

Week 5

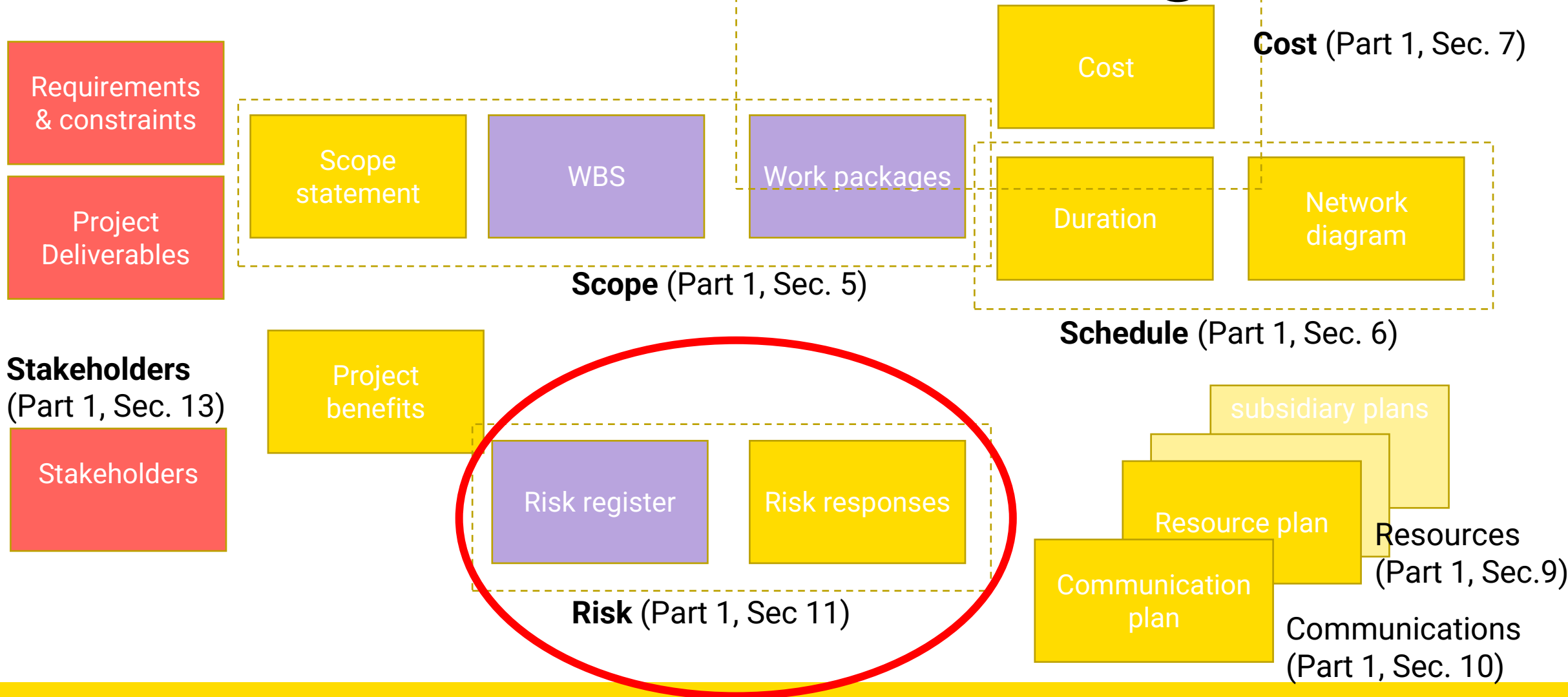


GSOE9820 Engineering Project Management
Term 1 2025
Dr. Imrana Kabir

Risk mgmt.



C3PE and PMBOK Knowledge Areas



What is Risk Management?

A **proactive** attempt to recognize and manage internal events and external **threats** that affect the likelihood of a project's success.

