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Intelligent Risk Mapping and Assessment System

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Abstract

Risk management is the identification, assessment, and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events or to maximize the realization of opportunities. In this paper describes a risk management approach designed to support the Risk Management Methodology and adapted to design software to be used in concurrent product/process design and development. A conceptual framework for integrating corporate, product and process knowledge that establishes context of projects is described and systematic approach used to identify, assess and mitigate risk at the early stages of project life cycle, thus preventing project failures are covered.

Keywords: *Risk management, Concurrent, Mapping*

1. Introduction

In ideal risk management, a prioritization process is followed whereby the risks with the greatest loss and the greatest probability of occurring are handled first, and risks with lower probability of occurrence and lower loss are handled in descending order. In practice the process of assessing overall risk can be difficult, and balancing resources used to mitigate between risks with a high probability of occurrence but lower loss versus a risk with high loss but lower probability of occurrence can often be mishandled [1, 2].

Concurrent Engineering is the product development process used to reduce time-to-market, decrease cost, and improve. Project team members from different departments carry out tasks simultaneously, especially in the design phase. Thus, information can be shifted from implementation to the design phase rapidly. Consequently, product and process information can be shared and a better understanding of product and process can be achieved. Customer requirements can also be translated into design features or manufacturing capability be considered in the very early phase of the design. Hence, CE allows changes in the design stage rather than in the manufacturing stage. A new design can be tested and corrected while the product model can be visualized by using prototyping technology before it is actually manufactured. Thus, product development cost is lowered and product quality is satisfied [3, 4]. Since, CE requires involvement from several departments to develop a successful design, continuous interactions with several entities in a project are essential in CE. Moreover, sharing of limited resources make CE projects complicated because parallel tasks consume or share the same resources with several other tasks simultaneously. Hence, CE requires more professional management to deal with a more complex environment [5].

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Thus, although the CE provides several benefits to the product design process, the concurrent nature of tasks in CE enhances complexity in the project environment. For instance, compressed project lead time creates coupled tasks that demand limited resource sharing and involve close team. Failure in one task may also impact on other subsequent tasks and cause problems to their linkages. It is not uncommon that a CE project shows cost overruns or time delays despite commitment of large resources early in the project, that are communication issues and misinterpretation of requirements. These aspects of CE inherently impart high risk to design projects due to uncertainty from early freezing of the design and higher investment in the early stages of the project. The uncertainty is generated from a lack of information that is generally available towards the end of the project [6, 7].

In multi-site CE projects, integrations and interfaces among different functional departments between projects are complex. For instance, technological prerequisites, system integration, several stakeholders, and different objectives increase difficulties in projects through resource and input-output interdependencies. Further problems in multi-site projects arise from allocation of resources, project locations, project priorities, job scheduling, and conflicts among project objectives [8]. In conclusion, multi-site CE projects environment is very complicated with emphasis on team collaboration, communication, organizational structure, and cultural support. Hence, difficulties encountered in CE projects need to be addressed for successful implementation of projects. Effective project management strategies as well as a systematic risk management methodology must be established to overcome these difficulties and complexities.

2. Risk Management Process

There are several different definitions for risk found in the literature. Generally two aspects of risk are referred to i) an exposure to loss or ii) probability of loss in a project. For the definition of risk to be universally applicable and also to be able to be measured, risk for the purpose of this research was defined as probability of an unexpected event that may cause an outcome to deviate from the plan. Risk management is the identification, assessment, and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events or to maximize the realization of opportunities. This risk management standard is generic in nature and applied to a variety of areas including health and safety, software engineering and project management. For the purposes of managing concurrent engineering projects, the generic processes in the standard, also illustrated in figure 1, have been defined below [7-10].

