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Programmatic Risk Management System

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Abstract

The purpose of the Programmatic Risk Management System (PRMS) is to evaluate and manage potential risks associated with proposed projects (i.e., new products or processes, or possible research and technological development projects). Although the PRMS considers some technical aspects of risk, the primary focus of the methodology is programmatic risk. That is, the methodology permits an assessment of risks associated with such issues as the ability to successfully produce a product that performs in accordance with all customer requirements, and the availability and allocation of resources (money, equipment, facilities, skilled personnel).

Introduction

The PRMS permits an expeditious assessment of programmatic risk by means of Risk Factors associated with each of six programmatic risk assessment categories. The PRMS process consists of five formalized activities that are essential for effective management of risks associated with proposed projects. These activities include risk assessment, development of appropriate risk mitigation strategies, estimating strategy implementation cost, ranking of risk mitigation strategies for resource allocation, and scheduling of strategy implementation. The PRMS utilizes a ranking system that allows the user to identify the most cost-effective investment of resources for minimizing risk.

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DISCLAIMER

Background

The Programmatic Risk Management System (PRMS) model is based on a Martin Marietta "technical risk management" model that was being used in a space vehicle production facility and provided the means for a qualitative assessment of risks. Although the Martin Marietta model provides management with a tool for decision making, it does not appropriately evaluate production risks and may, in fact, mislead decision making that is intended to be risk-based. Therefore, changes have been made to this model in order to adapt it for assessment of programmatic risks at Sandia National Laboratories (SNL). In addition, the PRMS analyzes the cost associated with mitigating programmatic risks and incorporates Vernon Grose's Hazard Totem Pole (Ref.) to provide a suitable means of prioritizing risk mitigation strategies.

Process Description

The PRMS process consists of five formalized activities that are essential for effective management of risks associated with proposed projects. These activities include risk assessment, development of appropriate risk mitigation strategies, estimating strategy implementation cost, ranking of risk mitigation strategies for resource allocation, and scheduling of strategy implementation. The Programmatic Risk Assessment Summary Sheet shown below (also shown in Appendix A) shows the risk assessment categories and can be used to summarize the results of the first four activities.

Table 1. Programmatic Risk Assessment Summary Sheet

PRMS Category	Risk Factor [A-E]	Mitigation Strategy Cost Code [I-M]	HTP Level [1-25]	Mitigation Strategy Priority [1-6]
1. Performance				
2. Producibility				
3. ES&H				
4. Technical/Support Personnel				
5. Facilities/Equipment				
6. Funding				

Risk Assessment - Risk Factors

The PRMS permits an expeditious assessment of programmatic risk by means of five Risk Factors associated with each of the six programmatic risk assessment categories as shown in Exhibits 1 through 6 in Appendix B. Within each category the five risk factors, designated A through E, represent levels of increasing risk. Each risk factor is associated with a set of conditions or circumstances relevant to that category. Selection of a particular risk factor represents the analyst's qualitative judgment about the most likely state of affairs for the assessment category. Table 2 (Appendix A) is a suitable form for documenting this risk assessment. The Risk Factor (A-E) selected for each assessment category is entered on the form along with the basis for the selection.

Risk Mitigation Strategies

Once the Risk Factors are selected for all six of the programmatic risk assessment categories, appropriate risk mitigation strategies should be explored to reduce the higher risks to lower residual risk levels. A risk mitigation strategy describes the discrete set of events or activities that will reduce risk and provides the success or exit criteria that determine when the desired degree of risk reduction has been achieved. A very clear, descriptive risk definition is necessary before a risk mitigation strategy can be developed.

Table 3 (Appendix A) illustrates a suitable form for summarizing the status of a risk mitigation strategy. In addition to describing the mitigation strategy, this form permits documentation of the initial risk factor for each risk assessment category, the associated risk factor goal, the current risk factor, and strategy status.

Estimating Cost - Mitigation Strategy Cost Code

The significance of a risk is based in part on how much it will cost to bring it under adequate control. Thus, the cost associated with implementation of a particular risk mitigation strategy must be estimated. Based on the estimated cost a Mitigation Strategy Cost Code (I-M) is provided below (Figure 1).