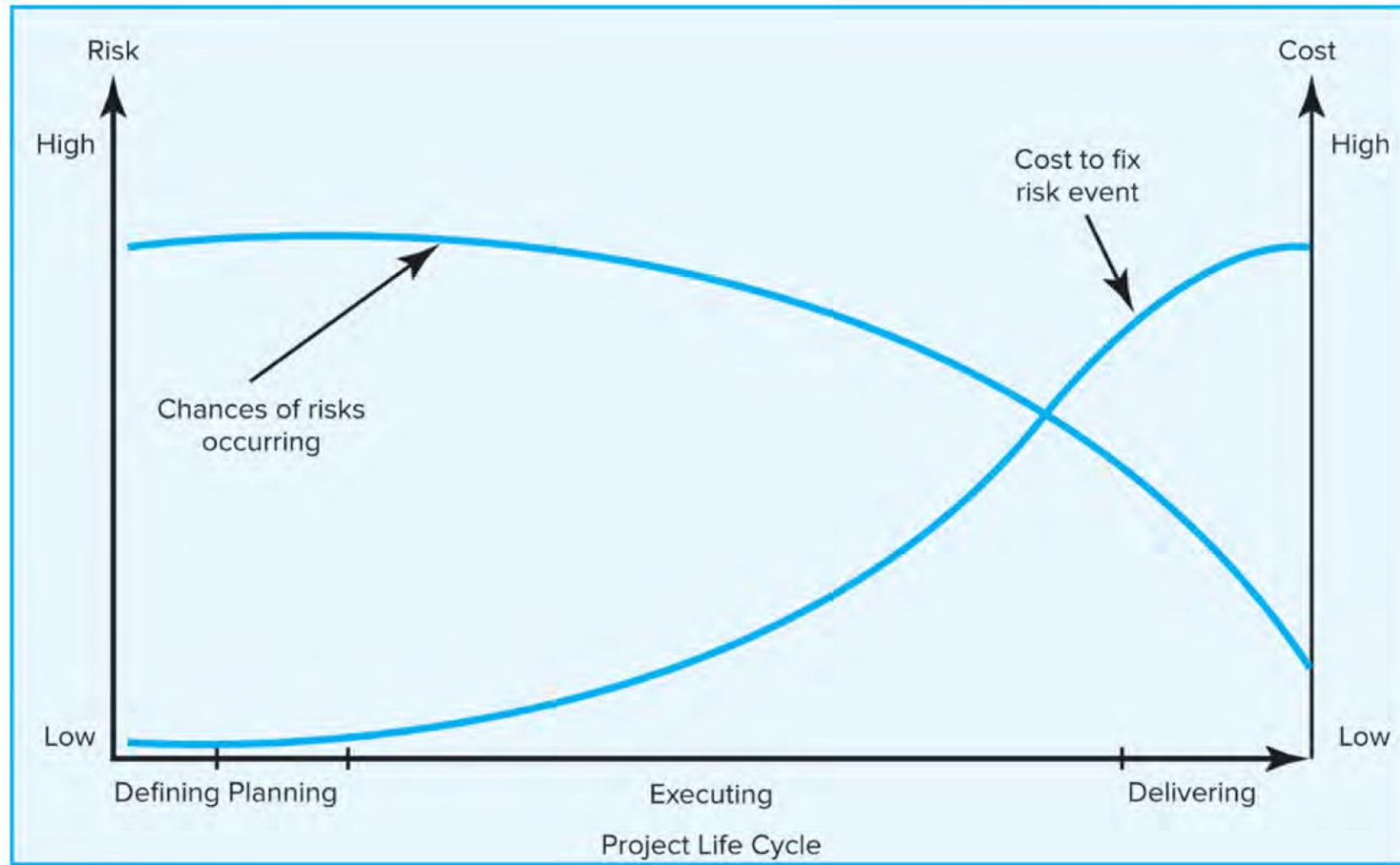
Incorporates an understanding of:

- What can go wrong (risk event)
- How to minimize the risk event's impact (consequences/effects)
- What can be done before a risk event occurs (anticipation)
- What to do when a risk event occurs (contingency plans)

