Qualitative Risk Management in Space Activities
Practical Risk Analysis of Project Planning

by

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Abstract

Risk management is the human activity which integrates recognition of risk, risk assessment, developing strategies to manage risk, and mitigation of risk using managerial resources. Risk management is an essential element of project management. In a project, risk analysis should be performed to identify which risks could occur and, knowing these risks, a project manager can then affect measures to control them. However, the effect of those measures must be assessed regularly throughout the life of the project. More often than not, qualitative risk analysis instead of quantitative risk analysis is used for risk management, because qualitative methods in general consume much less time and demand less specific theoretical knowledge of risk analysis. While other risk management techniques are available, it is considered that the RISMAN-method is highly suitable for space projects, due to its applicability throughout an entire project. When planning a (space) project, a global risk analysis of this planning is highly recommended to avoid extra costs such as for the project itself, damage because of loss of imago and loss of social status and public acceptance. This paper describes a Quick-Scan methodology, based on the RISMAN-method, which can be used to assess risks in the planning of space projects.

Introduction

Space projects, such as developing and building satellites and launch systems (space rockets), need a risk assessment tool that can be used in every phase of the project, including the planning phase, to produce quick visibility of project risks and their potential impact.

In every phase of a (space) project, risk analysis is the core element of risk management. Risk management begins with a risk analysis to systematically identify the risks within the project. A once only stock-taking of risks, at the beginning of the project, is not enough since projects tend to develop and change over time. Also, risk control measures taken during the project, can change the risks themselves. Consequently, risk management must be a cyclical process that has to be carried out continuously. (See figure 1)

The RISMAN-method is a technique to conduct risk analysis and is very well suited to be used in long duration space projects, as it can be utilized throughout the entire project. The RIS-
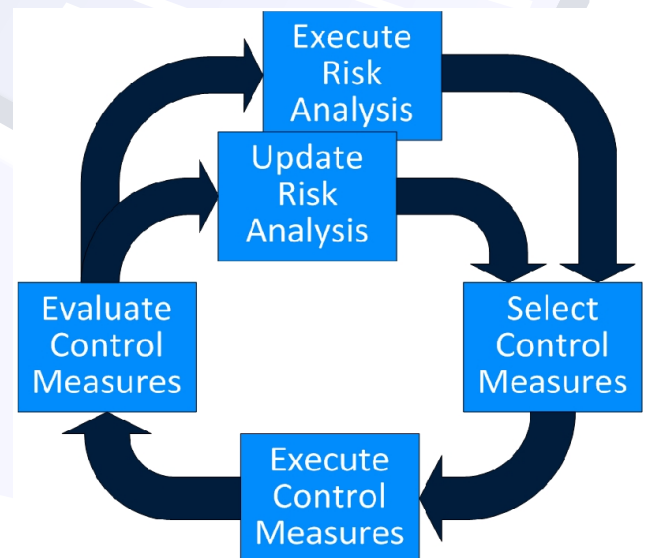

Figure 1. Risk management must be a cyclic process

MAN-method was initially developed as a risk analysis tool in the 1990s by the Dutch Ministry of Waterways and Public Works to assess the risks in planning large infrastructural projects.

Using the RISMAN-method, the risks are made clear in a systematic way, and are from a variety of perspectives and measures to control these risks, identified. (See reference 1)

While risk analysis for projects is generally accepted as absolutely necessary, risk analysis in the planning phase is not. The idea is that risk analysis for the project saves avoidable costs and budget overruns and that the planning of the project does not generate extra costs. Especially costs that arise when the project is delayed are considered here (time is not limitless and is a cost factor). Three types of extra project costs that can be distinguished, although they are not very visible, are extra project costs, costs as a result of damage because of loss of imago, and social costs (loss of social status and public acceptance).

— *Extra project costs*: Costs of personnel and material from the own organisation that must be operational longer than planned; extra costs to avert more delay; claims by participants in the project for extra costs.
— *Damage costs because of loss of imago*: When a project is delayed, this can be blamed on the project team. This is a form of imago damage that affects the good name of the organisation and/or the project manager.
— *Social costs*: A high value space project represents a social added value (it reflects on the people of the country). If a space project is delayed, the reflection of the status to be gained and the public acceptance are delayed or even could be lost. Loss of social status and public acceptance are considered social costs.

