Introduction to Risk Management

Dr Jane Marshall
Product Excellence using 6 Sigma Module

Objectives of the session

- Definition of Risk
- Types of risk
- Risk Management Process
- Example
- Risk and Innovation
Definition of risk

• Combination of the probability of an event occurring and its consequences for project objectives - uncertainty

The implications of the existence of significant uncertainty about the level of project performance achievable – measuring uncertainty
Definition of risk

- Risk = f(event, uncertainty, damage)
- Risk = f(hazard, safeguard)

Sources of risk

- External – legislation – outwith the control of the project team
- Internal – within control of project design, human factors and technology etc.
- Handle risk by taking action to avoid (mitigation)
- Build up reserves (contingency)
Spheres of Risk

- Risks cannot be transferred between disciplines
- Risks must be translated between disciplines

Project plan vs Risk plan

- **Project Plan**
  - Outlines what the project team intend to do
  - Supports the Project Management process

- **Risk Plan**
  - Covers how the project team might have to change the plan
  - Supports the Risk Management Process
What is in the Risk Plan

- Risk Register
  - Risk Identification Sheets
  - Risk Summary
- Risk Log
  - Risk Exposure
  - Risk Contingent Fund
- History of Mitigation Strategies
- Contingency Plans

Risk Management

- Risk management is the formal process by which risk factors are systematically identified, assessed, and provided for.
- Risk management is a formal, systematic method of managing that concentrates on identifying and controlling areas or events that have a potential for causing unwanted change.
- Risk management, in the project context, is the art and science of identifying, analyzing, and responding to risk factors throughout the life of a project and in the best interest of its objectives.
Risk Management Process

- Essentially, risk management is something that we all do every day, mostly without thinking about it.
- Difficulties arise when risks are hard to identify and assess, or when the work is unfamiliar or complex.
- Risk Identification
- Risk Quantification/Classify
- Risk Response
- Risk Control
Risk Identification

- Observation – close examination of a current system or project may help identify risks that may also be inherent in a new project;
- Reference to previous documentation/existing databases - past experiences may be recorded on company files, reports, third-party company analytical reports, etc;
- Interviews - bringing people with the greatest direct experience of similar situations or projects, into face-to-face sessions to determine the nature and extent of the risks;

How to identify risks

**Introvert** - Check Lists
Computer Q&A Systems
Leave it to Experts

**Extrovert** - Discussions and Prompt Lists
Experience/Expertise
Structured Interviews
Brainstorm
Systematic Risk Identification

- A structured approach that allows an organised critical analysis of risks of the system under consideration.
- All risks are reviewed systematically.
- Risks are addressed from the system level to the component level.
- Risks arising due to system functional, environmental profiles, implicit & explicit requirements, interaction of components/subassemblies, manufacturing/assembly processes & supply chain are considered.

Risk Categorisation

<table>
<thead>
<tr>
<th>Probability of occurrence</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>high 5</td>
</tr>
<tr>
<td></td>
<td>medium 3</td>
</tr>
<tr>
<td></td>
<td>low 1</td>
</tr>
<tr>
<td>Uncertainties Remain</td>
<td>Major redesign and program delay</td>
</tr>
<tr>
<td>Some uncertainties remain</td>
<td>Minor redesign and schedule readjustment</td>
</tr>
<tr>
<td>Few uncertainties remain</td>
<td>Requirements met within schedule</td>
</tr>
</tbody>
</table>

Risk element scores = probability X impact
Risk Quantification

Table 1: An Example of a Simple Risk Register

<table>
<thead>
<tr>
<th>Risk element</th>
<th>Likelihood value</th>
<th>Impact value</th>
<th>Weighting of hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front gate not available in chosen design</td>
<td>9</td>
<td>0.01</td>
<td>0.09</td>
</tr>
<tr>
<td>Earthquake</td>
<td>0.01</td>
<td>10</td>
<td>0.1</td>
</tr>
<tr>
<td>Heavy snow</td>
<td>3</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Heavy rain</td>
<td>6</td>
<td>2</td>
<td>12</td>
</tr>
</tbody>
</table>

Categorising Risks

- Risks are categorized by their probability of occurrence and their impact on the project.