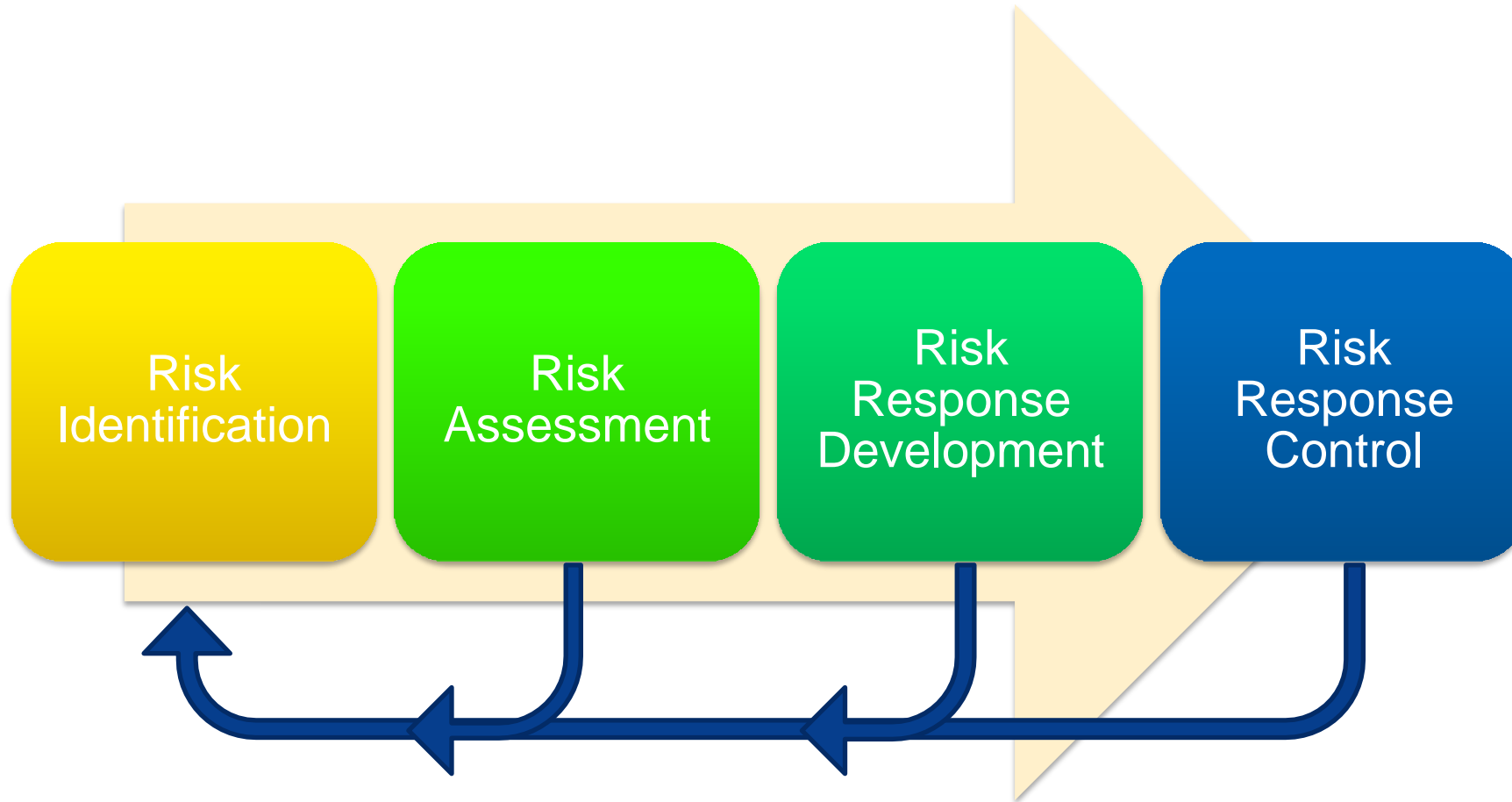
Benefits of Risk Management

- A **proactive** rather than reactive approach.
- Reduces surprises and **negative** consequences.
- **Prepares** the project manager to take advantage of appropriate risks.
- Provides better **control** over the future.
- **Improves** the chances of reaching project performance objectives within budget and on time.