Scope of paper

Risk analysis of a planning process is considered to be necessary. This paper describes a Quick-Scan methodology, based on the RISMAN analysis, to perform risk analysis of the planning process to improve the control of the total project.

Approach and Organisation

The RISMAN-method is an instrument to conduct risk analysis. By means of this instrument risks are made clear in a systematic way and from different points of view, and control measures for these risks are identified. Based on the RISMAN-method a so called Quick-Scan has been developed. The difference between the comprehensive RISMAN-analysis and the Quick-Scan is that with the latter, in a short period of time (two half days) and relatively little effort, a first and quick insight in the risks of planning a project can be obtained. The results of the Quick-Scan are inherently more global than the comprehensive RISMAN-analysis.

A Quick-Scan also can be used to assess the feasibility of the planning or to actualise a performed RISMAN-analysis in the process of risk management during a project phase.

The Quick-Scan is applicable for very complex as well as for less complex projects and can be executed during every phase of (the planning) of a project. The results of a Quick-Scan are:
— Perception of the most important risks in the planning of the project;
— Insight into cause and effect of these risks;
— Insight into possible control measures;
— Insight into the feasibility/practicability of the planning.

A Quick-Scan principally consists of two meetings, half a day each on different days not more than a week apart. The first meeting is problem oriented; focus upon and chart the risks for the planning. The second meeting is solution oriented; analyse the risks and formulate control measures. The meetings have to be prepared and afterwards a report has to be made and submitted. The complete method has been visualised in figure 2.

The basic principle is that the Quick-Scan for a great part will be executed by the project team. The project leader and project secretary organise the Quick-Scan and (a part of) the other project members take part in the meetings. Also an external process manager will be taken on to lead the meetings and at least one external expert will be invited to take part.

The Organisation Team. The Quick-Scan is organized by the project leader and the project secretary. Their tasks are to prepare the meetings and to report afterwards.
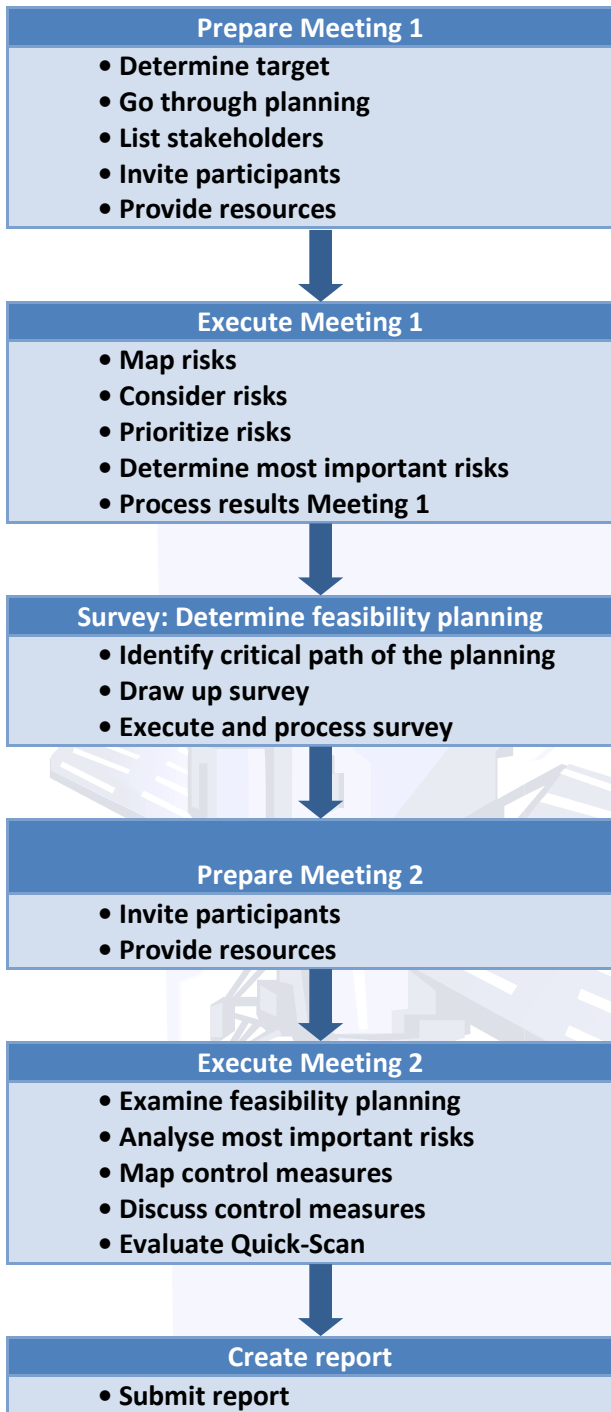
Prepare Meeting 1
- Determine target
- Go through planning
- List stakeholders
- Invite participants
- Provide resources