<table>
<thead>
<tr>
<th>Probability of Occurrence</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow Light:</td>
<td>Fix</td>
<td>Proceed with caution</td>
<td>Proceed before production</td>
</tr>
<tr>
<td>Red Light:</td>
<td>Address before proceeding</td>
<td>Proceed</td>
<td>Do not proceed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Impact on Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
</tr>
<tr>
<td>Medium</td>
</tr>
<tr>
<td>High</td>
</tr>
</tbody>
</table>

Yellow Light: Proceed with caution

Red Light: Address before proceeding

Red Light: Do not proceed

Red Light: Reassess project

Red Light: Proceed with caution

Red Light: Do not proceed

Red Light: Proceed before production

Red Light: Reassess project

Yellow Light: Proceed with caution

Yellow Light: Address before proceeding

Yellow Light: Proceed with caution

Yellow Light: Address before proceeding
Consistent Prioritisation of risks

• Concise/easily understandable scoring guidelines have been developed to ensure consistent prioritisation of risks.
• Evidence from product pedigree, development testing, analysis, statistical process control, manufacturing capabilities & supplier approval used to prioritise risks.

Mitigation versus Contingency

Mitigation involves *buying off* a problem in advance

Contingency means *being ready* to manage crises pro-actively
Risk assessment

- Based on the strategy developed, the risk assessment sessions are planned.
- This plan should be fed into the master plan for the project.
- Risk Assessment is an ongoing process & continues throughout the project
  - Risk assessments should be conducted on a regular basis.
  - Risks should be re-assessed at each phase of design and when management actions have been completed.
Who is involved in Risk

- Team approach
- Project team
- Impact owner
- Cause owner
- Risk co-ordinator

Responsibility

- The Technical Manager or the Lead Engineer of the project
- He/She acts as, or alternatively, nominates a team leader.
- Responsible for organising Technical Risk Assessment sessions & maintaining the information and selecting a team.
- The team consists of at least one representative from:
  - Project Management; Stress/Integrity; Design Engineering;
  - Development Testing; ILS; Quality; Manufacturing; Sourcing;
  - Systems/Requirements
Owner’s responsibilities

**Impact Owner**

- Identifies Risk and develops risk characterization
- Quantifies Risk
- Classifies Risk
- Names Cause Owner
- Helps develop mitigation strategies
- Develops and document contingency plan
- Supplies and/or endorses entries in Risk Register
- Monitors and Reports on their Risk Status

**Cause Owner**

- Leads the development of mitigation strategies
- Implements mitigation strategy

N.B. Avoidance of the ‘Pontius Pilot Syndrome’, especially if they can initially identify risk

---

Example: Risk assessment process

1. **RISK IDENTIFICATION**
   - Identify risk

2. **RISK PRIORITISATION**
   - Assess magnitude of the risk

3. **RISK MANAGEMENT**
   - Develop plans to manage the risk
Example

In order to ensure that all possible risks are identified, the risk identification for a component/sub-assembly is carried out in three stages:

- Brainstorm all risks associated with the ‘FUNCTION’ of the component (or subassembly)
- Brainstorm all risks associated with the ‘REQUIREMENT’ of the component (or subassembly)
- Brainstorm all risks associated with the ‘MANUFACTURE/ASSEMBLY/SUPPLY’ of the component (or subassembly)

In order to ensure that all possible risks are identified, the risk identification for a component/sub-assembly is carried out in three stages:

Example:

Brainstorming risks

<table>
<thead>
<tr>
<th>Sub-assembly</th>
<th>Part</th>
<th>Type of risk</th>
<th>Description of risk</th>
<th>Who</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotor Wound Main Assembly</td>
<td>Clamp Plate</td>
<td>Function - What does it do? (eg. Insulating, protecting)</td>
<td>Clamp plate is too weak to clamp the rotor windings axially – could cause windings to short against rotor framework.</td>
<td>Paul Harris</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Requirement - What does it have to cope with? (eg. CF loading, vibration, temp., oil)</td>
<td>Cannot withstand the high CF loads – could cause clamp plate to break &amp; thus, windings to short against rotor framework.</td>
<td>Paul Harris</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Manufacture - How do you make this or where did you buy it (supply chain)?</td>
<td>New manufacturing process to be used. This may cause porosity of the material.</td>
<td>Steve Robb</td>
</tr>
</tbody>
</table>

Remember all risks brainstormed must be considered & recorded!
Magnitude of risk

- After a risk has been identified, the next step is to assess the magnitude of the risk. This enables the prioritisation of all the risks identified & ensures that a concerted effort is made to mitigate the high scoring risks.

- The following factors are used to assess the magnitude of & prioritise technical risks:
  - Pedigree
  - Testing
  - Analysis
  - Severity
  - Probability

Risk Prioritisation

<table>
<thead>
<tr>
<th>FACTORS USED FOR PRIORITISING RISKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEDIGREE</td>
</tr>
<tr>
<td>Do we have any past experience (product/process) that can help us assess the magnitude of the risk?</td>
</tr>
</tbody>
</table>

Based on evidence

Based on expert judgement
### Risk Prioritisation – Function/Requirement Risks

**Pedigree**
- 1 Identical design in Long Field Service
- 3 Identical design in Development Units/ Similar design in long term service
- 9 New Design

If pedigree = 1, stop scoring, move onto next risk.

