Engineering Research Centers

Gen-4 ERC:
Risk Management
NSF 19-503

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Risk Management in ERC Context

- ERC's Four Foundational Components, Convergent Research (CR), Engineering Workforce Development (EWD), Diversity and Culture of Inclusion (DCI), and Innovation Ecosystem(IE):
  - Provide a focus to the organizational context
  - Set forth a framework for thinking about risk
  - Articulate and present a common vision to success
- Center-Level Risk Management Plan
  - Facilitates deliberate thinking on threats and opportunities to achieving the Center's objectives
  - Codifies structure and implementation for management of risk

Terms[1]

Overall project risk "is the effect of uncertainty on the [project], arising from all sources of uncertainty including individual risks, representing the exposure of stakeholders to the implications of variations in [project] outcome, both positive and negative."

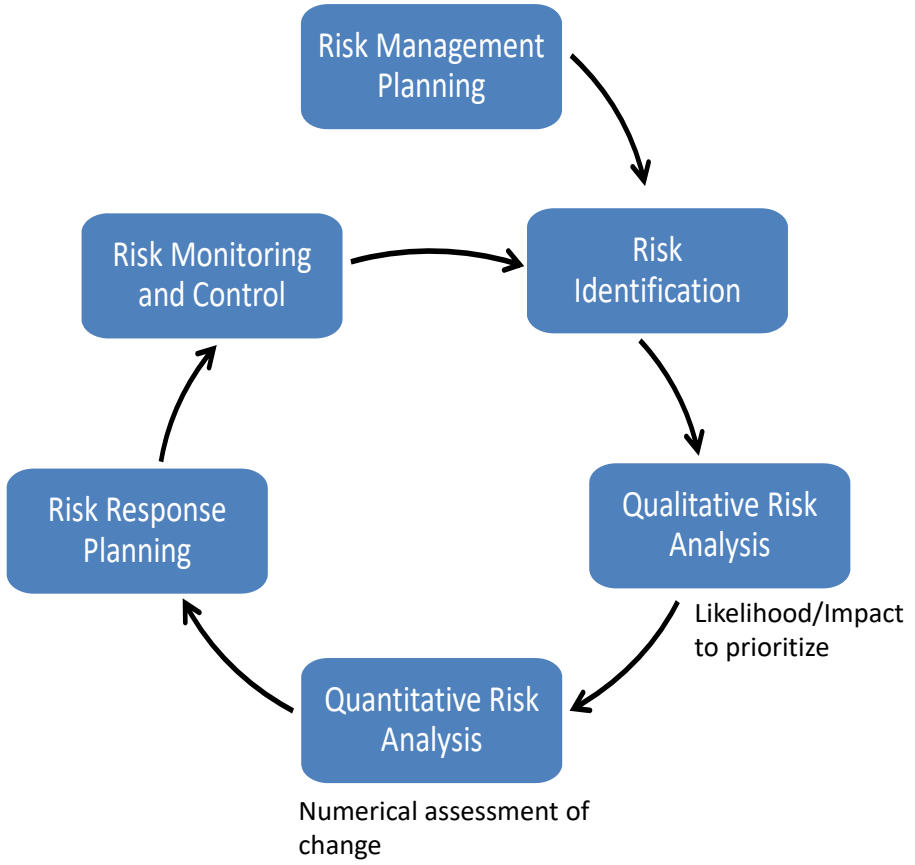
Individual Risk: "… an uncertain event or condition that, if it occurs, has a positive or negative effect on at least one [project] objective**."**

Risk Management: is a process which *increases the probability of a successful* [project] by identifying threats to the [project], assessing the nature of those threats, and identifying actions that can be taken to either *reduce the probability* of those threats occurring or *reduce the impact* of the threats

([1]*Guide to the Project Management Body of Knowledge*, Project Management Institute, 6th Edition, 2017)

Risk Management Process Steps

- **Planning:** Codifies risk management plan
- **Risk Identification:** Generates risk register
- **Qualitative Risk Analysis:** Defines level for reach risk
- **Risk Response Planning:** Specifies the plans and risk triggers
- **Risk Monitoring and Control:** Assures updates and stakeholder communication