Execute Meeting 1
- Map risks
- Consider risks
- Prioritize risks
- Determine most important risks
- Process results Meeting 1

Survey: Determine feasibility planning
- Identify critical path of the planning
- Draw up survey
- Execute and process survey

Prepare Meeting 2
- Invite participants
- Provide resources

Execute Meeting 2
- Examine feasibility planning
- Analyse most important risks
- Map control measures
- Discuss control measures
- Evaluate Quick-Scan

Create report
- Submit report

Figure 2. Quick-Scan method

The External Process Manager. The meetings are led by a process manager from outside the team but not necessarily from outside the organisation.

The Participants. All or some of the members of the project team are invited to take part in the Quick-Scan. Care should be taken to invite a variety of participants to make sure that the whole project is being represented well. This means not too many persons from one disci-

pline, but from every discipline at least one person.

An External Expert as Participant. It is wise to invite for the meetings, besides members from the project team, one or more external people who have experience with similar projects. With external people, persons are referred to as from outside the project team but not necessarily from outside the organisation. The task of such an expert is mainly to detect and break through project blindness. Often it is difficult for members of a project to stay objective and critical in matters in which someone is involved for a lengthy period of time. In choosing external experts, one should take care that they do not have conflicting interests concerning the project and so could have a negative influence upon the project. It is also sensible to look at the character of these external people. It is not wise to invite persons of which you can suspect that they could disturb the process of the meetings, e.g. because they are very dominant.

Time spending assessment and planning
The time for the execution of the RISMAN Quick-Scan needed by different persons is depicted in table 1. If, apart from the project leader, project secretary and process manager, nine persons take part in the Quick-Scan, the total time needed is not more than 140 hours.

The pass-through-time for the execution of the Quick-Scan depends on the exertion of the project team. Preferably the pass-through-time for a Quick-Scan is not more than two weeks. In table 2 an exemplary planning for a Quick-Scan has been depicted.

Activities	Project Leader	Secre-tary	Process Manager	Participants (# 1)	(# 9)
Prepare Meeting 1	4	4	2	1	9
Execute Meeting 1	4	4	4	4	36
Prepare Meeting 2	2	2	2	1	9
Execute Meeting 2	4	4	4	4	36
Create Report	4	6			
Total (in hours)	18	20	12	10	90

Table 1. Time Estimation Quick-Scan

Activities	Week 1		Week 2	
START	◊			
Prepare Meeting 1	▬▬▬▬			
Execute Meeting 1		◊		
Prepare Meeting 2		▬▬▬		
Execute Meeting 2			◊	
Create Report		▬▬▬	▬▬▬	
END				◊

Table 2. Pass-through-time Quick-Scan

The RISMAN Quick-Scan

Preparatory activities that have to be performed by the organisation team of the first meeting are:

— Determine and describe the target;
— Go through the planning;
— List the stakeholders;
— Find an external process manager;
— Invite the participants;
— Provide the necessary resources.