Cost Code	Cost
I	< $50 K
J	$50-$500 K
K	$500K-$1 M
L	$1 M-$10 M
M	> $10 M

Figure 1 Cost Factor

Ranking of Mitigation Strategies - The Hazard Totem Pole

For each of the risk assessment categories, the Risk Factor is combined with the Mitigation Cost Code to obtain a two-letter identifier. This two-letter identifier prioritizes risk mitigation strategies by means of the Hazard Totem Pole (HTP) shown in Figure 2.

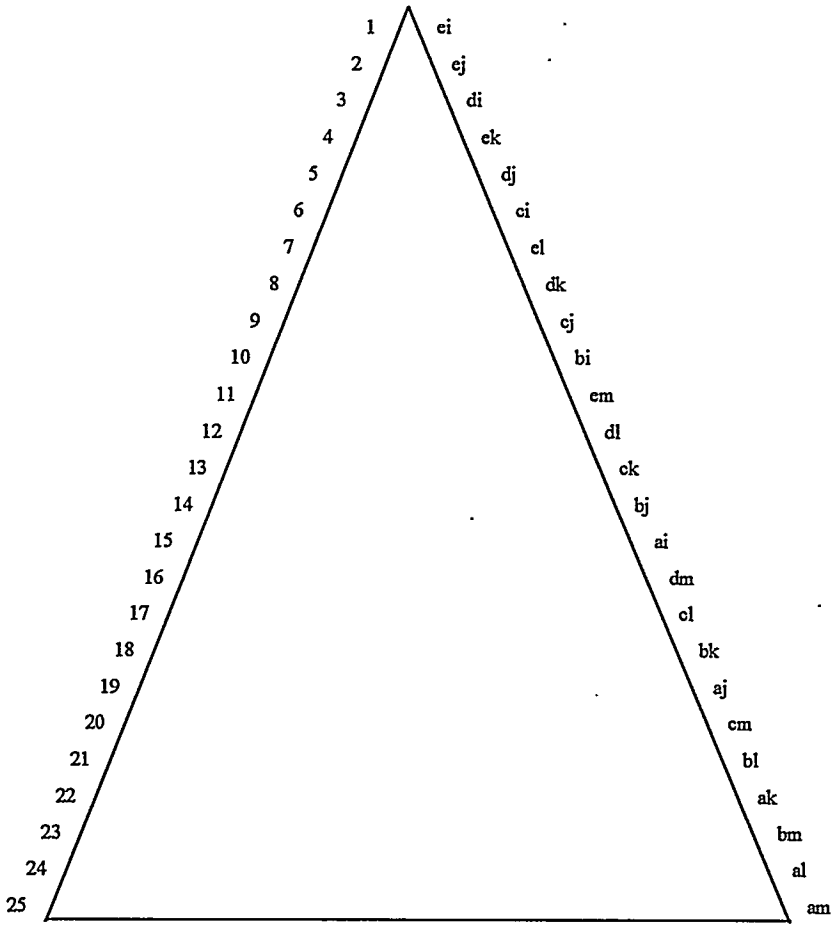

Figure 2 Hazard Totem Pole

Figure 2 is adapted from the HTP of Reference 1 and is constructed by combining the Risk Factor with the Mitigation Cost Code in a mathematically logical order for ranking risk mitigation strategies. At the top of the HTP (level 1) is the combination of highest risk level and least mitigation strategy cost. As one proceeds down the totem pole, the significance of ranked mitigation strategies diminishes. (At the bottom of the totem pole [level 25] is the combination of lowest risk level and highest mitigation strategy cost.) The purpose of the HTP ranking is to identify the most cost-effective investment of resources for minimizing risk.

Strategy Implementation

A risk reduction plan consists of a milestone schedule of risk reduction activities. Table 4 (Appendix A) illustrates a suitable form for summarizing risk reduction plan tasks. The relative priority for implementing risk mitigation strategies is obtained from the Hazard Totem Pole levels. That is, the highest priority mitigation strategy should be the one(s) that is located highest on the HTP. (The last column in Table 1 [Appendix A] is provided to rank [1-6] the risk mitigation strategies in accordance with their descending locations on the HTP.)

Process Summary

The five steps of the Programmatic Risk Management System process are therefore summarized as follows:

1. Assess the risk associated with each of the programmatic risk categories, shown in Table 1, using Exhibits 1-6 in Appendix B.
2. Develop risk mitigation strategies for categories assessed to have high or moderate risk potential (Risk Factors E, D, and C, respectively).
3. Estimate implementation costs for each risk mitigation strategy and select the appropriate Mitigation Strategy Cost Code from Figure 1.
4. Rank the risk mitigation strategies in accordance with the Hazard Totem Pole as shown in Figure 2.
5. Develop an implementation schedule for each risk mitigation strategy.

