Designing Out Risk

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Abstract

Minimisation and control of risk is a major issue in both public and private sectors operations in many countries, particularly in Australia. Many organisations are reluctant however to allocate scarce resources solely for this purpose. Application of formal Value / Risk Management (VRM) studies to projects, products, processes and programs has proven to be highly effective in minimising both risk and cost for existing and new projects.

Identification of the “functions” the project must perform and using this as the framework in which risks are identified is a crucial initial step. Then a formal Risk Management Study (RMS) is conducted and the higher-level risks are allocated to functions. The Value Management Study (VMS) may follow the risk study directly or after a few weeks if the RMS indicates that further research may be beneficial before conducting the VMS. Using value management “functions” as the common “platform” for both studies develops a synergy that can have a significant multiplier resulting in the simultaneous reduction of cost and risk.

The RMS is completed with the development of a Risk Register and Risk Management Plan once the stakeholders are confident that the functionally preferred option identified in the VMS can be achieved. This may be at the conclusion of the VMS or some months later if a number of complex actions need to be completed to confirm the preferred option.

Not only can the cost of the project be reduced and the functionality enhanced but, instead of just managing risks, many of them can be reduced or even “designed out” through the functional approach of value management.

This approach has a significant benefit for the client and lending authority as they receive formal VMS and RMS reports to their required investment standard.

Need

Public and private sector and not-for-profit organisations worldwide face two fundamental challenges:

- Effective and efficient use of scarce and **even more expensive resources**,
- A widening scope of liabilities and constraints on their operations (legislative, legal, practical, community, shareholders).

The widening scope of liabilities and constraints include the following areas in which risks may be present:

- Personal safety,
- Operational,
- Business,
- Legislative,
- Environmental, (including emission controls, energy conservation and global warming)
- Public perception.

The objective of Value Management (Value Engineering and Value Analysis**) is the identification and removal of unnecessary cost** in a project or program, Miles (1989).

The objective of Risk Management is to ensure that risks related to a project or program **are as low as reasonably practicable, (**Australian Standard HB 436:2004, 66).

Leaving unnecessary risks in a project also means leaving unnecessary cost in it too, because:

- Risks will have to be managed,
- If risks eventuate and the project or program does not proceed as planned then efficient use of resources may not occur leading to an accident, financial or economic loss or all three,
- Similarly, if externally generated risks impinge on the project, losses may also be incurred within the project.

It is entirely consistent therefore to use the tools and techniques of value management to **proactively** remove risks from projects and programs. Indeed, Green (1997), has postulated that value and risk management should not be treated as separate entities but as different elements in the single process of resource management.

Additionally, organisations are under increasing legislative and social pressure to be public accountable for their acts and omissions.

The value / risk management (V/RM) methodology proposed in this paper ensures that there are both a complying Risk Management Report and a Value Management Study Report leaving a transparent accountable resource management trail.

Scope of Projects

The V/RM methodology can be used on a very wide variety of projects, products, processes and programmes.

The process will however deliver the best return on investment on projects that have one or more of the following attributes:

- Are known to have high risks associated with them, such as, mining, heavy engineering, process engineering, high technology and information technology,
- Are large in scale and scope,
- Require the efforts of people and organisations from a wide variety of disciplines for their success,
- Have a multiplicity of users or stakeholders (eg: public transport systems, hospitals, shareholders, etc.)

Basis of this Paper

This paper is based on and references are generally to the Australian Standards for Value and Risk Management (respectively AS/NZS4183:1994, AS/NZS 4360:2004 and the related HB436:2004), Standards Australia. The methodology is however applicable to any acceptable Value or Risk Management standards. Similarly, some organisations will have their own value and risk management standards that are applied in their industry context. In the process and heavy engineering industries the risk management study may be superseded or augmented by a "HAZOPS" (hazardous operations) study. What is crucial that the V/RM approach is implemented within a value and risk / hazard management framework acceptable to the client (or to the community in the case of public sector projects).

Methodology Overview

Combination of VM and RM into a single VRM study provides a synergy which results in benefits to the client which are significantly greater than that provided by the two separate workshops. This is because VRM simultaneously optimises project functionality, reduces risk and ensures that the project cost accurately reflects the required functionality and risk profile. The VRM process provides a real opportunity to proactively "design out" or at the very least minimise the risks inherent in a project, Phillips, (2002).

