

BEST PRACTICE PRINCIPLES FOR THE PREVENTION OF CRISES IN PRODUCT DEVELOPMENT

Birgit Dick, Bernd Jokele, Udo Lindemann

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Abstract

In order to prevent crises, companies establish risk management systems. Risk management processes exist already in specific branches, but are often not applicable to product development. The focus of this study was to analyse risk management processes in various branches, including engineering as well as non-engineering, and finding typical process components and methods. As a result, a general risk management process structure suitable for product development and its process steps can be described. The verification of this process led to a number of best practice principles concerning the performance of risk management systems. The presented process structure serves as a flexible basis for the prevention of crises in general, while adoption is still needed due to a user's specific boundary conditions.

1 Introduction

Nowadays, products and therefore the processes in product development are becoming more and more complex. The two crucial reasons are steadily increasing customer requirements, and strong dependencies between companies and their component suppliers within the development process. Among other things, these boundary conditions lead to a rising number of insufficiently clarified changes that have an effect on products and on internal (e.g. assembly planning, logistics) and external (customer or supplier) processes [1]. As a result, product failures are more likely to happen. This can be recognised by the fact that the number of recalls in the automotive sector has more than doubled in Germany within a period of five years until 2004 [2]. Recalls can put the existence of a company at risk. In the worst case, neglected risk might lead the closure of a company at worst [3]. The prevention of this kind of crisis is the aim of risk management. Based on study of prevention practices, which are established in engineering as well as non-engineering branches, a general risk management process structure is presented.

2 Method

The method applied can be described as follows: risk management processes from different branches were analysed. The aim of the analysis was to find typical process components and common methods used in different domains. On the basis of these process components, abstract process steps were established (Figure 1). A suitable choice of methods for the

specific process steps could be determined. Bringing together identified process steps and relevant methods a general risk management process structure was built up. For each of these steps a characterisation was stated.

The created process structure was applied in the development of mechatronic products in the automotive sector for verification reasons. Based on the experience of this verification project some best practice principles, to be respected in order to assure a well operating risk management system, were derived.

Analysis of different risk management processes

Risk management processes in different branches were analyzed in order to record the variety of risk management systems and to find suitable analogies for the application to product development in general. By observing the manner risk management is realised in project A in aerospace industry or in project B in information technology, common points could be found (Figure 1). The analysis was carried out on a great number of risk management procedures. For a better understanding, the study presented in this paper is focused on a selection of diverse sectors: aerospace industry, information technology, and finance.

