W h i t e P a p e r

Project Risk Analysis & Management Methodology

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Table of Contents

List of Figures

List of Tables

1 METHODOLOGY PRINCIPLES

The following key points shall be taken into consideration in the development of Project Risk Analysis & Management procedure applicable to projects of all nature, including, but not limited to, Engineering, Procurement & Construction (EPC), IT, Automation and Digitalization projects executed on behalf of a Project Owner by a Project Contractor, engaged by the Project Owner, and involving use of digital technologies, or hereinafter referred to as technology.

1. The Project Risk Analysis & Management in this document shall follow the principles of contained in **PMBOK Chapter 11**.
2. Project Risks shall be identified in terms of Qualitative Risks related to Project Objectives.
3. The Qualitative Risk Analysis focus shall be on project execution aspects, which represent a common risk area for projects versus technology – related risks, which are generally manageable by focusing on mature products and high – value, referenced and proven features (functionalities) of Commercial – Off – The – Shelf (COTS) software products.
4. Project Execution shall mean the engagement of the Project Contractor in accordance with the Implementation Projects Plan.
5. While integration is considered as the main technology risk area, prototyping shall be used as proactive measure to manage related risks.
6. Risk Analysis shall be performed as early as and as part of the Project Contractor proposals and the subsequent evaluation of these proposals.
7. Parameters considered for Qualitative Risk Analysis are as follows:
   - 7.1. Project Objectives
   - 7.2. Risks
   - 7.3. Root Causes
   - 7.4. Assumptions
   - 7.5. Risk Triggers
   - 7.6. Risk Impacts
   - 7.7. Probabilities
   - 7.8. Responses
   - 7.9. Avoidance
   - 7.10. Transference
   - 7.11. Mitigation
   - 7.12. Acceptance
8. Analysis of the above parameters, from past projects of similar type, shall lead into preliminary assessments of Risk Prioritizations, which shall be related to the Probability of a Risk Event and its Impact on Project Objectives (e.g. Value, Schedule, Cost, Scope, Quality, Functionality, etc.) as presented below.
9. Risk Exposure, for each risk, shall be defined as a metric to the formula of:

   (Risk Exposure = Probability X Impact)
10. Classification of risk, and thus the resulting Risk Prioritization, followed by Risk Responses shall be outputs of this analysis.
11. Risk Responses shall represent actions to be taken during the project execution.
12. Impact and Probability shall be assessed on a five-level scale from very low to very high (0 – 5).

13. Risks with negative impacts shall be considered as ‘downside risk’, or threats. Risks with positive impacts shall be termed ‘upside risk’, or opportunities. In this document, only downside risks are considered.
14. Risk Triggers shall be considered as indications that a Risk Event is about to occur. Triggers shall be considered as risk symptoms or warning signs. Risk Triggers may be discovered in the risk identification process and watched in the risk monitoring and control process during project execution.
15. Additional parameters considered as part of a more detailed risk analysis shall include:
    15.1. Detectability, meaning whether and how soon a risk can be recognized in advance of the triggering event, during, after, etc. Values can range from 0 – 5.
    15.2. Vulnerability, meaning the susceptibility to a risk event in terms of criteria related to preparedness, agility and adaptability to deal with the risk event. Vulnerability is related to impact and probability. The more vulnerable to the risk, the higher the impact will be should the event occur. If risk responses including controls are not in place and operating as designed, then the likelihood of a risk event increases. Vulnerability can be also considered as a measure of effectiveness of risk responses taken to manage risk.
    15.3. Speed of onset, or “velocity”, meaning of what it takes for a risk event to manifest itself, which related to the time that elapses between the occurrence of the risk event and the point at which the project will feel the first effects. Knowing the speed of onset, detectability and velocity is useful while determining risk response plans and prioritizing risks.
    15.4. Various metrics generated by combining and weighing the above parameters, in combination with the calculated Risk Exposure, can yield additional metrics, as for example Risk Importance, which are useful for more detailed risk analysis at a later stage as part of the project execution.

2 RISK PARAMETERS

2.1 PROJECT OBJECTIVES

The key project objectives considered for risk assessment and analysis are as follows:

2.1.1 SCOPE

This objective refers to sustaining the integrity of the scope of work and deliverables defined in the Project specifications.

A Scope Creep Index can be defined as a metric related to deliverables, as for example to applications, functional requirements and related services, hardware and software components, number of WBS, etc. In the absence of such index, and depending on scope creep size, Table 2 can be used to select the estimated impact.

Scope Creep can be both a risk event and a root cause.

2.1.2 FUNCTIONALITY

This objective refers to the integrity of the specified functions provided by each application, as well as by the overall integrated system.

In tangible terms, functionality relates to the functional and technical requirements data base items as consolidated in the related data base and subsequently transformed into MUST and WANT evaluation criteria.

Functionality degradation represents a risk area related to specific root causes.

2.1.3 COST

This objective relates to the overall cost of the system integrator contract, as well as internal costs incurred, i.e. resources, incidental expenses, etc.
In tangible terms, cost relates to the budget set at the time of contract award for the project.
Cost increases represent a risk area related to specific root.

2.1.4 SCHEDULE

This objective refers to the integrity of the project schedule milestones and overall project duration.
In tangible terms, schedule related to the quantity and dates of the schedule milestones, and more specifically to measured schedule slippages or gains, etc.
Schedule delays represent a risk area related to specific root causes.