The VRM target is that after the study the project will have no "**Intolerable**" risks and no practically avoidable "**Tolerable**" risks because they have been eliminated. The only risks to be

managed should be those that are "**Broadly Acceptable**" or "**Tolerable**" risks that are low and cannot practically be reduced or eliminated. (see **Key Tools** below).

Key elements of VRM are:

- Project functions are identified (preferably by a small group prior to the V/RM study itself) and documented by Functional Analysis Systems Technique (FAST) diagram, Lenzer (2002), Function Listing, Function / Cost Matrix or Function Tree as appropriate.
- Once identified and classified, risks in the "**Intolerable**" and "**Tolerable**" categories (see **Diagram 1** and **Table 2** below) are linked to the identified project functions, Moontanah *et al* (1998).
- In the Evaluation (Judgement) Phase of the VMS, weight is given to the contribution of ideas for elimination or reduction of risk, in addition to improving project value.
- In the Evaluation Phase there needs to be a strong focus on using the value management techniques to **eliminate** risk by "designing it out" wherever possible – even in removing the need to perform the "function" if this is achievable.
- Finalising the Risk Register and agreement on the method of treating risks in the Risk Management Plan should be delayed until the conclusion of the VMS section of the study.

The VRM Process can be achieved by separate value and risk management studies but is generally more effective if the studies are combined into a single study, usually of 2 or 3 days duration as the introduction stage will be common to both disciplines. These days do not necessarily have to be consecutive, a break of a week or so would be acceptable, best timed after the allocation of risks to project functions or the creative phase (phases 6 and 7 of the VRM process below). The risk management component may be conducted by a specialist in risk management or by the value management facilitator provided that that person is sufficiently experienced in the risk management process.

If there are to be separate studies then the RMS should be held before the VMS and the risks then linked to "functions" before the VMS commences. Alternatively, a better solution is to identify the "functions" before the RMS, as this can then be a valuable tool to assist in identifying risks.

Study participants can be expected to be the same for both the risk and value management sections and the study group should retain the same personnel throughout the study to ensure commitment to and effective implementation of the study outcomes.

The VRM study should address the life of the project product or programme, not just initial construction or manufacture, to ensure a proper balance of risks and functionality.

The VRM Process

The VRM process, assuming a single study, is summarised below. The VM component is identified in regular type; the RM component is identified in *italics*.

Value Management / *Risk Management* Combined VRM Process

1. Information Phase / *Establish the Context*
2. Function Analysis Phase
3. *Identify Risks*
4. *Analyse Risks*
5. *Evaluate Risks*
6. *Allocate Very High and High Risks to the Project Functions*
7. Creative Phase
8. Judgement Phase
9. Development Phase
10. *Treat Risks*
11. Prepare Value Management Study Report / *Prepare Risk Management Plan*
12. Follow-up and implementation of the results of the study.

At the conclusion of the process it is important to check that in its enthusiasm, the study group has not introduced any new risks or increased any existing risk.

Key Tools

Key elements of the VRM Process are as follows:

- Function Analysis – FAST Diagram and other methods (VM)
- Classification of Functions (VM)
- The ALARP (As Low As Reasonably Practicable) Principle (RM)
- Classification of Risks (RM)

This paper will not canvas the methods of identifying and documenting functions as this has been adequately covered in a number of preceding papers. A review of the classification of functions and risks and the As Low As Reasonably Practicable (ALARP) principle is however appropriate as their use can focus the study team on the most effective use of its time.

Table 1: Function Classification

FUNCTION CLASSIFICATION	ACTION IN THE V/RM STUDY
Basic Function	• **Reduce Life Cycle Cost** • Improve Value to the Customer
Required Secondary Function	• Eliminate if possible • **Reduce Life Cycle Cost**
Secondary Function	• **Eliminate if possible** • Reduce Life Cycle Cost
The generally preferred action is identified in **bold.**	

Diagram 1: ALARP Principle (Australian Standard, HB 436:2004)