The risk management challenge



4-Step Risk Management Process



Risk Identification

The process of generating a list of possible risks that could affect the project.

A common mistake is to identify **project objectives** rather than **events** as risks.

- E.g. Failure to meet schedule is a project objective, whereas adverse weather is an event which will effect the schedule.



Common risk identification tools

- Personal experience
- Individual pondering
- Group processes
 - Brainstorming
 - Nominal group (PMBOK Sec. 5.2.2.6)
 - Delphi method
- SWOT(strength, weakness, opportunity, threat)
- Root cause analysis
- Past Project information
- Checklists and Risk Profiles
- Risk breakdown structure (RBS)



PMBOK Guide (6th Ed.) 2017 Part 1 Sec. 11.2.2.
Identify Risks: Tools & Techniques

Sample Risk Profiling questions

Technical Requirements

Are the requirements stable?

Design

Does the design depend on unrealistic or optimistic assumptions?

Testing

Will testing equipment be available when needed?

Development

Is the development process supported by a compatible set of procedures, methods, and tools?

Schedule

Is the schedule dependent upon the completion of other projects?

Budget

How reliable are the cost estimates?

Quality

Are quality considerations built into the design?

Management

Do people know who has authority for what?

Work Environment

Do people work cooperatively across functional boundaries?

Staffing

Is staff inexperienced or understaffed?