2.1.5 QUALITY

This objective refers to the adherence to the quality plan as defined in the Project Execution Plan and/or in the related Preliminary Design Review documents.
In tangible terms, quality related to number of quality issues recorded, resolution approach and time required to resolve such issues, etc.
Quality degradation represents a risk area related to specific root causes.

2.1.6 VALUE

This objective relates to the value to be realized and sustained, as for example to its use and thus benefits of its applications.
In tangible terms, a Total Value of Ownership model can be applied in order to quantify such value, but at this stage, a quantitative approach can relate to the number of people, departments or divisions associated with the use of the project deliverables. This approach accounts for the ability to sustain the core objectives and justification related to the investment associated with the project deliverables.
Value degradation represents a risk area related to specific root causes.

2.2 ROOT CAUSES

Root causes are considered for each risk area in relation to project objectives.
The impact of root causes to multiple project objectives is considered.
A Root Cause may represent a Risk itself, as for example in the case of Unclear Requirements > Scope Creep > Cost Increase. In this case, a chain reaction must be broken and risk analyzed in segments, including implications of project objectives.

2.3 COMPOSITE IMPACT

The Composite Impact is used to assess the Risk Importance of each root cause.
Risks may have implication on multiple Project Objectives, much like a “chain – reaction”.
The Composite Impact metric indicates the propagating impact of a root cause on multiple project objectives.
If a root cause has an impact on all objectives, such propagation is determined on a sequential basis.
In this assessment, the main project objectives are six, therefore the propagation sequence can be

for each root cause, indicating in what sequence each project objective is impacted from the specific root cause.

2.4 Probability Matrix Definition

The adopted Probability Matrix accounts for a "five levels of probability" shown below.

Table 1 – Probability Matrix

Rank	Ranking Value	Probability	Notes in case historical data exists
Very High	4-5	> 50%	Based on occurrence of more than 5 projects
High	3-4	> 25%	Based on occurrence of one in every 5 projects
Moderate	2-3	> 10%	Based on occurrence of one in every 10 projects
Low	1-2	> 5%	Based on occurrence of one in every 20 projects
Very Low	0-1	< 5%	Based on occurrence of less than 1 in every 20 projects

In the absence of historical data, the ranking of probabilities can be agreed by the project stakeholders based on previous experience.

2.5 Impact Matrix Definition

The adopted Impact Matrix accounts for a "five levels of impact" shown below related for each project objective.

Table 2 – Impact Matrix

Rank	Ranking Value	Value	Scope	Functionality	Cost	Schedule	Quality
Very High	4-5	>25%	>10%	>10%	>25%	>3m	>10%
High	3-4	<20%	<10%	<10%	<20%	<3m	<10%
Moderate	2-3	<10%	<5%	<5%	<10%	<1m	<5%
Low	1-2	< 5%	<3%	<3%	< 5%	<0.5m	<3%
Very Low	0-1	<1%	<1%	<1%	<1%	< 0.25m	<1%

The impact of each root cause is considered on the primary the objective.

2.6 Risk Importance

This metric is a combined metric based on the Composite Impact of each Root Cause as well as other parameters referenced above (e.g. Detectability, Vulnerability, Speed of Onset.)
In this preliminary analysis, only the Composite Index is accounted for. A rating of 3 is applied for Detectability, which means that given the risk responses being in place, root causes can be detected prior to a risk trigger event. As such, risks can be mitigated prior to trigger.
A more detailed analysis during project execution can reassess and account for proper Detectability rankings.

2.7 Risk Categories & Factors

These are parameters used to classify the root causes.
The rationale followed for these categorizations are as follows:
The components of success of projects fall under three main factors (**TEAM**):

- **T**echnical (Technology, Engineering & Scope),
- **E**xperience, **A**nd
- **M**ethodology

Therefore, any categorization of risks related further back into two basic factors which is either Technical or Human Capital (Human Asset) related factors.
These categorizations help further assess and prioritize risks.

2.8 Risk Triggers

Risk triggers represent the basis for generating proper risk responses, which need to be of a predictive and proactive nature.
During project execution, Key Performance Indicators for project execution must be established and monitored in case of reaching a KPI threshold.

2.9 Risk Responses

Risk Responses are thought of the means and actions taken to minimize risk exposure, in a proactive and predictive manner as started previously.
Risk monitoring and on – going analysis must be based on metrics or project performance KPIs.
Risk Responses are also classified in order to highlight the importance of certain ones versus others,

3 Risk Assessment Results

3.1 Risk Register

Based on the previous definitions, risks and related assessments shall be summarized in the Risk Register Matrix.
The initial Risk Register shall contain the minimum of 37 risks related to the Project Objectives noted above in section 2.1 and presented in the example of Appendix A.

3.2 Risk Prioritization

Risk prioritization is determined on the basis of the various parameters defined in section 7.
Based on the definition of Risk Exposure = Probability x Impact, prioritization of risks can be defined on this basis.
Heat Map presentation relates Risk Probabilities and Impact while accounting for the Relative Risk Exposure in the form of the graph bubble sizes in Appendix C are defined on the following basis:

- RED LINED AREA (Intolerable): Risk must be reduced at any cost by applying engineering controls, or otherwise operation shall not be allowed to continue. Actions must be resolved by 30 days. Continued operations must be approved by the Manager with interim measures.
- YELLOW LINED AREA: As Low As Reasonably Practicable (ALARP). Risk reduction measures must be incorporated based on cost efficiency. Actions must be resolved by 90 days. Continued operations must be approved by the Manager with interim measures.
- GREEN LINED AREA: Broadly Acceptable. Implement measures to maintain risks at this level. Improve through administrative measures and manage for continuous improvement.