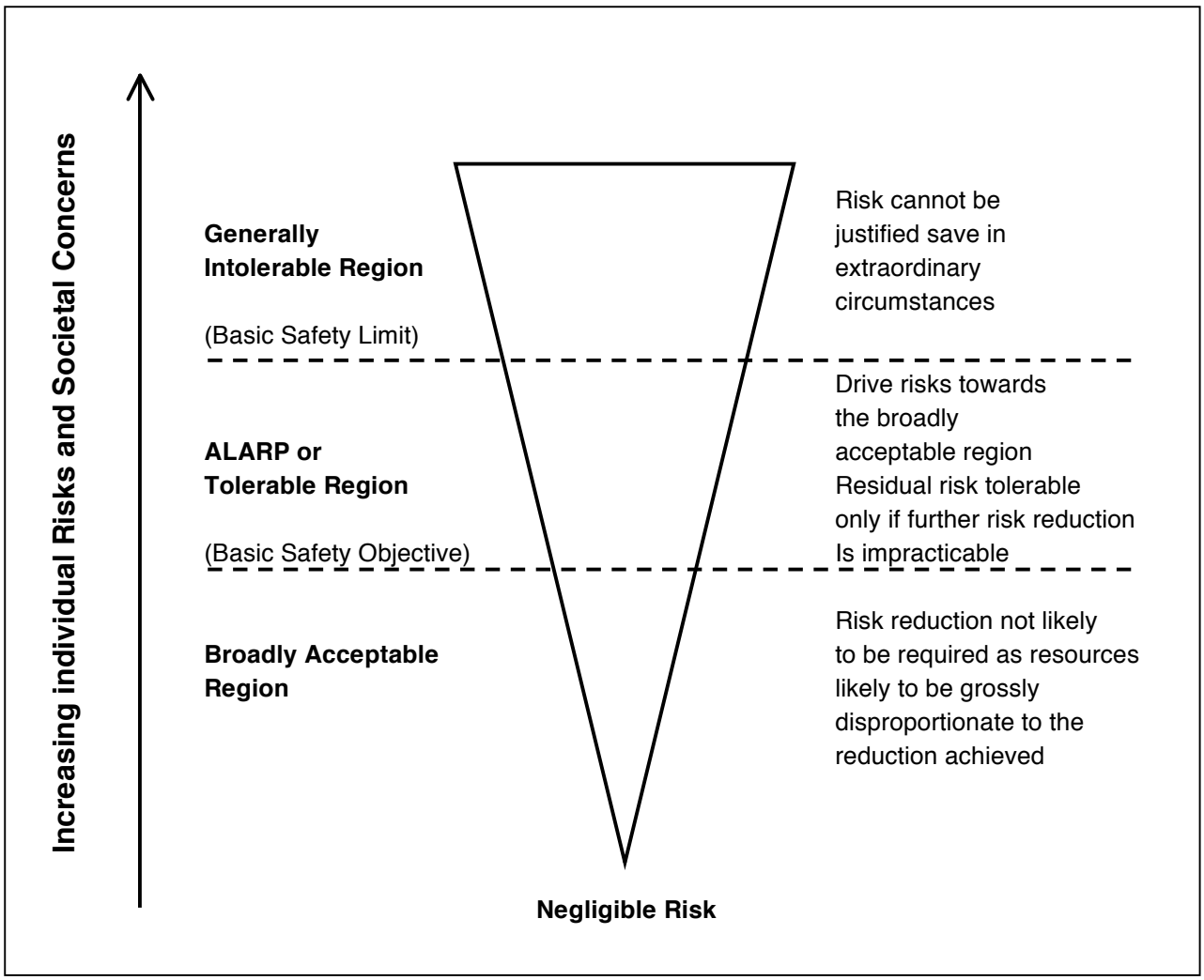

Table 2: Risks Classification

DESCRIPTION	RISK CATEGORY	ACTION IN THE V/RM STUDY
Generally Intolerable Region	Very High, High	• **Eliminate activity** • Reduce frequency and consequence
ALARP or Tolerable Region	Medium	• **Reduce frequency and consequence of risk** • Do nothing • Eliminate activity
Broadly Acceptable Region	Low	• Reduce frequency and consequence of risk • Manage in accordance with new protocols • **Manage in accordance with existing protocols**
The generally preferred action is identified in **bold.**		

Use of **Tables 1** and **2** will greatly assist the study group to target appropriate actions for the functions and risks identified.

In another dimension it provides an excellent correlation between functions and risks. For example, if a **Required Secondary** functions (or functions) have a number of Very High or High risks then the in the Creative phase of the study serious consideration must be given to eliminating that function if possible, or alternatively performing the function in a manner in which risks will be eliminated or their consequences significantly reduced.

Complex Projects

Roberts, (2001), recommends that for complex projects, particularly in the high technology, defence and aerospace industries, the cost and schedule impacts of all the risks in the highest category be identified and quantified before addressing possible risk mitigation. This quantification process will not only reveal further risks but provides a greater understanding of the project baseline prior to the Creative Phase of a VRM study.

