) to ensure that an appropriate response is possible when the danger occurs and thus to eliminate or at least minimize its adverse effects.

The concept of risk is also connected with possible occurrence of events with the nature likely to result in positive effects, where the risk is called an opportunity (Jaafari, 2001). The role of the person accountable for the project stage which it refers to should consist in ensuring its occurrence.

For companies whose operations are based on successful project completion, it is highly important to pay attention to various task completion aspects. The aim is to improve efficiency, reduce any unplanned costs and, primarily, to achieve the intended objectives as planned. In such circumstances, it is important to draw suitable conclusions following the end of each project and during them.

They should refer to such aspects as e.g. task implementation management, cooperation with vendors and the quality of work carried out by specific operating groups. The information concerning those aspects may be useful for future risk management as the awareness of the past occurrence of certain threats or opportunities, combined with knowledge of the ways of coping in such circumstances, may contribute to a rapid implementation of an appropriate risk

response and, consequently, improve the company's competitive advantage (Larose, 2006; Pickett and Elliot, 2007).

Nevertheless, once the project is completed, the time duration spent analyzing it and drawing valuable conclusions based on it is insufficient as a subsequent project is started soon afterwards.

In such circumstances, it may be impossible to share knowledge gathered during project implementation with other company employees, not to mention its correct cataloging. For this reason, it would be useful to have a tool to support rapid archiving of the information and knowledge held and also, to a certain degree, to allow drawing conclusions based on the data held (Butler *et al.*, 2018; Carter *et al.*, 2013; Dias *et al.*, 2020).

An obstacle to the practical use of such a tool is the fact that each of the implemented projects is innovative and unique to a certain degree, meaning that their comparative analysis will not always make sense. However, if a group of projects which are identical in certain aspects is examined, comparing them may provide useful information and result in drawing conclusions helpful when managing similar projects which will be implemented by the company in the future (Hand, Mannila and Smyth, 2006; Kadlubek *et al.*, 2022).

This is the case for companies in the automotive sector which implement numerous programs composed of similar projects for specific customers (Drucker, 1993; Gajendran *et al.*, 2011). This means that the implemented projects are comparable and, based on it, it is possible to identify past risks during various project stage implementations which may contribute to more effective risk management during current and future projects (Dvir, Raz and Shenhar, 2003).

To be able to employ the above approach in practice, it is necessary to know the methodology of analyzing data concerning the completed projects in terms of identifying risk related to them (Borys and Rogala, 2012; Brajer-Marczak, 2014; Burnasheva, 2016; Czainska *et al.*, 2021).

The purpose of this work is to develop a methodology for gathering and analysis of data concerning the implemented projects in a way enabling their subsequent analysis in order to identify key project risks and provide valuable information.

3. Methodology of Data Gathering and Analysis

To be able to carry out a valuable data analysis, it is indispensable to select their correct gathering method. It was determined that data may be gathered as follows:

- 1) At the start of the project and each of its stages, the following information should be provided:

- a) what budget is allocated to the works within the project (the planned implementation cost);
 - b) planned implementation duration;
 - c) on identified sources of uncertainty;
 - d) on identified risks;
 - e) on the project success factors which should be ensured.
- 2) Following the end of the project and each of its stages, the following information should be gathered:
- a) amount spent on the implementation (actual cost);
 - b) implementation duration;
 - c) person accountable for the work result;
 - d) person/operating group who did the work;
 - e) other stakeholders involved in the implementation and their impact on the project;
 - f) sources of uncertainty identified during the implementation;
 - g) sources of uncertainty from which the materialized risks resulted;
 - h) risks identified during implementation;
 - i) materialized risks;
 - j) impact (in terms of finance and time) of the materialized risks on the project/stage;
 - k) ensured project success factors.

When the above data have already been gathered, they can be analyzed. Based on the literature and solutions presented in it (Atkinson, 1999; Gardiner and Stewart, 2012; Pritchard 2002) and on experience, it was attempted to create a methodology to support project implementation risk management in an automotive manufacturing enterprise.

The developed methodology is presented below.