3.3 Conclusions

On - going Risk Management by the system integrator during project execution shall be aligned with and based on the use of a risk register and analytics framework defined in this document.
Instructions To Bidders shall include guidelines for the system integrator/bidders to present applicable Risk Registers to be used for the project based on PMBOK.
TBE for Risk Management shall account for the level of comprehension by the bidders as demonstrated in the proposals in terms of adherence to the PMBOK standards adopted in this document.

Preliminary conclusions drawn from analyzing the Risk Register are as follows:

Table 3 – Summary of Conclusions

Top 3 Risks	1. Schedule Delays 2. Value Degradation 3. Functionality Degradation	Figure 1
Top 3 Root Causes	1. Insufficient Resources 2. Insufficient Experience/Skills 3. Scope Creep	Figure 2
Risk Factor assessment	Human capital related risks and risk responses far outweigh technical issues	Figure 3
Top 3 Risk Responses	1. Resource Management 2. Clear Requirements 3. Project Management	Figure 4
Risk Heat Map	Risk exposure, at least based on the current allocations of risk rankings, are in the yellow domain.	Figure 5

Further risk and response assessments are required regarding:

- Risk related to specific technologies (COTS).
- Specific technical topics addressed in the Functional Map Document.
- The implications of using system integrators with very little or no invested interest in COTS.

APPENDIX A PRELIMINARY RISK REGISTER MATRIX (37)

ID	Risk	Root Cause	Risk Category	Risk Factor	Trigger KPI	Response Type	Key to Response	Response Descriptions/ Comments	Contingency	Owner	Status	Date	Date to
1	Cost Increase	Scope Creep	Scope	Scope	Scope Creep Index defined on based on actuals versus specified or planned functional requirements count, number of WBS activities in baseline schedule and deliverables	Mitigation	Clear requirements	On - going deviation analysis and reporting for compliance matrix, WBS and deliverables to monitor scope creep index. Index calculation to be agreed. Calculation converted to % of project cost.		C			
2	Cost Increase	Schedule Delays	Management	Human Capital	Milestones Deviations Forecasted	Mitigation	Project Management	Actual versus planned versus forecasted schedule monitoring on bi weekly basis. Calculation converted to % of project cost based on weeks of total slippage.		C			
3	Cost Increase	Excessive Internal Expenses	Management	Human Capital	Headcount cost + Travel X Item 22	Mitigation	Cost Management	Optimize use of PMT resources, travel, etc.		PMT			
4	Decision Delays	Insufficient Executive Support	Management	Human Capital	Pending Decisions X Weeks Overdue	Transference	Sponsorship	Generate executive summaries and conduct biweekly meetings with sponsors.		PMT			
5	Decision Delays	Ineffective Project Management	Management	Human Capital	Pending Decisions X Weeks Overdue	Mitigation	Project Management	Generate pending decisions log		C			
6	Functionality Degradation	Data Quality & Availability	Management	Human Capital	Missed Milestones X Weeks Overdue	Transference	Project Management	Generate/monitor interface milestones		IT			
7	Functionality Degradation	Integration Defects	Integration	Technical	Prototyping Unresolved Punches X Weeks Overdue	Mitigation	Prototyping	Derived from biweekly project progress report.		C			

ID	Risk	Root Cause	Risk Category	Risk Factor	Trigger KPI	Response Type	Key to Response	Response Descriptions/ Comments	Contingency	Owner	Status	Date	Date to
8	Functionality Degradation	Functional Overlaps	Scope	Technical	Overlaps Count - [(Agreed Resolutions + Implemented Resolutions)/2]	Mitigation	Clear requirements	Derived from biweekly project progress report.		C			
9	Functionality Degradation	Software Limitations	Technology	Technical	Deviations from Compliance Matrix - [(Agreed Resolutions + Implemented Resolutions)/2]	Mitigation	Clear requirements	Derived from biweekly project progress report.		C			
10	Functionality Degradation	Integration Limitations	Integration	Technical	Deviations From Compliance Matrix - Agreed Resolutions	Mitigation	Clear requirements	Derived from biweekly project progress report.		C			
11	Functionality Degradation	EPC Design Inputs	Management	Human Capital	Number Of Pending Inputs X Weeks Overdue	Transference	Interface Management	Derived from biweekly project progress report.		EPC			
12	Underuse of Applications	Insufficient Resources	Resources	Human Capital	Resources Required - Resources Engaged	Transference	Resource Management	Derived from resourcing plan included in biweekly project progress report		O			
13	Underuse of Applications	Complexity In Use	Engineering	Technical	To be defined based on KPIs (i.e. KPI 8, 9, 10, etc.).	Transference	Resource Management	Derived from biweekly project progress report. Root cause to be defined based on options, interfaces, overlaps management.		O			
14	Underuse of Applications	Insufficient Executive Support	Resources	Human Capital	Sponsors Required - Sponsors Engaged	Transference	Sponsorship	Derived from resourcing plan included in biweekly project progress report		O			
15	Underuse of Applications	Insufficient Experience/Skills	Resources	Human Capital	Skills X Number Of Years Of Experience (Required - Engaged)	Transference	Resource Management	Derived from resourcing plan included in biweekly project progress report		O			