Appendices

Appendix A
Programmatic Risk Management Forms

Table 1. Programmatic Risk Assessment Summary

Programmatic Risk Management System (PRMS) Category	Risk Factor [A-E]	Mitigation Strategy Cost Code [I-M]	Hazard Totem Pole Level [1-25]	Mitigation Strategy Priority [1-6]
Performance				
Producibility				
ES&H				
Technical / Support Personnel				
Facilities / Equipment				
Funding				

Table 2. Programmatic Risk Assessment

Project ID:	Milestone ID:	Revision #:	Revision Date:
Risk Item Title:			Record Search:
Author Name:	Author Organization.:	Phone:	
Risk Item Description:			

Risk Assessment Category:	Risk Factor: [A -E]	Rationale for Assessment
Performance		
Producibility		
ES&H		
Technical / Support Personnel		
Facilities / Equipment		
Funding		

Table 3. Risk Mitigation Strategy Data Sheet

Mitigation Rev. #: Mitigation Rev. Date:

Project ID:	Milestone ID:	Revision #:	Revision Date:
Risk Item Title:			Record Search:
Author Name:	Author Organization:	Phone:	
Mitigation Strategy:			

Assessment Category:	Risk Factor [A - E]			Strategy Status
	INIT	CUR	GOAL	
Performance				
Producibility				
ES&H				
Technical/Support Personnel				
Facilities / Equipment				
Funding				

Table 4. Risk Mitigation Plan

Assessment Category:

Risk Title:

Date:
Current Risk Factor [A - E]:

Activity Description	Cost $	Resultant Risk Factor [A -E]	Month/Year
Task # 1:			
Task # 2:			
Task # 3:			
Task # 4:			
Task # 5:			

Appendix B
Programmatic Risk Management Factors

Exhibit 1

Performance Category	
Code	**Risk Factor Description**
A	**Hardware:** No technical or integration issues need to be addressed; process, system, or equipment meets requirements. **Software:** Existing, proven software or no new software required; non-critical software, few or no software integration considerations.
B	**Hardware:** All major technical and integration issues have been addressed and are near resolution; current process, system, or equipment meets requirements. A successfully tested and integrated prototype is currently in existence. **Software:** Some minor changes in existing software; non-real time software; some interfaces with other software; interfaces not of high complexity; failure to meet requirement would create inconvenience or non-operational impact, but essentially no reduction in technical performance.
C	**Hardware:** Development lots exist; technical and integration issues have been addressed but not resolved; current system does not meet performance requirements. **Software:** Average reliability; many interfaces with other software; failure to meet requirement would result in degradation of secondary mission; minimal to small reduction in technical performance.
D	**Hardware:** Minor amount of lab testing of components has been undertaken; major technical issues must be addressed before the process, system, or equipment will meet performance requirements. **Software:** Low reliability and availability; difficult response times; extensive interfaces with other software; failure to meet requirement would degrade system performance to a point where mission success is questionable; moderate reduction in technical performance.
E	**Hardware:** The configuration is only broadly defined; integration issues have not been addressed. **Software:** Mission critical; failure to meet requirement would result in mission failure; significant degradation/non-achievement of technical performance.

Exhibit 2

Producibility Category	
Code	Risk Factor Description
A	***Existing technology.*** *Schedule estimates based on vendor quotes for a well defined item, an off the shelf item, or a catalog item.* **Hardware:** An identical item/process meeting all performance requirements is currently in production. **Software:** Reusable or commercial-off-the-shelf (COTS) software is available; almost no new coding is required to execute functions.
B	***Minor modifications to existing technology.*** *Item schedule estimates based on, or extrapolated from, program actuals or supplier information for a very similar item that is already in production.* **Hardware:** Similar item/process is currently in production; simple retooling and/or minor capital investment is needed. **Software:** Equivalent software in another language; significant use can be made of reusable modules or COTS software is available for a portion of the functionality; code can be translated to another language or rehosted on a different machine with minimal new functionality.
C	***Moderate modifications to existing technology.*** *Schedule based on a model in which the scope/definition of the system is adequate.* **Hardware:** An item/process with similar performance has not been produced in quantity, but all materials and requirements are known. **Software:** Similar software functions have previously been used. Modifications to algorithms and software implementation differences are significant but known; moderately new functionality.
D	***Significant modifications to existing technology.*** *Schedule estimate developed with some uncertainties in the scope/definition of the item.* **Hardware:** Production has been limited to the laboratory environment. Most, but not all, materials required for the production process are known. **Software:** Software prototypes and simulations have been used in an engineering hardware environment; software created mostly from scratch with major engineering development using existing technology.
E	***New technology.*** *Major schedule uncertainties exist related to the scope/definition of the item.* **Hardware:** Production experience has been limited to R&D environment; material requirements are not well defined. **Software:** An integrated control structure for the software must be developed; software created entirely from scratch; required engineering development is unknown.

