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PROGRAM RISK PLANNING WITH RISK AS A RESOURCE

Prepared By:	Paul S. Ray
Academic Rank:	Associate Professor
Institution and Department:	The University of Alabama Industrial Engineering Department Tuscaloosa, Alabama

NASA/MSFC

Office:	System Safety and Reliability Office
Division:	Safety and Mission Assurance
MSFC Colleague:	Edward H. Kiessling Deputy Director. Safety and Mission Assurance Office

1.0 INTRODUCTION

The current focus of NASA on cost effective way of achieving mission objectives has created a demand for a change in the risk management process of a program. At present ,there is no guidelines as to when risk taking is justified due to high cost for a marginal improvement in risk. As a remedial step Dr. Greenfield of NASA, developed a concept of risk management with risk as a resource (6,7)

2.0 RISK MANAGEMENT APPROACH

According to the present rule-based approach, the effort is directed to minimize all identified risks to a program until all resources are exhausted (6,7). In this process , there is no conscious effort to evaluate the cost of a marginal gain in risk level. The whole process is not cost effective .The proposed knowledge -based approach is to trade risk with other resources (e.g. Cost, schedule etc.) for acost effective way.

3.0 PLANNING RISK AND PROGRAM LIFE CYCLE

According to NASA practice, a program has five phases during its life cycle (3,4,5).Program formulation to select the most economic and feasible combination resources will be appropriate during the program formulation phase A and B, while design,development,and operation are implemented during the phases C,D,and E respectively. The risk planning method will be useful for initial planning as well as to review a plan at any time during the program lifetime particularly when some changes occur in program resources

4.0 KEY COMPONENTS OF A TYPICAL PROGRAM

4.1:Typical NASA program areas and resources:

A typical NASA program has the following key functional areas(6,7): technology utilization, system design, parts quality, fabrication, validation/test, and operation. Resources required for a typical functional area are(6,7) are: Cost, schedule, safety/risk, mass, Power, performance,and may include other resources for special program.

4.2 Typical options in a risk trade space:

Usually there are several feasible options any functional area. Each option requires different kind and amount of resources and has different characteristics , limitations, and advantages. Identification of the options available for a functional are is critical to effective planning of a program. Table 1 illustrates the typical options for technology and system design (6,7).

Function	Options
Technology utilization	1. Existing technology, and 2. Advanced technology
System design	1. Single string, 2. Selected redundancy, and 3. Redundancy (blocks and functions)

Table 1 Illustration of Options

4.3 Resource categories ratings, and weights:

Each resource has been classified into five categories based on its impact on a program. The category 1 indicates a low-level resource option ,with rating of 20 while, the category No. 5 indicates a high-level resource option having a rating of 100. The resource categories and their ratings are illustrated in Table 2 below.

Ratings	20	40	60	80	100
Categories	1	2	3	4	5
Resources					
Cost	No impact	Exceeds budget by less than5%	Exceeds budget by 5-9%	Exceeds budget by 10-14%	Exceeds budget by 15% or more
Safety/Risk	Risk score 1-3	Risk score 4-6	Risk score 7-9	Risk score 10-12	Risk score 13-25

Table 2: Illustration of Resource Categories and Ratings

4.4 Safety /risk categories and ratings:

To determine risk resource ratings ,a safety assessment matrix (Table3) has been developed having five levels of severity and five levels of likelihood of a mishap (1,2,8). A risk score is calculated by multiplying the level numbers of the applicable likelihood and severity. Based on this risk scores five risk resource ratings have been assigned as given in Table 3.

		Risk Matrix Score					Risk Score	Risk Trading Score
Chance	5	5	10	15	20	25	1-3	20
	4	4	8	12	16	20	4-6	40
	3	3	6	9	12	15	7-9	60
	2	2	4	6	8	10	10-12	80
	1	1	2	3	4	5	13-25	100
	Severity	1	2	3	4	5		

Table 3: Illustration of Risk Assessment and Ratings

4.5 Resource weights:

The resource weights indicate relative importance of the resources depending on the nature and management priorities. For a one-time rare event flight program schedule ios more important , while for a repeated use program like space shuttle program, cost may be more important. The total weight s for a functional option should be equal to the number of resources used for a program.

RISK TRADING METHODOLOGY

5.1 Risk trading process:

The process is program specific and starts with a possible budget, program duration, and management priorities. The first step is to identify the functions and options available for each function in the risk trading space. The step is to identify resources required for each option and assign resource weights according to the nature and priorities of a program. The next step is to compare the feasible options for each functional area and assign resource category appropriate for each option and assign the resource rating as per the Table 1.

5.2 Computational algorithm:

All the computational work is planned to be computerized as a very large number of different option sets are feasible in the risk trade space. The formulae to use are:

$$Rfjk = \frac{1}{n}\sum_{i=1}^{n}(wijk)*(rijk) \quad = \text{Resource score for the jth option in k th functional area.}$$

Where, wi = Weight of the ith resource
ri = score assessed for the resource i
n = number of the resources considered for an option

The computer software will repeat the same process for all feasible option sets and compute the overall program risk trade rating for an option set as follows:

PRTRl = Program resource rating for the l th set of the functional options.

$$= \frac{1}{N}\sum_{k=1}^{N} Rfjk$$

where, N = Number of functions assessed .

Larger value of PRTRl indicates a higher-resource option.

$$PRRl = \text{Program risk Rating} = \frac{1}{N}\sum_{k=1}^{N} rijk(\text{Safety/Risk})$$

6.0 REVIEW AND DECISION PROCESS

6.1 Review process:

The first step in the review process is to examine the computer generated Program resource (PRTR) vs. Program risk (PRR) curve to identify the option sets near the critical zone where the amount of resources required for a marginal improvement in risk increases significantly. The next step is to obtain and review the Resource Trading Summary reports also generated by computer for the selected program risk levels close to the economic boundary determined during the first step of review.

6.2 Decision process:

During the decision step ,the program planning and relevant functional representatives will select the most desired set of options considering residual risk, cost, and other factors relevant to the program. The PRTR vs.PRR curve being nearly flat near the optimal zone, a flexibility of selecting different sets of resources for practically the same level of overall risk will be a great advantage in several cases.

7.0 MERITS OF THE PROPOPSED RISK PLANNING APPROACH

- The knowledge-based approach will improve the risk management process for all future programs.
- The proposed risk planning system will provide a structured guideline for a cost effective way of planning risk for a program.
- Risk planning is based on the overall risk of a program.
- The program characteristics as well as management priorities are taken into account.
- Risk management will be integrated with program planning to ensure efficient overall management.
- The proposed risk planning tool will be useful for adjusting a program in response to change in program resource allocation.
- The potential order-of-magnitude estimate of savings is about 8% of the budget..
- The approach is consistent with the current NASA policy of "better, faster, and cheaper" focus.

8.0 RECOMMENDATIONS

As the proposed knowledge-based system presents definite advantages over the present rule-based approach of risk management of NASA , the following recommendations are made:

- Continue to fine-tune the risk planning methodology developed during the Summer 1997 for computerization. This is needed because a very large number of resource combination sets are feasible for a typical program.

The computation work is heavy and justifies the use of computer.

- Continue developing the proposed computerized risk planning system as continuation of the Summer research program of the University of Alabama.
- Conduct test and /or parallel run of the proposed risk planning system to adjust the sensitivity of the resource rating if needed for better perception of the results.
- Include the use of the proposed risk planning system in the requirements for program planning during the early phase 'B'.
- Implement the computerized system for risk management on trial basis.

9.0 REFERENCES

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