ID	Risk	Root Cause	Risk Category	Risk Factor	Trigger KPI	Response Type	Key to Response	Response Descriptions/ Comments	Contingency	Owner	Status	Date	Date to
16	Quality Degradation	Insufficient Resources	Resources	Human Capital	Resources Required - Resources Engaged	Mitigation	Resource Management	Derived from resourcing plan included in biweekly project progress report		C			
17	Quality Degradation	Ineffective QA/QC Program	Methodology	Technical	Non - Conformance Items	Mitigation	Quality Management	Derived from biweekly project progress report.		C			
18	Schedule Delays	Insufficient Resources	Resources	Human Capital	Resources Required - Resources Engaged	Mitigation	Resource Management	Derived from resourcing plan included in biweekly project progress report		C			
19	Schedule Delays	Ineffective Project Management	Management	Human Capital	To be defined from combined KPIs i.e. milestones slippage, etc.	Mitigation	Project Management	Derived from biweekly project progress report.		C			
20	Schedule Delays	Scope Complexity	Scope	Technical	To be defined from combined KPIs (i.e. KPI 7, 8, 9, etc.).	Mitigation	Clear requirements	Derived from biweekly project progress report. Root cause to be defined based on options, interfaces, overlaps management.		PMT			
21	Schedule Delays	Scope Creep	Scope	Technical	Compliance Matrix Unresolved Deviations	Mitigation	Clear requirements	On - going deviation reporting for compliance matrix, WBS and deliverables to monitor scope creep index. Index calculation to be agreed. Calculation converted to weeks of schedule slippage.		C			
22	Schedule Delays	Ineffective Methodology	Methodology	Human Capital	Non - Conformance Items count X Weeks Overdue	Mitigation	Project Management	Derived from biweekly project progress report.		C			
23	Schedule Delays	Insufficient Experience/Skills	Resources	Human Capital	Skills X Number Of Years Of Experience (Required - Engaged)	Mitigation	Resource Management	Establish metric upfront and re-assess if turnover occurs.		C			

ID	Risk	Root Cause	Risk Category	Risk Factor	Trigger KPI	Response Type	Key to Response	Response Descriptions/ Comments	Contingency	Owner	Status	Date	Date to
24	Schedule Delays	Insufficient Productivity	Management	Human Capital	Milestones Deviations Forecasted	Mitigation	Project Management	See item 3. Calculation reported on basis of weeks of total slippage.		C			
25	Schedule Delays	Insufficient Motivation	Management	Human Capital	Milestones Deviations Forecasted	Mitigation	Project Management	See item 3. Calculation reported on basis of weeks of total slippage.		C			
26	Schedule Delays	Missed Milestones	Management	Human Capital	Milestones Deviations Forecasted	Mitigation	Project Management	See item 3. Calculation reported on basis of weeks of total slippage.		C			
27	Schedule Delays	Resource Turnover	Management	Human Capital	Number Of Changes in Project Staff X Project Month/Project Duration in Months	Mitigation	Resource Management	Impact is greater when occurred late in project versus earlier. Impact is 1 at start 3 at midpoint 4-5 after CDR.		C			
28	Schedule Delays	EPC Design Inputs	Management	Human Capital	Number Of Pending Inputs	Mitigation	Interface Management	Derived from biweekly project progress report.		C			
29	Scope Creep	Unclear Requirements	Scope	Human Capital	Overlaps/Integration Challenges Count - [(Agreed Resolutions + Implemented Resolutions)/2]	Mitigation	Clear requirements	Derived from biweekly project progress report.		C			
30	Value Degradation	Insufficient Resources	Resources	Human Capital	Resources Required - Resources Engaged	Transference	Resource Management	Derived from resourcing plan included in biweekly project progress report		O			
31	Value Degradation	Unrealistic Expectations	Management	Human Capital	Expectations Scorecard Score	Transference	Alignment	Define expectations prior to ITB through interviews of end users. Develop metrics.		O			
32	Value Degradation	Insufficient Training	Training	Human Capital	Training Courses X Number Of Attendees (Actual - Planned)	Mitigation	Training	Derived from biweekly project progress report.		C			

ID	Risk	Root Cause	Risk Category	Risk Factor	Trigger KPI	Response Type	Key to Response	Response Descriptions/ Comments	Contingency	Owner	Status	Date	Date to
33	Value Degradation	Complexity In Use	Engineering	Technical	To be defined from combined KPIs (i.e. number of interfaces, number of KPIs per user, etc.)	Mitigation	Clear requirements	To be reported in bi-weekly progress report.		C			
34	Value Degradation	Insufficient Alignment	Management	Human Capital	Expectations Scorecard	Mitigation	Alignment	Alignment to be dealt with as expectations prior to ITB through interviews of end users. Develop metrics.		PMT			
35	Value Degradation	Underuse of Applications	Management	Human Capital	To be defined from combined KPIs (i.e. KPI 30, 31, 32)	Mitigation	Resource Management	To be reported in bi-weekly progress report.		C			
36	Value Degradation	Insufficient Lifecycle Support	Support	Human Capital	Compliance Matrix Unresolved Deviations X Weeks Overdue	Mitigation	Lifecycle Management	Derived from biweekly project progress report.		C			
37	Value Degradation	Insufficient Experience/Skills	Resources	Human Capital	Skills X Number Of Years Of Experience (Required - Engaged)	Transference	Resource Management	Establish metric upfront and re-assess if turnover occurs.		O			