**Testing**
- 1 Full representative test
- 3 Read across tests with good sample size/ limited tests/ Verification
- 9 Zero testing/ small sample size

**Analysis**
- 1 Full Capable Analysis
- 3 Preliminary Analysis
- 9 No Analysis/not capable of analysis

### Example: Scoring Function/Requirements Risks

<table>
<thead>
<tr>
<th>Sub-assembly</th>
<th>Part</th>
<th>Type of Risk</th>
<th>Description of risk</th>
<th>P</th>
<th>T</th>
<th>A</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotor Wound Main Assembly</td>
<td>Clamp Plate</td>
<td>Function - What does it do ? (eg. Insulating, protecting)</td>
<td>Clamp plate is too weak to clamp the rotor windings axially.</td>
<td>9</td>
<td>9</td>
<td>3</td>
<td>Stress / Report 1244</td>
</tr>
</tbody>
</table>

This is a new design. Therefore, Pedigree = 9

Preliminary analysis suggests design meets requirements. Therefore, Analysis = 3

No development testing has been done using the new design of the clamp plate. Therefore, Testing = 9

Remember to record evidence used for scoring. This can be updated as management's actions are completed.

### Risk Prioritisation – Severity and Probability

**Severity**
- 1 Low impact on product/project
- 3 Medium impact of product/project
- 9 High impact on product/project

**Probability**
- 1 Low
- 3 Medium
- 9 High

### Example: Scoring Severity & Probability

<table>
<thead>
<tr>
<th>Sub-assembly</th>
<th>Part</th>
<th>Type of Risk</th>
<th>Description of risk</th>
<th>P</th>
<th>T</th>
<th>A</th>
<th>RP</th>
<th>N1</th>
<th>S</th>
<th>P</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotor Wound Main Assembly</td>
<td>Clamp Plate</td>
<td>Function - What does it do ? (eg. Insulating, protecting)</td>
<td>Clamp plate is too weak to clamp the rotor windings axially.</td>
<td>9</td>
<td>9</td>
<td>3</td>
<td>24</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

The likelihood of the risk being realised is medium. Therefore, Probability = 3

If the clamp plate fails to clamp windings axially, windings centrifuge outwards & short on rotor framework, leading to catastrophic failure. Therefore, Severity = 9

Winding short on rotor framework
Risk prioritisation – project risk score

- The ‘Project Risk Score’ is calculated using the formula:
  
  \[
  \text{Project Risk Score} = S \times PR
  \]

- The Project Risk Score is used by the project managers for the prioritisation of technical risks in the overall project risk management process.

**Example : Calculating the ‘Project Risk Score’**

<table>
<thead>
<tr>
<th>Sub-assembl y</th>
<th>Part</th>
<th>Type of risk</th>
<th>Description of risk</th>
<th>P</th>
<th>T</th>
<th>A</th>
<th>RP N1</th>
<th>S</th>
<th>P R</th>
<th>RP N2</th>
<th>Project Risk Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotor Wound Main Assembl y</td>
<td>Clam p Plate</td>
<td>Function - What does it do ? (eg. Insulating, protecting)</td>
<td>Clamp plate is too weak to clamp the rotor windings axially.</td>
<td>9</td>
<td>9</td>
<td>3</td>
<td>243</td>
<td>9</td>
<td>3</td>
<td>6561</td>
<td>27</td>
</tr>
</tbody>
</table>

Risk prioritisation – managing actions

**Example : Managing Risk Management Actions**

The project manager is responsible for managing the risk management actions and maintaining the risk curve.

<table>
<thead>
<tr>
<th>Management Action</th>
<th>Who</th>
<th>Planned Closure Date</th>
<th>Actual Closure Date</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carry out full stress analysis of clamp plate</td>
<td>David Bonniema n</td>
<td>15/01/02</td>
<td></td>
<td>Open</td>
</tr>
<tr>
<td>Monitor per f ormance of clamp plate</td>
<td>Peter</td>
<td>15/01/02</td>
<td></td>
<td>Open</td>
</tr>
</tbody>
</table>

At early stages, more risks identified, total RPN2 rises.
Risk Identification

• MSc projects
• Identify the risks for your project
• Classify the risks
• Attempt to prioritise
• Attempt to look at contingency and mitigation

Risk and Innovation

• How does a company trade off risk and innovation?

Discuss