- 1) A separate analysis for each project/stage:
 - a) comparison of the project budget with costs which had to be allocated to its implementation;
 - b) comparison of the budget of subsequent project stages with costs which had to be allocated to their implementation;
 - c) comparison of the planned project implementation duration with the time required for its completion;
 - d) comparison of the planned duration of the subsequent stage implementation with the time required for their completion;
 - e) comparison of the list of uncertainty sources identified before the project was started with the ones identified during consecutive stage completion;

- f) highlighting the uncertainties included in the developed collective list which resulted in the risks materialized during project implementation;
 - g) comparison of the list of risks identified before the project start and at each and every stage with the ones defined during the project implementation;
 - h) highlighting the risks in the developed collective risk list which materialized and noting their effect on the project in terms of costs and implementation duration;
 - i) comparison of the project success factors which should be ensured during its implementation (including for each and every stage) with the list of success factors guaranteed during task performance;
 - j) determination of the people from the list of other stakeholders involved in the project who had a positive or negative impact on its implementation;
 - k) determination of the people accountable for the result of works within individual stages, including the list of stages which ended early, on time or were delayed;
 - l) determination of the people accountable for the result of works within individual stages, including the list of stages which exceeded their budget, incurred the planned costs, and were completed cheaper than expected;
 - m) determination of the people/operating groups who performed work within individual stages, including the list of stages which ended early, on time or were delayed;
 - n) determination of the people/operating groups who performed work within individual stages, including the list of stages which exceeded their budget, incurred the planned costs, and were completed cheaper than expected;
- 2) Identification of performance indicators for each project/stage separately:
- a) indicator of the financial effectiveness of the project/stage implementation:

	$W_F = \frac{K_R}{K_P} \cdot 100\%.$	(1)
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- where: K_R – actual cost of the stage/project;
 K_P – planned cost of the stage/project.
- b) indicator of the time-related effectiveness of the project/stage implementation:

	$W_T = \frac{T_R}{T_P} \cdot 100\%.$	(2)
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- where: T_R – actual project/stage implementation time;
 T_P – planned project/stage implementation time
- c) indicator of the effectiveness of the project/stage uncertainty source identification:

$W_{N_I} = \frac{N_{P_Z}}{N_{P_Z} + N_{P_{NZ}} + N_{R_{NZ}}} \cdot 100\%.$	(3)
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- where: N_{P_Z} – number of the uncertainty source types identified before the project/stage was started which were also identified during its implementation;
 $N_{P_{NZ}}$ – number of the uncertainty source types identified before the project/stage was started which were not identified during its implementation;
 $N_{R_{NZ}}$ – number of the uncertainty source types not identified before the project/stage was started which were identified during its implementation.
- d) indicator of the effectiveness of identification of uncertainty sources leading to risk materialization:

$W_{N_M} = \frac{N_{P_{ZM}}}{N_{P_Z} + N_{P_{NZ}} + N_{R_{NZ}}} \cdot 100\%.$	(4)
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- where: $N_{P_{ZM}}$ – number of the uncertainty source types identified before the project/stage was started which were also identified during its implementation and resulted in risk materialization;
 N_{P_Z} – number of the uncertainty source types identified before the project/stage was started which were also identified during its implementation;
 $N_{P_{NZ}}$ – number of the uncertainty source types identified before the project/stage was started which were not identified during its implementation;
 $N_{R_{NZ}}$ – number of the uncertainty source types not identified before the project/stage was started which were identified during its implementation.
- e) indicator of the effectiveness of guaranteeing the project/stage success factors:

$W_{CS} = \frac{CS_R}{CS_P} \cdot 100\%.$	(5)
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where: CS_R – number of the project/stage success factors guaranteed during its implementation;
 CS_P – number of the project/stage success factors which should be guaranteed during its implementation.

f) indicator of the financial effectiveness of the person accountable for the result of work carried out within the project/stage:

	$O_{OF} = \frac{K_P - K_R}{K_P} \cdot 100\%.$	(6)
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where: K_P – planned cost of the project/stage;
 K_R – actual cost of the project/stage.

g) indicator of the time-related effectiveness of the person accountable for the result of work carried out within the project/stage:

	$O_{OT} = \frac{T_P - T_R}{T_P} \cdot 100\%.$	(7)
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where: T_P – planned project/stage implementation time;
 T_R – actual project/stage implementation time.

h) indicator of the financial effectiveness of the person/operating group accountable for the work carried out within the project/stage:

	$O_{WF} = \frac{K_P - K_R}{K_P} \cdot 100\%.$	(8)
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where: K_P – planned cost of the project/stage;
 K_R – actual cost of the project/stage.

i) indicator of the time-related effectiveness of the person/operating group accountable for the work carried out within the project/stage:

	$O_{WT} = \frac{T_P - T_R}{T_P} \cdot 100\%.$	(9)
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where: T_P – planned project/stage implementation time;
 T_R – actual project/stage implementation time.

j) indicator of the effectiveness of the project/stage risk identification:

	$W_{RI} = \frac{R_{PZ}}{R_{PZ} + R_{PNZ} + R_{RNZ}} \cdot 100\%.$	(10)
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where: R_{PZ} – number of risk types identified before the project/stage was started which were also identified during its implementation;
 $R_{P_{NZ}}$ – number of risk types identified before the project/stage was started which were not identified during its implementation;
 $R_{R_{NZ}}$ – number of risk types not identified before the project/stage was started which were identified during its implementation.

k) indicator of the effectiveness of the materialized project/stage risk identification:

	$W_{R_M} = \frac{R_{P_{ZM}}}{R_{P_Z} + R_{P_{NZ}} + R_{R_{NZ}}} \cdot 100\%.$	(11)
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where: $R_{P_{ZM}}$ – number of risk types identified before the project/stage was started which were also identified during its implementation and which materialized;
 R_{P_Z} – number of risk types identified before the project/stage was started which were also identified during its implementation;
 $R_{P_{NZ}}$ – number of risk types identified before the project/stage was started which were not identified during its implementation;
 $R_{R_{NZ}}$ – number of risk types not identified before the project/stage was started which were identified during its implementation.

- 3) Preparation of a reference library by summarizing corresponding data from all projects to enable further analysis of the data held and the direct insight into its form in the future.
- 4) Calculation of the mean value of each and every project/stage implementation indicator based on the values determined by the completion of section 2).
- 5) Identification of the key project/stage risks:
 - a) calculation of the occurrence probability for each risk based on data;
 - b) determination of the severity degree for each risk, with retained division into the financial risk degree and time-related risk degree, based on the following formulas:

	$S_{R_F} = P_R \cdot WR_F ,$	(12)
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where: P_R – risk occurrence probability;
 WR_F – average financial impact (loss/profit caused by risk);

	$S_{R_T} = P_R \cdot WR_T ,$	(13)
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where: P_R – risk occurrence probability;

- WR_T – average time impact (time shortening/delay caused by risk);
- c) classification of risks at individual stages into categories – appropriate limit values should be selected based on the information held, project manager's experience and the implemented project nature. For this paper, the categories were determined based on the following criteria:
- low risk – risk degree value from 0 to 0.15;
 - moderate risk – value from 0.16 to 0.37;
 - high risk – value from 0.38 to 0.75;
 - critical risk – value from 0.76.

4. Conclusions and Practical Implications

This paper attempted at developing a methodology for gathering data concerning the implemented projects in a way enabling their subsequent analysis and the data analysis method was developed in order to identify key project risks and provide valuable information. The developed methodology shall be used subsequently to create a tool supporting project implementation, taking the form of a spreadsheet.

During continued work devoted to the topics covered herein, it is recommended that the developed methodology of data gathering and analysis be implemented into a computer application (Gembalska-Kwiecień, 2017).

However, when using the developed methodology, it should be kept in mind that such phenomena as risk and uncertainty are often highly dynamic and interdisciplinary meaning that their repeatability degree may differ significantly depending on the nature and level of innovation and uniqueness of the delivered project.

For this reason, using the solution developed for this paper, it should be remembered that it is aimed solely at supporting the project manager's decision-making process meaning that they should employ logic, sector experience and their own judgment first relating to risk management.

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