Notations:

1. Project Owner: O
2. Owner Project Management Team: PMT
3. Project Contractor: C

APPENDIX B PRELIMINARY RISK REGISTER METRICS (EXAMPLE DRAFT)

ID	Risk	Root Cause	Risk Category	Risk Factor	Value	Scope	Cost	Schedule	Quality	Functionality	Composite Impact	Probability	Impact	Risk Exposure	Detectability	Importance	Vulnerability	Speed of onset
1	Cost Increase	Scope Creep	Scope	Scope	6	2	1	3	4	5	2.0	3	2	2.4	3	2.7		
2	Cost Increase	Schedule Delays	Management	Human Capital			1	2			1.2	3	2	2.4	3	2.3		
3	Cost Increase	Excessive Internal Expenses	Management	Human Capital			1				1.0	2	1	1.4	2	1.5		
4	Decision Delays	Insufficient Executive Support	Management	Human Capital		3	2	1			1.4	1	2	1.4	3	2.0		
5	Decision Delays	Ineffective Project Management	Management	Human Capital	6	3	2	1	4	5	2.0	1	2	1.4	3	2.1		
6	Functionality Degradation	Data Quality & Availability	Management	Human Capital	2				3	1	1.4	3	3	3.0	3	2.5		
7	Functionality Degradation	Integration Defects	Integration	Technical	2				3	1	1.4	3	3	3.0	3	2.5		
8	Functionality Degradation	Functional Overlaps	Scope	Technical	2				3	1	1.4	3	3	3.0	3	2.5		
9	Functionality Degradation	Software Limitations	Technology	Technical	2				3	1	1.4	2	3	2.4	3	2.4		
10	Functionality Degradation	Integration Limitations	Integration	Technical	2				3	1	1.4	3	3	3.0	3	2.5		
11	Functionality Degradation	EPC Design Inputs	Management	Human Capital	2				3	1	1.4	2	3	2.4	3	2.4		
12	Underuse of Applications	Insufficient Resources	Resources	Human Capital	1						1.0	3	3	3.0	3	2.3		
13	Underuse of Applications	Complexity In Use	Engineering	Technical	1						1.0	3	3	3.0	3	2.3		
14	Underuse of Applications	Insufficient Executive Support	Resources	Human Capital	1						1.0	3	3	3.0	3	2.3		
15	Underuse of Applications	Insufficient Experience/Skills	Resources	Human Capital	1						1.0	3	3	3.0	3	2.3		
16	Quality Degradation	Insufficient Resources	Resources	Human Capital	2				1	3	1.4	2	2	2.0	3	2.2		
17	Quality Degradation	Ineffective QA/QC Program	Methodology	Technical	2				1	3	1.4	2	2	2.0	3	2.2		
18	Schedule Delays	Insufficient Resources	Resources	Human Capital				1			1.0	3	2	2.4	3	2.2		
19	Schedule Delays	Ineffective Project Management	Management	Human Capital				1			1.0	2	2	2.0	3	2.1		
20	Schedule Delays	Scope Complexity	Scope	Technical	6	2	3	1	4	5	2.0	2	2	2.0	3	2.4		
21	Schedule Delays	Scope Creep	Scope	Technical				1			1.0	3	2	2.4	3	2.2		

ID	Risk	Root Cause	Risk Category	Risk Factor	Value	Scope	Cost	Schedule	Quality	Functionality	Composite Impact	Probability	Impact	Risk Exposure	Detectability	Importance	Vulnerability	Speed of onset
22	Schedule Delays	Ineffective Methodology	Methodology	Human Capital				1			1.0	2	2	2.0	3	2.1		
23	Schedule Delays	Insufficient Experience/Skills	Resources	Human Capital				1			1.0	3	2	2.4	3	2.2		
24	Schedule Delays	Insufficient Productivity	Management	Human Capital				1			1.0	3	2	2.4	3	2.2		
25	Schedule Delays	Insufficient Motivation	Management	Human Capital				1			1.0	2	2	2.0	3	2.1		
26	Schedule Delays	Missed Milestones	Management	Human Capital				1			1.0	2	2	2.0	3	2.1		
27	Schedule Delays	Resource Turnover	Management	Human Capital				1			1.0	2	2	2.0	3	2.1		
28	Schedule Delays	EPC Design Inputs	Management	Human Capital				1			1.0	2	2	2.0	3	2.1		
29	Scope Creep	Unclear Requirements	Scope	Human Capital	6	1	2	3	4	5	2.0	2	2	2.0	3	2.4		
30	Value Degradation	Insufficient Resources	Resources	Human Capital	1		2				1.2	2	3	2.4	3	2.3		
31	Value Degradation	Unrealistic Expectations	Management	Human Capital	1		2				1.2	2	3	2.4	3	2.3		
32	Value Degradation	Insufficient Training	Training	Human Capital	1		2				1.2	2	3	2.4	3	2.3		
33	Value Degradation	Complexity In Use	Engineering	Technical	1		2				1.2	2	3	2.4	3	2.3		
34	Value Degradation	Insufficient Alignment	Management	Human Capital	1		2				1.2	3	3	3.0	3	2.4		
35	Value Degradation	Underuse of Applications	Management	Human Capital	1		2				1.2	3	3	3.0	3	2.4		
36	Value Degradation	Insufficient Lifecycle Support	Support	Human Capital	1		2				1.2	3	3	3.0	3	2.4		
37	Value Degradation	Insufficient Experience/Skills	Resources	Human Capital	1		2				1.2	3	3	3.0	3	2.4		