Determine and describe the target. The project leader determines the target and the scope of the Quick-Scan. Here it is important to determine the phase (e.g. planning) on which the Quick-Scan is targeted.

Go through the planning. The planning of the project is the most important information for the execution of the Quick-Scan. It is important that the planning is updated to the last information available, otherwise the first meeting cannot be used optimally to map the risks. Also, the current state of affairs must be clear. E.g., is there a (conditional) go for the project? The project leader, with the planner and/or assistant project leader, goes through the planning. In table 3 a survey example of pitfalls for the planning and remedies, is presented.

List the stakeholders. Preceding the first meeting the project leader (if need be with assistance of his assistant or someone other that is knowledgeable) executes a stakeholder inventory. This means that it is drawn up which parties have influence upon the project by answering questions such as:

— Who decide on the project?
— Who use the result of the project (or benefit)?
— Who carry out the activities?
— Who advice about the project?

Pitfalls	Remedies
The activities show the project in an unbalanced way.	Extend the planning, cluster activities, split activities.
Too many activities are not well surveyable.	Cluster and rearrange activities.
The critical path is not clearly recognizable.	Make critical path recognizable by colouring or shading.
For the activities it is not clear which persons/organizations will execute them.	State which persons or organizations will execute the activities. If necessary split activities with different executing parties.
Important moments when to decide on something are not clearly marked and have no pass-through-time.	Mention decision moments explicitly and describe who decides. Making decisions cost time and must be given pass-through-times.
Important products or results (e.g. buildings, constructions, reports, etc.) are not clearly recognizable.	Milestones for important products or results must be clearly marked

Table 3. Pitfalls and remedies for the planning

The resulting list of stakeholders will be used during the first meeting as a tool to determine possible risks for the planning of the project coming from the identified parties and their influence on the project. It can be helpful to visualize in a two-dimensional map the relations between the stakeholders and the project, and the relation among the stakeholders themselves. In figure 3 an example of such a stakeholder relation map is shown.
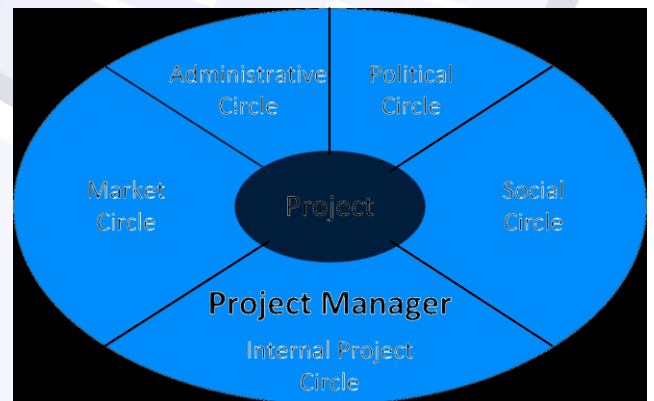

Figure 3. Stakeholder Relation Map

Find a process manager. The process manager should preferably have experience in this kind of work. Although he should not take part substantively to much in the discussion, his most important tasks are:

— See to it that the team during the meetings works together for the common goal;
— Structure and clarify discussions;
— Control the progress of the meeting.

Invite the participants. The participants are invited by the project leader who makes certain that there is a variety in interest among them. The amount of participants should not exceed ten people (including the project leader, excluding the process manager and project secretary). It is important to inform the participants in the invitation about the target of the meetings and tell them what is expected from them. It could be wise to submit with the invitation, information that already has come forward (such as the stakeholder relation map, a general idea of the planning, etc.), so that the participants already can think about possible risks that might influence the planning.

Provide the necessary resources. Make sure that sufficient resources are readily available for the participants. This includes everything from whiteboard or flip-over, information lists on poster formats, prepared risk tables for every participant for mapping the risks (see table 4) and all other things necessary such as memo stickers, writing material etc. No time of the participants should be lost because of inadequate preparations.