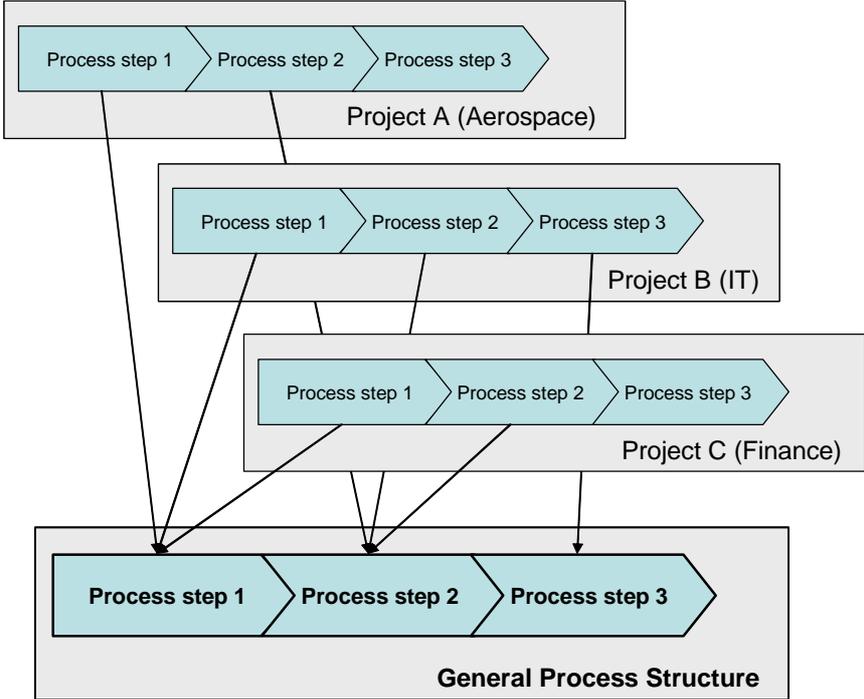


Figure 1. Approach: Analysis of different risk management processes

For the aerospace industry, the National Aeronautic and Space Administration (NASA) provides a risk management [4], which is designed as follows. The first phase is dedicated to planning, which means establishing a risk management plan. In a second phase risks are identified and characterised. Therefore, a risk portfolio is used: bringing together the probability occurrence of a risk and the consequences related to this risk you can judge the importance of risks. In the succeeding phase, a risk analysis is made in order to become more acquainted with the risks and the reasons leading to risks. Methods used in this context are for example fault tree analysis and evaluation on probabilistic basis [4]. In the last phase the

focus of the risk management process is upon finding a strategy to mitigate and track risks. That means suitable measures have to be defined for this aim.

In the field of IT projects, a systematic approach is suggested in order to track project risks. The risk management process according to Gaulke [5] can be described in the following way: First, an assessment of projects risks is carried out. In this step, risks are identified and evaluated on the basis of a checklist giving typical risks and references/recommendations for an assessment. This checklist provides questions on areas such as project management, business processes, users, technology and data [6]. In a second step, the effectiveness of project controls is assessed by a similar kind of checklist as used in the first step. According to this assessment, the stated project risks are evaluated. In the next step, the remaining risks and project controls are merged in a risk control portfolio. Using this portfolio knowledge is deduced whether there is a need for action or not. The former is the case if project controls do not work and the risk is high. In the last step of the risk management process, measures have to be defined. With a risk reduction portfolio, possible strategies, e.g. risk prevention, risk minimisation, risk relocation or risk acceptance, can be determined [6]. This portfolio is made up of the probability of occurrence and the level of damage in terms of risk. Having chosen a risk reduction strategy, adequate measures have to be put into action. All these steps are connected in an iterative way and have to be repeated continuously in order to adapt the results of every step to the current project status.

Another way to prevent crises is realised in the finance sector. The reference therefore is the risk management procedure applied in the German savings banks [7]. First, possible risks are identified and analysed. The risk analysis is carried out with a specific kind of checklist and has the aim to evaluate and classify risks. The factors regarded in the analysis are the probability of occurrence and the costs arising in case a risk takes place. Dependent on these factors, reasonable measures and their costs are determined. Thus, a remaining risk, including its occurrence probability and its possible costs, can be estimated. Second, indicators are watched out for, which can help to identify a risk as soon as possible. If a situation defined as a risk comes to pass, the foreseen measures will be started. Within the scope of project management, information on the risk management process are reported and updated if necessary.

The examination of these different risk management systems has shown a couple of characteristic process components and methods, which are suitable for a general risk management process.

3 Results

Merging the different introduced risk management procedures, some typical components and methods could be identified. On this basis, a general risk management process structure was generated.

3.1 Analysis of different risk management processes

General process components to be found in different specificity in most of the regarded risk management systems are risk identification, risk evaluation, action and monitoring (Figure 2). There is a need to state all possible risks in a certain development area. This means doing research on potentially hazardous topics, in order to have a basis for the following evaluation.

Once the most important risks are identified, actions have to be defined with the aim to minimise risk. Finally, the introduced actions have to be monitored. In the cause of measures failing to mitigate risk, other actions need to be chosen. The initialisation of a risk management process is not always expressed in a special way but seems necessary to define the boundary conditions of the risk management system.