APPENDIX C PRELIMINARY RISK ANALYSIS RESULTS

Figure 1 - Risk Prioritization

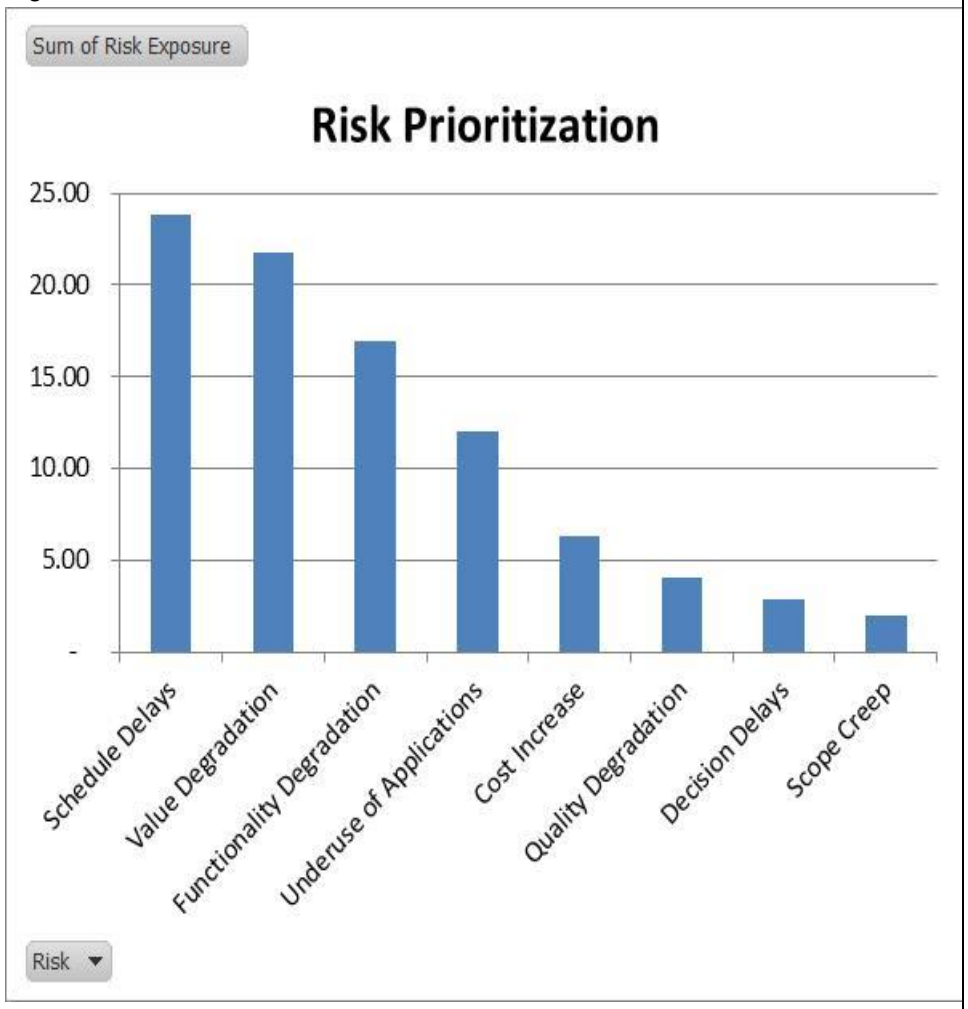


Figure 2 - Root Cause Categorization

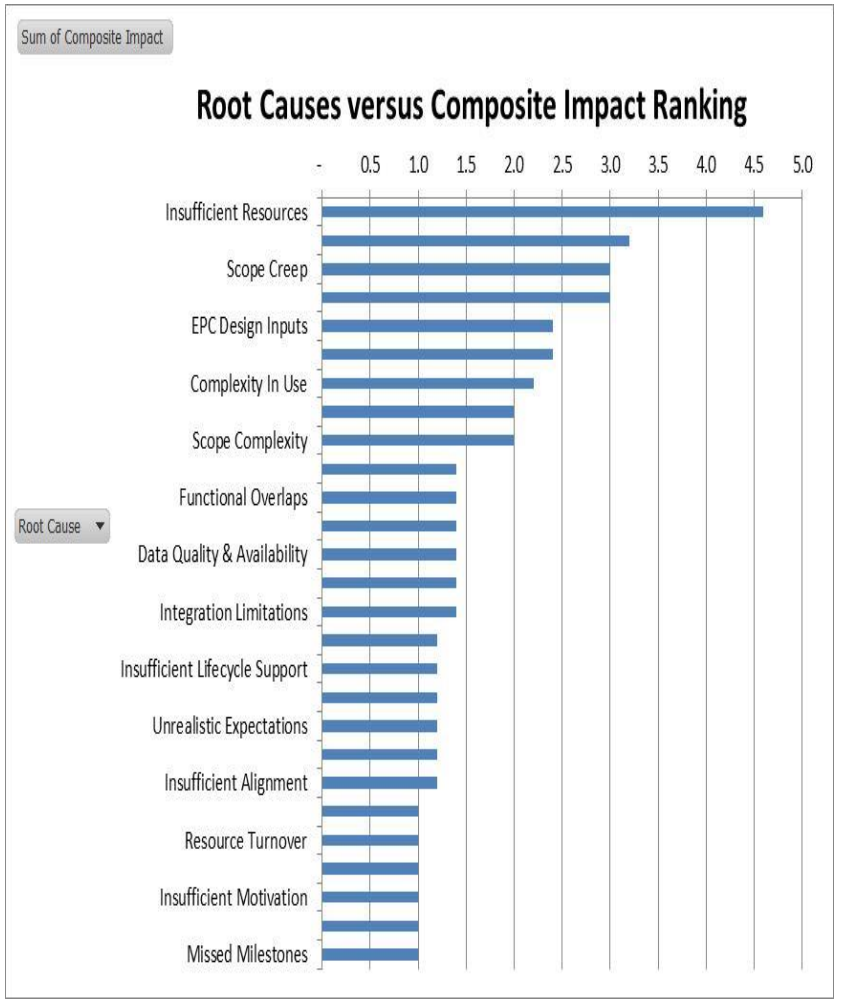


Figure 3 - Risk Factor Categorization