This risk based decision support (RBDS) process has, through detailed quantification of risks, identified fundamental flaws in the structure of a number of aerospace projects in time for the defects to be rectified and the projects brought back on track. Without the application of the RBDS process the flaws would have eventually been discovered but far later in the project and with significant cost and time repercussions.

The quantification of risks in the RBDS process provides an excellent methodology to evaluate the trade-off of the life cycle cost, functionality and risk of competing VM generated risk mitigation measures.

Key Benefits of V/RM

Key benefits of the V/RM study process, particularly the combined study can be summarised as follows:

- It is the most cost-effective use of the project team's time (effective use of this time if often overlooked on many projects);
- Classification of both risks and functions means that there is a clear hierarchy of actions as to how they should be dealt with, thus optimising both the study group's time and the use of resources in the project itself;
- The process is **proactive** in eliminating and reducing risk, rather than just managing it.
- The process is auditable thus ensuring transparency and quality control.
- It is more cost-effective of project team time and more efficient in respect of results achieved than unlinked RM and VM studies. VRM therefore delivers excellent return on investment.

Results

Results from the application of VRM have demonstrated a significant shift in the view of the project by its stakeholders. As a result project value has been greatly increased and risks to be managed substantially reduced as demonstrated by the following examples.

- On a hazardous exit end of an existing steel plating mill the VRM approach resulted in the recommendation of a scheme that eliminated 86% of the risks for a 72% capital cost saving and 20% less plant downtime than the original proposal: a return on investment in the VRM study of 240:1.
- In the VRM study on a proposed $70 million chemical manufacturing process plant the study group recommended initiatives to reduce or eliminate 37% of the identified risks. The study group also recommended that the capital cost of the plant could potentially be reduced by 14.3% (with a possible further 6% saving depending on the outcomes of trials). Subsequent bench tests and plant trials have verified that all saving and risk reduction identified will be realised in the new plant.
- 25 risks to staff were identified on high-level access platforms used for train maintenance. The VRM study resulted in the implementation of cost-effective, practical solutions that eliminated 23 "Extreme", "High" and "Moderate" risks, with the exception that 2 risks were

reduced from “High” to “Moderate”. Operations staff participated in identifying the risks and developing physical and protocols solutions.

- The small rural settlement of Kings Plains in the state of New South Wales, Australia had a regional road running through it. This 5 km length of road has an accident rate four times that of the State average. The VRM process reduced of 11 out of 26 identified risks (2 risks downgraded to a lower risk category) and a marginal increase in one construction risk as a consequence of route selection on a proposed $8 million roadworks project. Life-cycle safety of the functionally preferred option was critical to the client and the community.
- In suburban Sydney a steel-framed multi-story car park had been constructed on leased land over a railway line some 50 years ago. Subsequent rail infrastructure development had created a track junction and rail traffic had increased considerably resulting in a foreseeable risk of a derailed train hitting the structure and causing it to collapse on top of the train. Following the first section of the VM study, risk identification and evaluation the team developed a number of structure protection options and a demolition option. In the Development Phase of the study the team resolved that demolition of the car park would eliminate all the identified risks and recommended this action, Jain (2002).
- Results from the more detailed, quantified, risk identification and management process RBDS can be demonstrated in the case of two competing approaches for a robotic manipulator to be used in the assembly of International Space Station components. The consultants performed a cost, schedule and technical risk assessment for both the competing options. Investigation of management risks was specifically excluded from the commission but the quantification of the three risk categories under investigation revealed significant under resourcing of program management and systems engineering functions. As a result of these discoveries the risk consultant and the project team developed Integrated Master Plans and Schedules for both projects. This permitted the difference between the existing and revised plans to be identified and the risks and related costs quantified. The result was the elimination of some $20 million worth of at-risk cost from a project with a total value of $50 million (Roberts, 2001).

Conclusions

Return on the investment in VM preparation, workshop participation, and follow-up can be expected to be a minimum of 10:1. Individual workshops may deliver a significantly higher return, Adam, (1990).

When RM is incorporated into the VM process as described in this paper the returns are even greater because there is a strong focus on “designing out” risks from first principles thereby reducing ongoing risk management activities as well as opening up other functions for potential cost saving and value improvement

On appropriate projects, further investigation and quantification of the costs and schedule impacts of the most severe risks using the RBDS methodology can further reduce project costs and may in some cases save the project from disaster. Quantifying costs associated with risk provides the basis for evaluating competing methods of addressing risk that have been developed during the Creative Phase of the VM study.

What other activity of an organisation will deliver the level of return on investment that the VRM process can deliver?

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