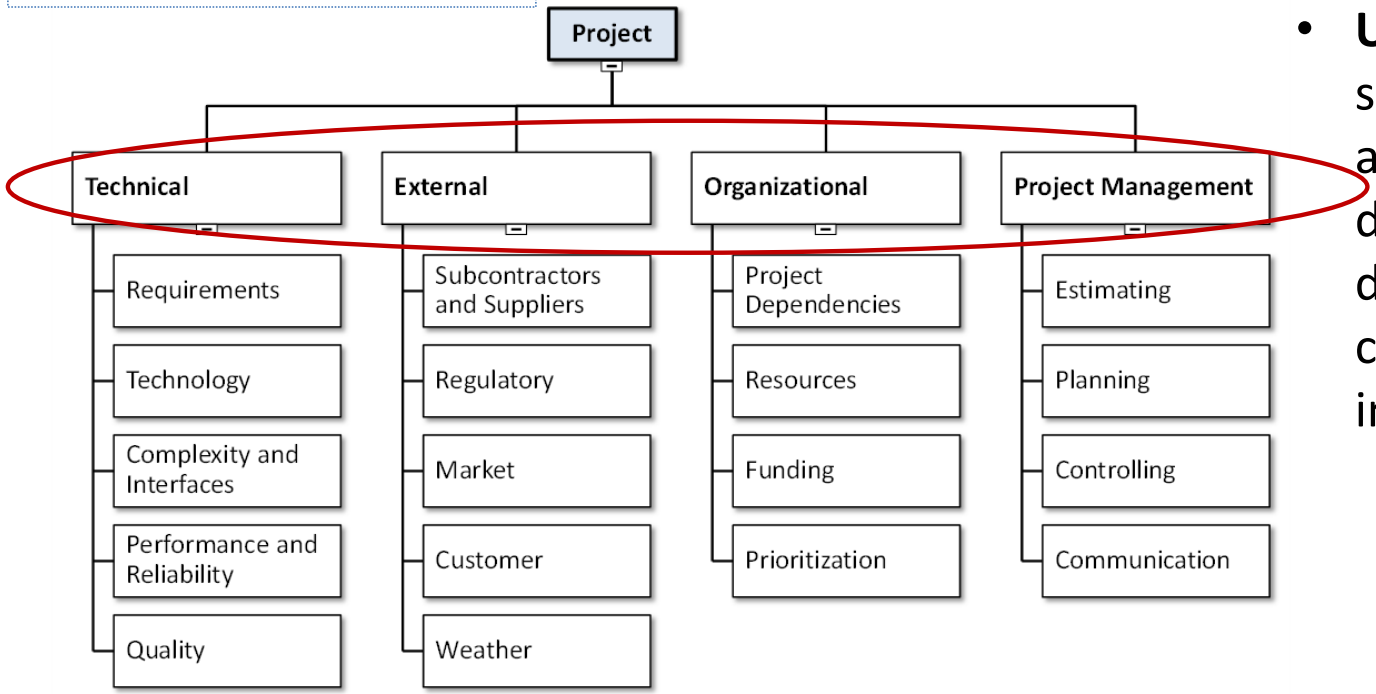


Example: Risk Management Plan Format

- **Introduction:** Purpose, objective, and [Project] description
- **Definitions:** Explain applicable terms e.g., ratings, schedule, qualitative risk analysis
- **Risk Management Strategy and Approach:** Overview
- **Organization:** Participant roles and responsibilities
- **Schedule Implications of the Plan:** Time period of risk management planning
- **Risk Identification:** Outline process for examination, quantitative/qualitative
- **Risk Register Analysis and Ranking:** Summarize establishment of ratings (probability and impact)
- **Risk Response Planning:** Describe response planning, updates, approval process etc.
- **Risk Handling:** List tools and options for handling
- **Risk Monitoring:** Process for checking-in on status

Example: Risk Identification Steps

Other Sample Categories:
Programmatic, Business, Economic, Design Requirements, Software and Technology Risks



- **Involve** all stakeholders
- **Identify** all risks to the [project] as early as possible.
- **Use** techniques and methods such existing [project] artifacts and guidance documents, brainstorming, diagramming, interviewing, comparison of historical information

Example: Qualitative Risk Analysis Method

Probability of Occurrence Descriptor	Probability of Occurrence Numerical Ranges equivalent levels[1]	Criteria in Words
Very Low	<0.1	Will not likely occur anytime in life cycle of the facilities; or the probability of occurrence is less than equal to 10%.
Low	>0.1 but <0.4	Will not very likely occur in the life cycle of the project or its facilities; or the probability of occurrence is greater than 10% but less than or equal to 40%.
Moderate	>0.4 but <0.6	Will likely with middling probability (e.g., a coin flip) to occur sometime during the life cycle of the project or its facilities; or the probability of occurrence is greater than 40% but less than 60%.
H		
Very		