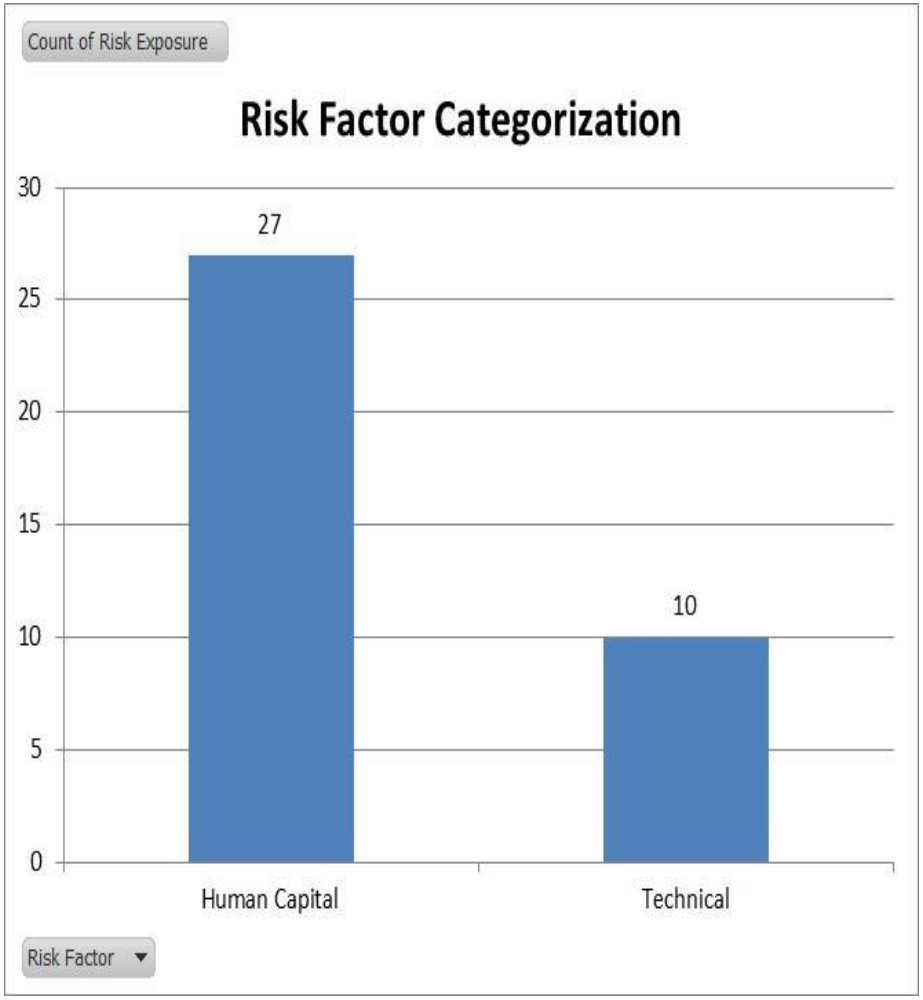


Figure 4 - Risk Response Prioritization

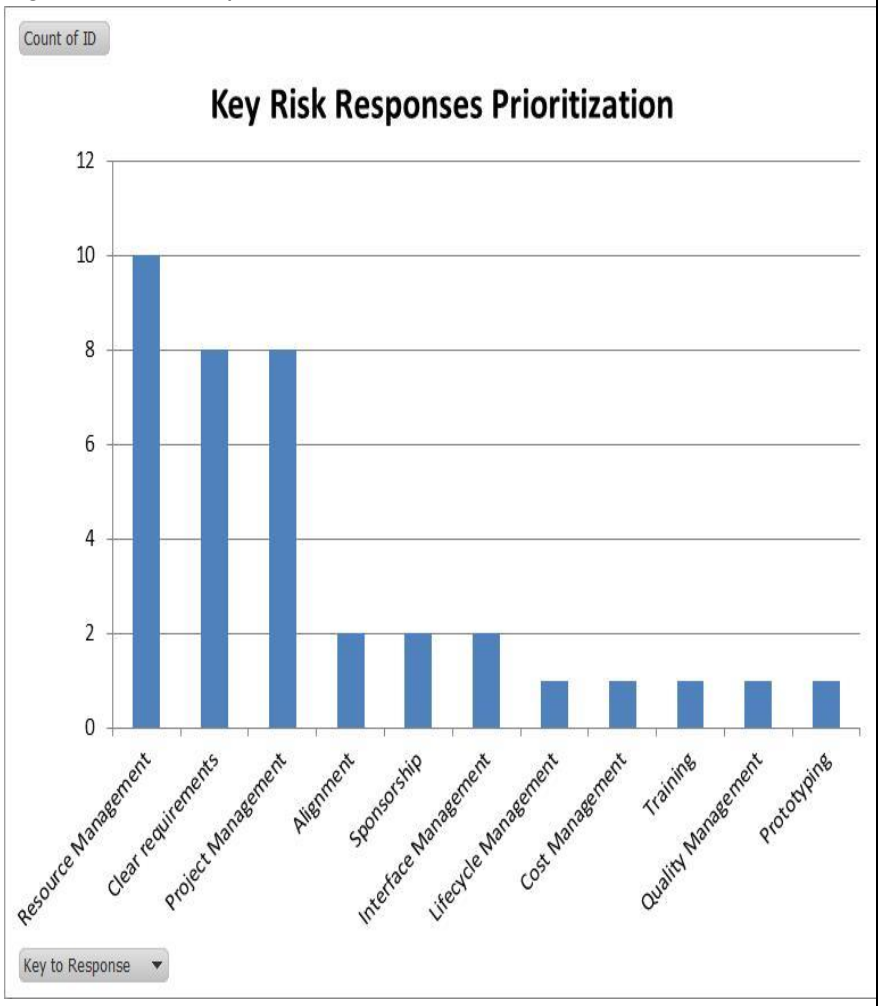
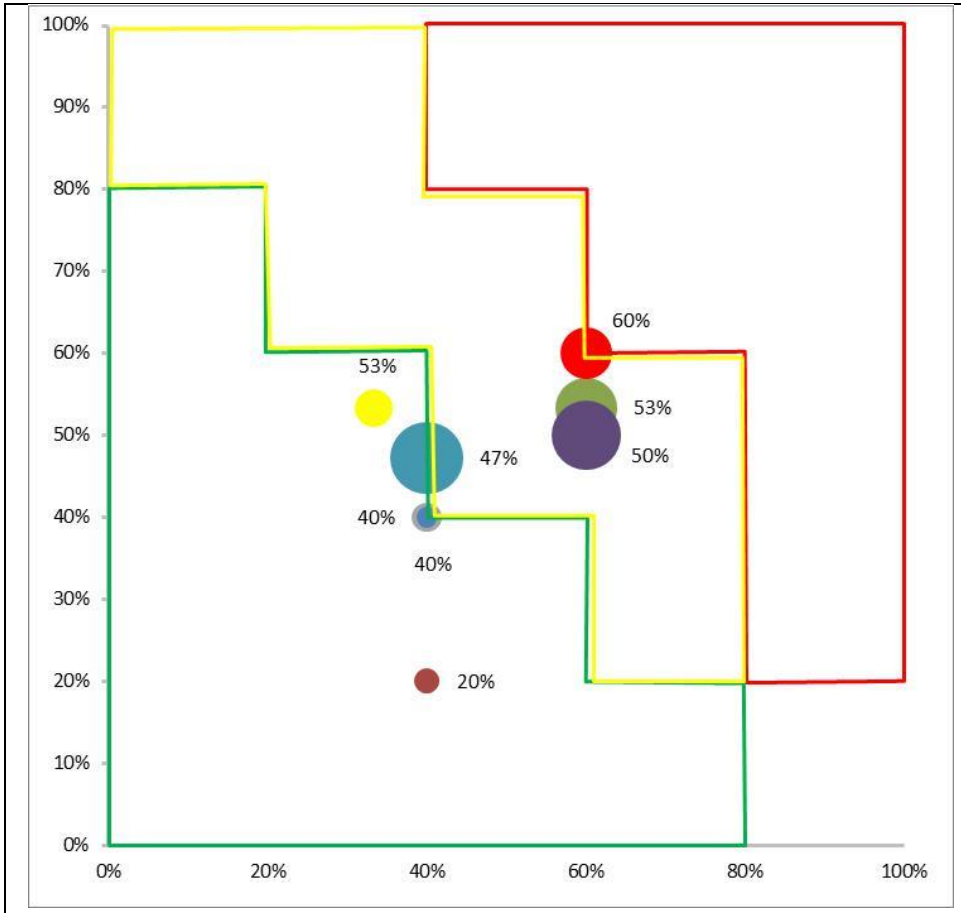


Figure 5 - Risk Heat Map



Risk Area	Impact	Probability	Relative Risk Exposure	Symbol
Cost Increase	33%	53%	7%	
Decision Delays	40%	20%	3%	
Functionality Degradation	60%	53%	19%	
Insufficient Use	40%	40%	5%	
Quality Degradation	40%	47%	27%	
Schedule Delays	40%	40%	2%	
Scope Creep	60%	50%	25%	
Value Degradation	60%	60%	14%	