		General Process Components					Methods											
	Process Step	Special Process Component	Initialisation	Risk Identification	Risk Evaluation	Action	Monitoring	Checklist	Critical Item List	Estimation	Expert Interviews	FMEA, FTA	Lessons Learned Documents	Portfolio	Probabilistic Methods	Program Plan	Templates	Watchlist
Aerospace	1	Planning	x													x		
	2	Risk Identification & Characterisation		x							x	x	x				x	
	3	Risk Analysis			x										x			
	4	Risk Mitigation & Tracking				x	x		x									x
IT	1	Risk Assessment		x	x			x										
	2	Control Assessment			x			x										
	3	Risk Analysis			x	x								x				
	4	Measure Implementation				x								x				
Finance	1	Risk Identification		x							x							
	2	Risk Analysis			x					x							x	
	3	Control Indicators					x											x
	4	Measure				x										x		

Figure 2. Result: Analysis of different risk management processes

Observing the methods used in risk management, it can be noticed that special types of methods are related to certain process phases. In the early phase of risk management, planning methods can be found. In order to figure out possible risks, experts' opinion is useful. More information for risk identification can be derived from former projects. If techniques such as FMEA (Failure Mode & Effects Analysis) or FTA (Fault Tree Analysis) have been applied already in a project, essential information about hot spots from the project's documentation can be derived [4]. Finally, checklists can be helpful at this point of the process as well. For the determination of an important and less important risk, evaluation methods are needed. Therefore, probabilistic methods and portfolios are commonly used. Despite existing experience, sometimes only estimations are possible. When it comes to taking actions, a suitable strategy needs to be found. Portfolios may help to decide how to deal with risk, e.g. avoid or mitigate risk. In addition, it is approved to make up lists and plans. These documents contain information such as critical items to be watched or concrete measure to be taken.

The identified process components in combination with commonly used methods form the basis of the general risk management procedure.

3.2 Risk management process structure

The established risk management process is structured according to the results of the interbranch process analysis (Figure 2). Thus, the process structure contains the general steps initialisation, identification, evaluation, action, and monitoring (Figure 3).

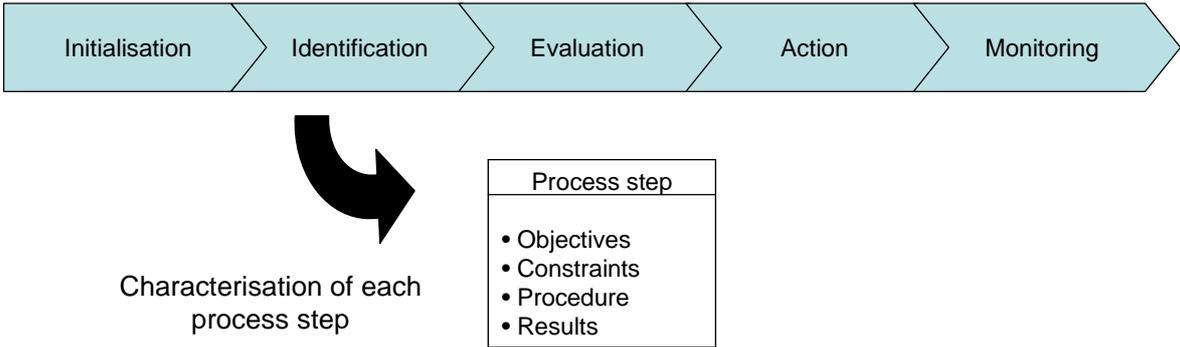


Figure 3. Risk management process structure

The different process steps can be characterised as follows: within the step of initialisation the planning of the whole risk management process is established. The aim is to plan the specific contents of the following process steps. Therefore, suitable methods have to be chosen. The development area has to be specified too. Boundary conditions are inputs from project management such as project plans. A method used in this context is a checklist providing questions on typical risk situations related to the product or process. As a result, the scope of the ongoing risk management process is provided.

The phase of identification aims on finding risky situations or gates, which have the potential to cause crises in the chosen development area. Taking the chosen scope as a basis, global and related concrete risk can be found with the help of specific checklists. The result is a number of explicit risks to be followed up.