10 Most Important Risks
Risk 1
Risk 2
Risk 3
Risk 4
Risk 5
Risk 6
Risk 7
Risk 8
Risk 9
Risk 10

Table 4. Example of a Risk Table

First meeting

When meeting for the first time, the process manager introduces the target of the Quick-Scan by explaining the scope of the scan and that it is necessary to map the risks that could lead to delay. It is important that the participants deal with that part of the project that fits the scope. Then the following steps are completed:

− Map the risks;
− Consider and prioritize the risks;
− Determine the most important risks.

Map the risks. When mapping the risks, those risks must be defined first. A useable definition of a risk is an event that may or may not occur and that could lead to an extension of the project (phase). Mapping of the risks is done by looking to the planning along different lines of approach. In the RISMAN method seven different lines of approach are distinguished: Politics/administrative, public acceptance/social, technical/execution, organisational, legal, spatial/geographical and financial/economical. The lines of approach can be used as triggers to name the risks of the project or planning.

Apart from these lines of approach, the following tools can be used by the participants to identify the most important risks:

− The planning of the project, well displayed in the meeting room, which has been send to the participants on beforehand. The activities in the planning could also serve as a trigger to reach a list of the most important risks. By going through these activities and thinking about what is necessary to reach the main goals of the planning, other risks might manifest.
− The list of participants in the project and the stakeholder relation map, well displayed also. Viewing and considering these parties one could imagine how they could affect the outcome of the project or planning.

Every participant of the meeting writes down the ten most important risks he can think of on the provided risk table (see table 4). It is important to describe the risks clearly and specific and to annotate every risk with the activity it reflects upon. Risks are best described starting with the word "The" followed by a full lexical verb. Example: "The lack of …" or "The change of …".

Consider and prioritize the risks. The process manager collects the risk tables and by reading them to the participants, makes sure that everybody understands what is written down in the tables. Assembling all the risks creates a new risk table, now with 100 risks. The duplicate mentioned risks are reduced to just one appearance which makes the table smaller. Now the participants have named a number of risks and

they know exactly what is meant by the specifically named risk and how it will affect the project.

Then all participants divide 100 points each over a minimum of five and a maximum of twenty risks that they want to control, considering the 100 points to be money, time or effort at one's disposal. (See Table 5). When all participants have distributed their points, the risks can be sorted to their importance. The highest risk is the risk with the highest score. Of course there are more ways to prioritize the risks once they are named, but this method is the most easy and shortest way.

Risks →	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⟹
Partici-pants ↓											
A	20	5	0	10	0	0	0	15	30	20	100
B	5	10	30	0	0	20	10	0	25	0	100
C	10	25	15	20	0	0	5	0	5	20	100
D	5	20	17	15	33	10	0	0	0	0	100
E	5	18	20	7	20	30	0	0	0	0	100
⬇											
Totals	45	78	82	52	53	30	15	15	60	40	500
Ranking	7	2	1	6	5	3	9	10	4	8	

Table 5. Example of a Risk Prioritization Table

Determine the most important risks. The last action in the first meeting is to determine the risks list. (See Table 6). Principally the first ten to twenty risks will be on this list. Then the process manager should ask the participants whether they feel that this is a good list considering that the list is based on a quick, instinctive assessment by the participants and that the list is a random indication.

Top 20 Risk List	
Risk 1	**The occurrence of …**
Risk 2	The change of …
Risk 3	The lack of …
Risk 4	Etc.
Risk 5	Etc.
Risk 6	
Risk 7	
Risk 8	
Risk 9	
Risk 10	
Risk 11	
Risk 12	
Risk 13	
Etc.	
Etc.	
Risk 20	

Table 6. Example of an Overall Risk List

The project secretary assimilates the results from the first meeting for the follow-on of the Quick-Scan and for the necessary reporting. The result that will be used henceforth is a list with ten to twenty prioritized risks (with the annotation of the activity every risk relates to).

Feasibility of the planning

Now that the participants have a feeling of what the prioritized risks are and how they relate to activities in the planning, they can be called forth (and almost always are) to assist in a survey to determine the feasibility of the planning.