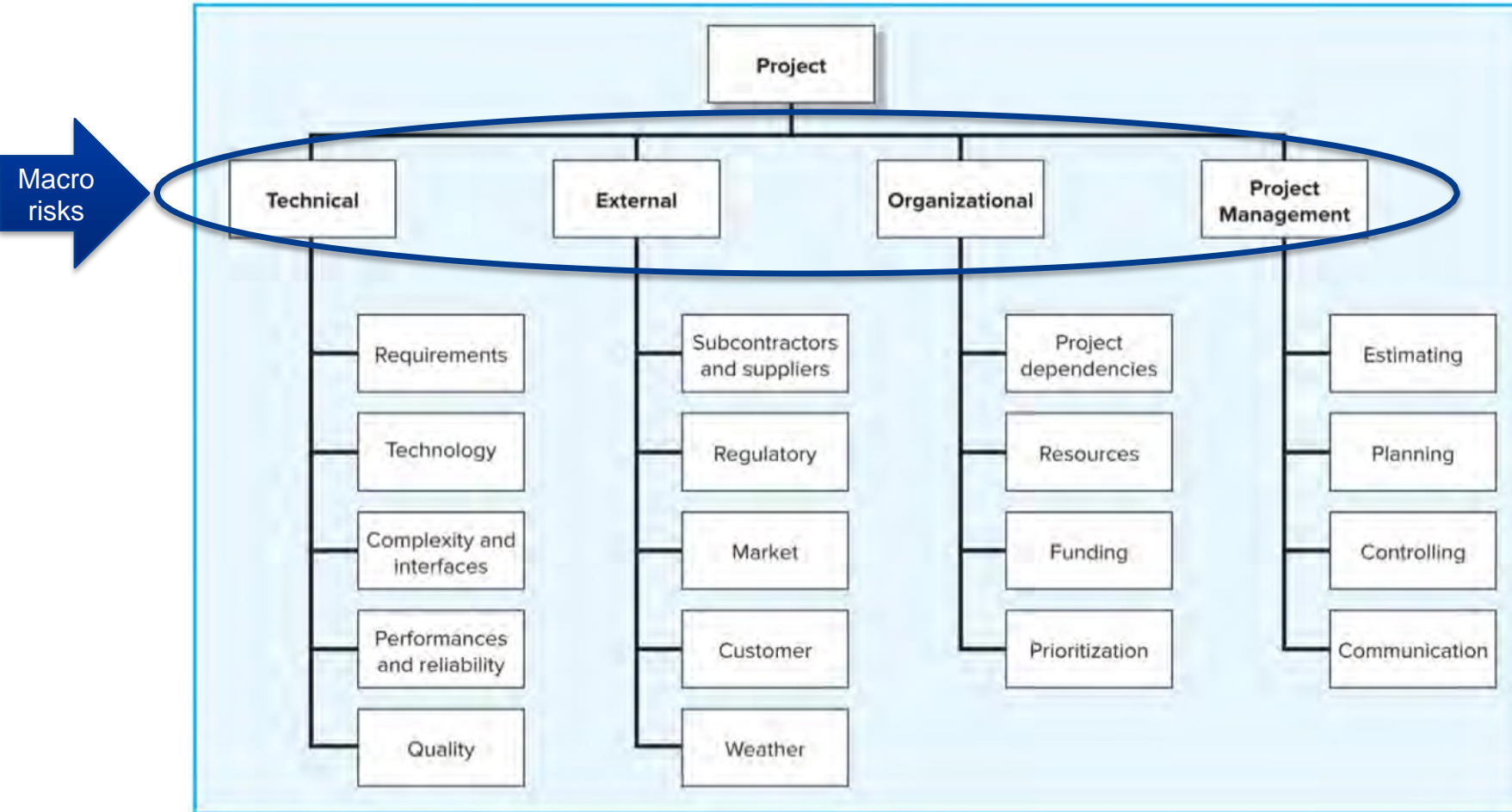
Customer

Does the customer understand what it will take to complete the project?

Contractors

Are there any ambiguities in contractor task definitions?

Sample risk breakdown structure (RBS)



Risk Assessment

- Takes the list **of risks identified** in step 1 and
- **filters** out
- **prioritize** them.

We typically evaluate each risk in terms of:

Probability / Likelihood

Impact / Severity

Ease / Difficulty of Detection

PMBOK Guide (6th Ed.) 2017 Part 1 Sec.
11.3.2 Perform Qualitative Risk assessment

Stanton, D. “[Manage project risks](#)” video in course [Leading Projects](#)
accessed 16/02/2021, LinkedIn Learning [accessed through UNSW](#)

Risk Assessment Tools

Scenario analysis

PMBOK Guide (6th Ed.) 2017 Part 1 Sec. 6.5.2.4 Scenario analysis

Impact Scales – (Simple (e.g. low/moderate/high))/Numerical e.g. 1-5)

Risk severity matrix – (Probability & Impact)

Failure Mode and Effects Analysis (FMEA) – (Probability, Impact & Ease of Detection)

Statistical Techniques

- Quantitative analysis/ Monte Carlo modelling
- Decision trees – used to assess alternative action using expected values
- NPV – for cash flow risks

PMBOK Guide (6th Ed.) 2017 Part 1 Sec. 11.4.2
Perform Quantitative Risk assessment

Chua, R. “[How to use failure Mode and Effects analysis](#)” video in course [Six-Sigma green Belt](#) accessed 16/02/2021, LinkedIn Learning [accessed through UNSW](#)