Within the step of evaluation, the chosen risks have to be assessed. A boundary condition is the commitment on a small number of evaluation criteria, e.g. cost and quality. The assessment is carried out with the help of a risk portfolio. Applying this portfolio method, a risk is analysed and a statement is given, about the risk’s potential impact, for example, on the product’s quality. The result of this step is a ranking of risks.

In the phase of action, measures to be realised are defined for the most highly rated risks. There is focus on finding short-term measures. Using a specific critical item list, suitable arrangements, responsible persons and deadlines are brought together for each risk. As a result, an overview of actions to be taken is derived.

After a fixed period, a monitoring has to be carried out. This period usually lasts about four weeks but with the option to shortening it before milestones. The aim of this step is to determine the current status of the chosen risks. The list of critical risk items is advanced to a watchlist. This means, that the critical item list gets an extension containing information on

the status of the measures such as noncritical, critical, and very critical. In addition, risks, measures and deadlines have to be checked and updated if necessary. In the end, a representative overview of the current risk situation is derived.

Until the end of a project, the final monitoring step is repeated continuously in order to update risk information. With the beginning of a new development project, the risk management process starts again with the initialisation step.

The introduced risk management procedure was applied in the automotive sector for verification. As mechatronic car components are becoming more complex, it is more likely that neglected development failures evolve to a crisis. In order to prevent crises in the sector of mechatronic components, a risk management process was installed. Due to secrecy agreements, the realisation of the single process steps on a verification project is described at an abstract level, and detailed results are mentioned exemplarily only.

3.3 Best practice principles for a general risk management process

On the basis of the experiences from the verification project, the following general requirements can be stated as best practice principles for the design of an optimised general risk management process:

- Team aspect
- Holistic procedure
- Focus on initial phase

First, the team aspect plays an important role in risk management. It should be ensured to establish a good working atmosphere in the team working on the risk management system. It is known that this atmosphere has an impact on the cooperation within a team [8] and thus on the results of a team work. As it is customary for product developers nowadays to work together on development projects, it seems likely to identify risk by teams and to decide about measures to be started in case a risk takes place. In the verification project, a multidisciplinary team was set up. This was of advantage, because developers from different background, e.g. drive developers and production planners, were given a common forum by risk management. In this forum, different points of view on possible risks could be discussed in consideration of specific interface information. In addition, the communication skills within this multidisciplinary team played an important role. The participants of the risk management process showed openness to name even sensitive risk information, as well as a strong willingness to cooperate apart from division differences. These aspects had a big impact on the good quality and quantity of the risk information determined when applying the risk management process for the first time.

A holistic procedure for risk management is recommended. Efforts on risk management have to be made companywide in order to prevent unexpected, critical events. A good way to show the importance of risk management is to establish a risk policy. A risk policy containing a company's specific objectives concerning the prevention of crises had been built up in the context of the verification project. Introducing a risk policy needs support by management. If project managers with knowledge about sensitive development risks are not convinced about a companywide risk policy, the performance of a risk management system is disturbed. Therefore, the participation of all levels of management has to be assured, in order to establish a well operating risk management process. Besides, a systematic approach ought to

be provided. The established risk management process contains a systematic, generic structure, which can be applied in different divisions easily. Although the applied methods can vary from division to division due to different practices, it is necessary to have a general commitment about risk management. In consideration of the holistic aspects, a successful risk management process could be realised.

Finally, it is of special importance to put a focus on the initial phase of the process. There ought to be an emphasis on the initialisation of a risk management system due to the variety of agreements made at this time. Thus, a special phase of planning was provided when starting the verification project on risk management. Another important aspect during the initial phase of risk management process was the team’s commitment on common objectives. For example, by discussing the expected risk management results, it was possible to prevent misunderstanding within the team during the implementation of the process. In addition, it is important to establish transparency about risk management process. Within the verification project, team members were informed in advance about the risk management process structure. This led to a good understanding of risk management among the involved product developers and their divisions as well. At last, it is necessary to assure transparency about risk responsibility. By determining so called risk owners, it is assured that measures are watched and realised. This was a positive experience from the verification project, which is therefore stated as a recommendable principle.