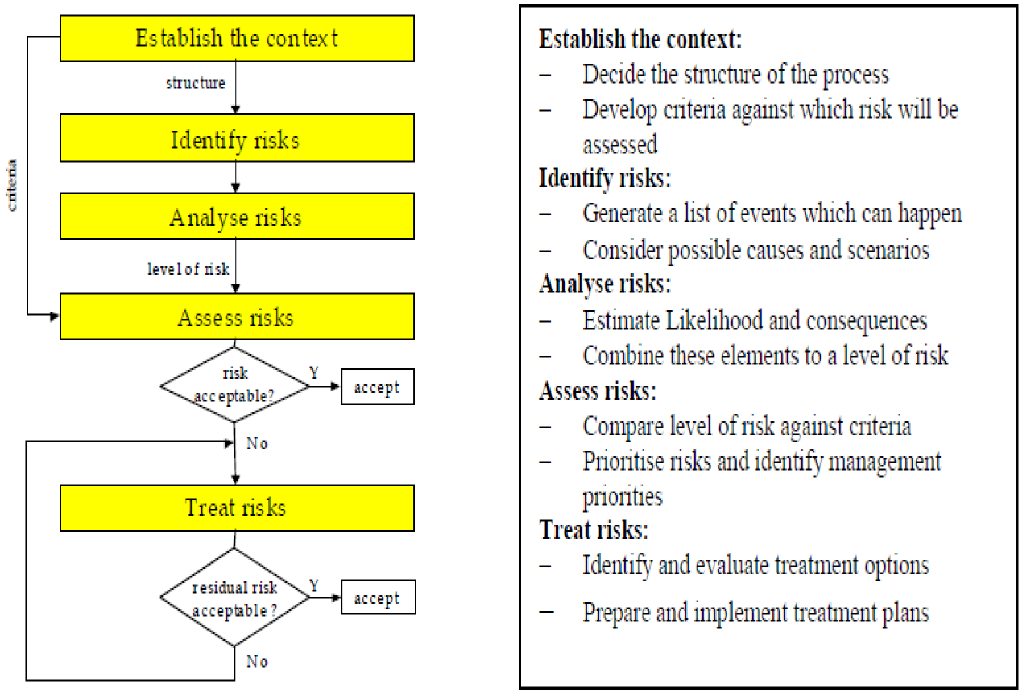

Figure 1. The Risk Management Process

Establishing the context – It involves establishing the boundaries of the project being worked on by defining the external environment, the organization and the specific project objectives. These are best captured through recording previous experiences and tailoring questions to prompt responses from a knowledgeable source. Risk identification - In this step, risks are identified and classified into potential sources of risk or risk factors during the life cycle of the project. For the current purposes, risk factors were classified into eight different categories – physical, technical, schedule, resource, network, financial, organizational and external risk factors

3. Design of Risk Management Process

Risk management process (Figure 2) is as much about identifying opportunities as avoiding or mitigating losses. According to the Risk Management Standard, the governing body must develop and implement systems which: are fully supported by management and backed up by an organizational policy and framework, which are fully communicated to all affected parties; result in an effective program for the management of risk; ensure that the risk management process is adopted by those in charge of projects; and ensure that the risk management activities remain effective and relevant by way of regular monitoring and review.

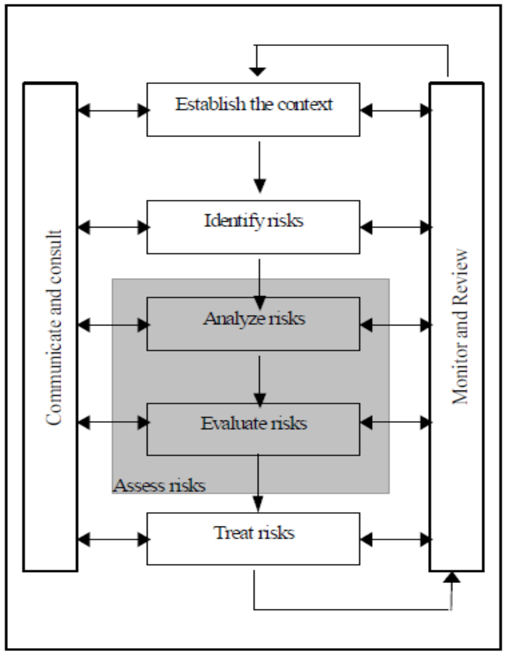

Figure 2. Intelligent Risk Mapping and Assessment System

The roadmap provides the required platform for the development of an "Intelligent Risk Mapping and Assessment System" The primary aim is to support the Project Managers in managing potential project risks during the life cycle of the project[7]. To design and develop its functional requirements need to be identified and the framework formulated. Based on the formulated system framework, the modules are required to meet the functional requirements. Considering the requirements for risk management in a environment and the risk management process presented in need to cover the following:

- ✓ Provide user input facilities to define project involvement and promote interactions between project participants;
- ✓ Establish project context from the defined project involvement;
- ✓ Identify the project risks and trigger events based on the established project context;
- ✓ Analyze the relative risks impact and their probability of occurrence;
- ✓ Prioritize the project risks based on their degree of magnitude;
- ✓ Identify relevant risk mitigation alternatives, based on captured knowledge;
- ✓ Prioritize the mitigation alternative to formulate an optimum risk management plan; and
- ✓ Capture lessons learned from previous projects, thus providing the basis for risk management of future projects.

- Virtual Workbench

The virtual workbench is to provide user interactions to define the project involvement and choice of mitigation actions, as well as to review risk mitigation plans. In addition, the workbench will facilitate communications and promote interactions with other project participants that may be non-geographically co-allocated. Other functions of the workbench may allow the presentations of computed results for user consumptions.

- Warehouse

The Warehouse stores information consisting of knowledge captured from experts and lessons learnt, user accounts, analysis results, and the relationships between success factors, risks factors, event drivers and mitigation alternatives. The stored information needs to be continuously updated, to ensure accuracy in analysis. This module also needs to interact with other modules, thus allowing a degree of intelligence.

- Context Establishment

Based on the process defined in Australian/New Zealand Standard on Risk Management, the first step in risk management is to establish the project context. In CE, the project context can be categorized into organizational, product and process based information.. The Context Establishment module is designed to automatically establish the context of a CE project, by acquiring user responses to a series of structured questions that are related to organization, product and process.

- Risk Identification

Based on the project context, the Risk Identification module identifies the risks inherent in organization, product and process. The analysis of the Risk Identification module utilizes an Expert System technology, where the rules are formulated using the captured knowledge. In addition to identifying potential risks, the rules contained in this module will determine the intensities of the risks.

- Risk Assessment

The next stage in risk management prescribed by the Australian/New Zealand Standard on Risk Management is to determine the risk magnitude, based on which the risk can be prioritized. The Risk Assessment module is designed to automate the risk magnitude analysis, by computing the relative risk impact, weight and probability. To compute the risk impact and weight, the module adopts the ‘Analytical Hierarchy Process' concept.

- Mitigation

Based on the captured knowledge, the Risk Mitigation module identifies the alternative mitigation actions for risks with high magnitude. The captured knowledge also allow the estimation of cost for each mitigation alternative. Subsequently, the mitigation plan can be formulated by prioritizing the mitigation alternative. The prioritization of mitigation alternative is governed by the risk magnitude, mitigation alternative and associated costs, as well as mitigation budget. The Risk Mitigation module adopts the developed algorithms in its analysis.

4. Results

A comprehensive framework has been formulated for the development of for risk management during the product and process design and development process of multi-site CE projects. In this consists of six modules synergistically integrated to provide for highly automated risk identification, assessment and mitigation as well as a Warehouse with updating provisions; and a risk management plan for a holistic view of the project risks. The compatibility of the software on which the modules are built is important and the real test of the degree of compatibility remains to be seen. The results of the analysis are governed by the knowledge stored in the Warehouse and user's response to structured questions in regard to risk identification, as well as mitigation alternative selection. The knowledge stored in the Warehouse needs to be continually checked for its validity, as it may alter with time. The lessons learnt on several on-going and previous projects as well as cases gathered from several manufacturing industries will be stored in the warehouse.

In this paper describes a risk management approach designed to support the Risk Management Methodology and adapted to design software to be used in concurrent product/process design and development. A conceptual framework for integrating corporate, product and process knowledge that establishes context of projects is described and systematic approach used to identify, assess and mitigate risk at the early stages of project life cycle, thus preventing project failures are covered.

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