By determining the most probable pass-through-time of the project and the inherent dispersion, it is possible to calculate the chance that the current planning is feasible. In such a survey the participants estimate the minimum, most probable and maximum pass-through-time of all activities that lay on the critical path. As this survey is not part of the Quick-Scan method, no further attention will be given to it here.

Second meeting

The second meeting will feature possible control measures for the most important risks. During this meeting the following steps are performed:
- The feasibility of the planning is presented and discussed (optional);
- The cause and effects of the risks are analysed;
- The control measures are mapped, discussed and chosen from;
- The Quick-Scan is wound up and evaluated.

The feasibility of the planning is presented and discussed. When, after the first meeting a survey to determine the feasibility of the planning has been performed (optional), it is necessary to present the outcome of this survey at the beginning of the second meeting. The process manager will then probe the participants' reaction on these results. Data from this part of the second meeting could help in the planning process.

The cause and effects of the risks are analysed. This step in the Quick-Scan is essential for the designation of control measures and therefore the analysis of the most important risks must be performed in a very well structured way. For each risk, the causes are named and then the consequences. It is very well thinkable that a risk has multiple causes and consequences. All these causes and consequences, how trivial they might seem, must be written down by the process manager. When naming consequences it must be clear what the unwanted effects of the occurrences are for which activities of the planning. Consequences are described in terms of delay. Usually standard forms are used to enable transparent routines and reporting. In this way all of the most important risks are evaluated, described and reported.

The control measures are mapped, discussed and chosen from. The process manager explains to the participants a list with control measures that could be applied. Thereupon the participants are divided into three groups in which every participant receives the list of possible control measures. Every group now makes an inventory of the control measures for the most important risks and writes this down. Per risk this means a short brainstorm (max. five minutes) about possible control measures, a choice of one or two control measures, and determination what the intended effect will be of these measures and what the effort (time, money, energy) will be to execute these measures. At the end a proposal to assign who could execute the measure, has to be made.

Subsequently the groups meet again and with all participants present the inventoried control measures per risk are discussed. The process manager directs this process. For each control measure it is discussed who could be responsible for it. The process manager writes down the control measures and the accompanying responsible persons next to the concerning risk. The project secretary copies these notes on a standard form for reporting later on. (See Table 7)

Risk 1: The occurrence of …

Causes	Conse-quences	Possible Measures	Selected Measures	Responsible Person(s)
A	1	a	X1	Y1
B	2	b	X2	Y2
C	3	c	X3	Y3
D	4	d	X4	Y4
E	5	e	X5	Y5

Table 7. Selected Control Measures and Responsibilities

This ends the substantive part of the Quick-Scan. The following steps are the actual selection and execution of the control measures.

The Quick-Scan is wound up and evaluated. These kinds of meetings always must end with an evaluation. With all participants present the Quick-Scan is discussed, which points were experienced as the stronger and which as the fewer strong points, and how useful will the results of the Quick-Scan be for the project.

Reporting

The results of the Quick-Scan are described in a report that is used to communicate about the risks with the commissioner of the project and the persons that were not part of the Quick-Scan but have a need to know.

Conclusions

The Quick-Scan is a tool for a global assessment of the risks that are part of the planning of a project and is sufficient for small, not too complex projects. For more complex projects a more extended RISMAN analysis will be needed.

By adapting the Quick-Scan method for space planning projects, a universal tool for risk analysis was developed and was successfully utilized in different projects.

Once performed a Quick-Scan, one has performed a risk analysis; the process of risk management still has to begin.

[1] Smid, Henk H.F.; Qualitative Risk Management in Space Activities, A risk analysis method explored. *Proceedings of the 7th Iranian Aerospace Society Conference*, Sharif University of Technology, Tehran 19-21 Feb 2008 (in English)

[2] Well-Stam, D. van; Lindelaar, F.; Kinderen, S. van; Risk Management for Projects. The RISMAN method applied. Het Spectrum, 2003 (in Dutch).

[3] ribs Space Consultancy & Insurance / Data Banking & Control, 1984 – 2008.

When building the flooding control in the Oosterschelde estuary in the Netherlands, use was made of the RISMAN method for risk management