Exhibit 3

Environment, Safety and Health Category	
Code	**Risk Factor Description**
A	**Env:** No environmental resources are potentially at risk (biological, geologic, water, or air). The activity will have essentially zero impact on the environment. **H & S:** No onsite or offsite populations are potentially at risk. The activity will result in no health and safety effects.
B	**Env:** Few environmental resources are potentially at risk. The activity poses only a minor threat to the environment. The nature of hazard characteristics and potential environmental pathways are such that there is no credible scenario by which released radioactive or toxic materials or other hazards could impact sensitive environmental resources at sufficient levels to cause significant damage. At worst, exposures would produce a minor and temporary impact on the environment which would cause no lasting damage. **H & S:** Few onsite personnel and no offsite personnel are potentially at risk. Exposures are unlikely to produce more than minor injury (e.g., cuts, bruises)
C	**Env:** Some environmental resources are potentially at risk. The activity poses more than a minor threat to the environment. The nature of the hazard and potential environmental pathways are such that credible scenarios would result in decreasing environmental quality with time. Action to prevent significant deterioration of environmental quality will probably be needed in less than 10 years. At worst, exposures would produce an impact on the environment which would be largely self correcting, albeit not totally. **H & S:** No offsite populations, but a significant onsite population are potentially at risk. Exposures may produce injury or illness, but the effects are not likely to be long-term (<1 year) or life threatening.
D	**Env:** Significant environmental resources are potentially at risk. The nature of the hazard and environmental pathways are such that credible scenarios would result in rapidly decreasing environmental quality with time. Action to prevent significant deterioration is needed in <5 years. At worst, exposures would produce significant permanent damage to the environment. **H & S:** A very large onsite population and a significant offsite population are potentially at risk. Exposures may produce permanent debilitating injury or serious long-term illness.
E	**Env:** Major environmental resources are potentially at risk. The nature of the hazard and potential environmental pathways are such that credible scenarios would produce widespread and permanent damage to the environment. **H & S:** The entire population of the Laboratories and major offsite populations are potentially at risk. Exposures may produce death or are likely to produce permanent and near total loss of quality of life.

Exhibit 4

Technical/Support Personnel Category	
Code	Risk Factor Description
A	All necessary technical/support expertise is available with current staff.
B	Necessary technical/support expertise is easily obtainable.
C	The availability of necessary technical/support expertise is questionable.
D	Some technical/support expertise is lacking.
E	The necessary technical/support expertise does not exist.

Exhibit 5

Facilities/Equipment Category	
Code	Risk Factor Description
A	Existing facilities/equipment meet all requirements needed to achieve the desired functions and capabilities.
B	Existing facilities/equipment meet most requirements needed to achieve the desired functions and capabilities.
C	Existing facilities/equipment meet only some of the requirements needed to achieve the desired functions and capabilities.
D	Existing facilities/equipment meet few requirements needed to achieve the desired functions and capabilities.
E	Existing facilities/equipment meet essentially none of the requirements needed to achieve the desired functions and capabilities.

Exhibit 6

Funding Category	
Code	Risk Factor Description
A	Funding is sufficient to achieve all mission goals.
B	Funding is sufficient to achieve most mission goals.
C	Additional funding is required to meet operational requirements. Funding only partially meets requirements needed to achieve mission goals.
D	Lack of funding will affect major milestones. The funding meets few requirements needed to achieve mission goals.
E	No funding. Meets no requirements needed to achieve mission goals.

Reference

Grose, Vernon L., *Managing Risk - Systematic Loss Prevention for Executives*, 1987.