Defined Conditions for Impact Scales of a Risk on Major Project Objectives, e.g., Time Definition for Threats Only

Project Objective	Very Low	Low	Moderate	High	Very High
Cost	Insignificant Cost Increase	<5% Cost Increase	<5 - 10% Cost Increase	<0 - 20% Cost Increase	>20% Cost Increase
Time	Insignificant Time Increase	5% Time Increase	<5 - 10 % Time Increase	<0 - 20 % Time Increase	>20% Time Increase
Scope	Scope Decreases are Barely Noticeable	Minor Areas of Scope Affected	Major Areas of Scope Affected	Scope Reduction Unacceptable to Sponsor	Project End Item is Effectively Useless
Quality	Quality Degradation Barely Noticeable	Only Very Demanding Applications are Affected	Quality Reduction Requires Sponsor Approval	Quality Reduction Unacceptable to Sponsor	Project End Item is Effectively Useless

PART #1

- Create probability and impact scales
- For each identified risk determine qualitative probability of occurrence value (P) range
- Determine qualitative consequence or impact of occurrence value (I)

Example: Qualitative Risk Analysis Method

Probability and Impact Matrix for a Specific Objective (Time, Cost, Scope or Quality)					
Probability	Symmetrical				
Very High	Mod	Mod	High	High	High
High	Low	Mod	High	High	High
Mod	Low	Mod	Mod	High	High
Low	Low	Low	Mod	Mod	Mod
Very Low	Low	Low	Low	Low	Mod
	Very Low	Low	Moderate	High	Very High
	Impact				

Definitions from Probability Table

Definitions from Impact Table

PART #2

- Determine risk position from intersection on heat map
- Translate probability and impact,
  High = red; Mod = yellow;
  Low = green
- Log result in Risk Register

Risk Management Plan, Monitor and Control

Risk Response Planning

- Develop options and actions to increase opportunities and to reduce threats to project objectives.
- Develop measures and action plans:
  - avoid, mitigate, transfer, accept
  - exploit, enhance, share, accept
- Summarize decisions and backup plans

Risk Monitoring and Control

- Check continuously
- Update status in the Risk Register and communicate impacts to [project] and plans.
- Close or retire risks from the active list as they are addressed.

Example: Risk Register

			Pre-Mitigated Scores										
			Probability and Impacts				Resulting Risk Score			Risk Action			
Risk ID	Risk Description	Associated WBS	Prob. Risk Occurs	On Sched.	On Cost	On Scope/ Quality/ Perform-ance	Risk on Sched.	Risk on Cost	Risk on Scope/ Quality/ Perform-ance	Risk Owner	Risk Mitigation Actions	Trigger or Watch date	Major Risk Flag
PM1	If ...., then ...	2.2	H	VH	H	M	H	H	M				
TECH1	If ...., then ...	3.2.5	H	VH	H	H	H	H	H				
EXT8	If ...., then ...	3.1.3	M	VH	H	M	H	H	M				
ORG4	If ...., then ...	1.2	M	H	M	M	H	M	M				
PM4	If ...., then ...	2.4.1	M	H	H	M	H	H	M				
TECH5	If ...., then ...	3.3.1	M	VH	H	M	H	M	M				
TECH6			L	H	M	M	M	M	M				
EXT6			L	H	H	L	M	M	L				
PM2			M	L	H	L	M	H	M				
TECH9			VL	VH	VH	L	M	H	L				
TECH10			VL	VH	M	VL	M	L	L				

Risk ID: unique number
Risk Description: Statement of the risk

Probability Risk Occurs: Likelihood of occurrence
Impact: Extent [project] is affected

Risk Scores: Results of Risk Analysis

Risk Actions: Actions to reduce the probability of occurrence or impact of a risk, or other response.
Risk Owner: Accountable person for risk

Risk Management Best Practices

- Scale and tailor to needs of the [project]

- Assign qualified personnel to lead and/or guide the planning and analyses
- Involve all stakeholders

- Perform risk analysis continuously, with periodic risk reviews of the risks
- Regularly communicate the risk
- Make the Risk Register accessible (read-access) to all [project] members

Resources

- Project Management Institute (PMI), https://www.pmi.org/
  - G*uide to the Project Management Body of Knowledge*, Project Management Institute, 6th Edition, 2017
- Risk Management Society (RIMS), https://www.rims.org/about-us
- National Science Foundation, Major Facilities Guide, https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf19068