Best practice principles to prevent crises by risk management can be summarised as follows (Figure 4):

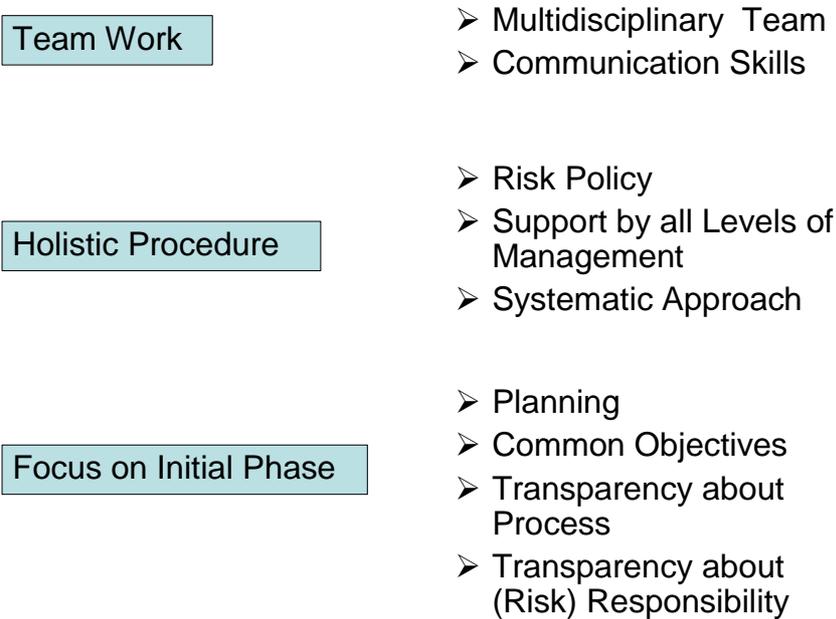


Figure 4. Best practice principles

Furthermore, a proper reporting system ought to be provided. All representative risk information should be gathered in order to support a teams’ communication on risk management. This information has proved to be an important input on project management as supplementary information on a project’s status.

4 Discussion

With the help of the introduced risk management structure, the occurrence of serious problems could be prevented within the verification project. One of the main success factors was an optimised communication among product developers involved in the risk management process. Different divisions had the possibility to discuss risk-relevant situations, which can emerge when, for example, electrical components do not operate properly conjointly. Within the verification project, several aspects, which might have led to a crisis, were found and discussed as well as successful measures defined. All this is only possible in an atmosphere suitable for open discussion. Thus, the performance of the risk management system is strongly dependent on the input given by the team members. Nevertheless, good results can be expected as long as all information related to potentially hazardous topics is discussed. If team members stop naming sensible information, stable working of the risk management system is put at danger. Thus, the open communication atmosphere has to be assured, as it is a sensible point about applying risk management.

5 Conclusions

Based on the analysis of different risk management processes, a general process structure to prevent crises could be derived. Knowledge about a sensible risk management process structure, and details on the characteristics of the process steps were built up. With this information, it was possible to prevent serious problems, as it could be proved on a verification project. Besides, useful requirements, which have to be regarded by working on the risk management system, had been stated. Having generated a process structure at an abstract level, there is potential to implement risk management in various divisions even in big companies.

Despite all prevention actions, the occurrence of crisis is still possible [9]. However, applying the right strategies at an early time in the process of product development, critical events can be kept away. We know by experience, that a successful risk management system can reduce the probability of crises [10]. In case the prevention does not succeed and a crisis occurs to a company, it is useful to provide a specific kind of trouble shooting methodology.

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Birgit Dick
Institute of Product Development
Technische Universität München
Boltzmannstraße 15
D-85748 Garching
Germany
Phone: +49 89 289-15150
Fax: +49 89 289-15144
E-mail: dick@pe.mw.tum.de