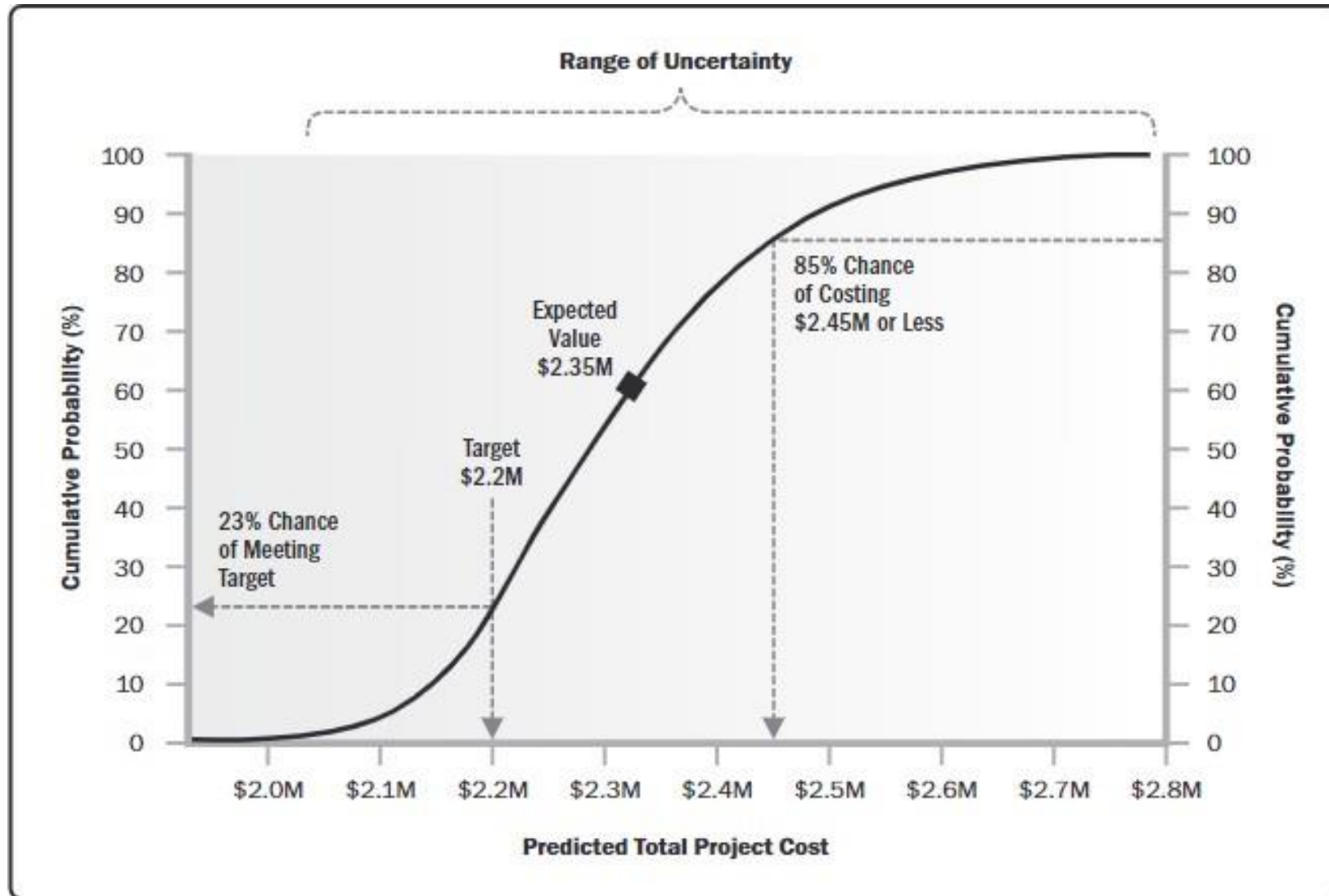
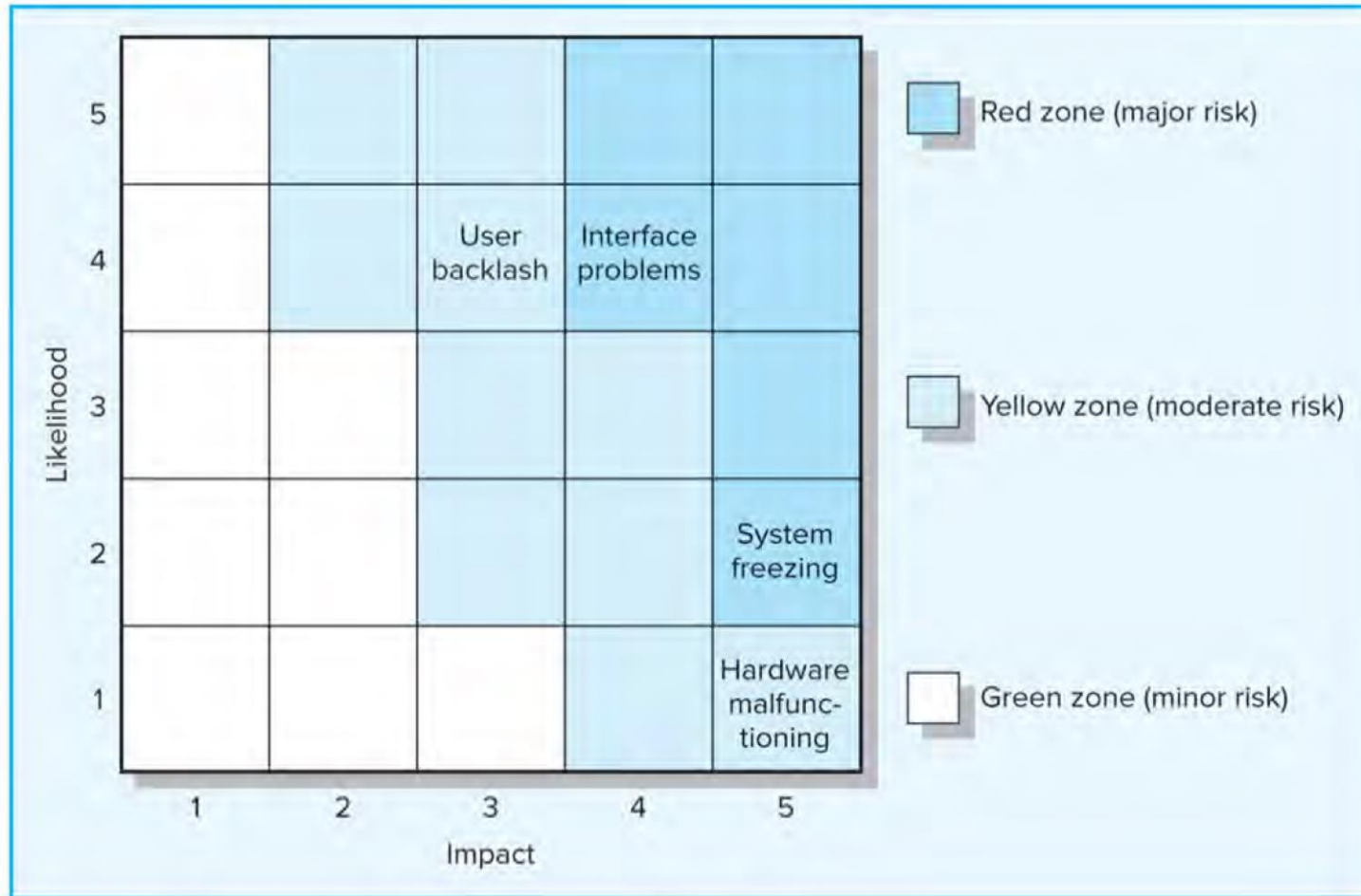


Figure 11-13. Example S-Curve from Quantitative Cost Risk Analysis

Example – Risk Severity Matrix 1



Example - Risk Severity Matrix 2

		Severity of the potential injury/damage				
		Insignificant damage to Property, Equipment or Minor Injury	Non-Reportable Injury, minor loss of Process or slight damage to Property	Reportable Injury moderate loss of Process or limited damage to Property	Major Injury, Single Fatality critical loss of Process/damage to Property	Multiple Fatalities Catastrophic Loss of Business
0 – 5 = Low Risk						
6 – 10 = Moderate Risk						
11 – 15 = High Risk						
16 – 25 = extremely high unacceptable risk						
Likelihood of the hazard happening	Almost Certain 5	1	2	3	4	5
	Will probably occur 4	5	10	15	20	25
	Possible occur 3	4	8	12	16	20
	Remote possibility 2	3	6	9	12	15
	Extremely Unlikely 1	2	4	6	8	10
		1	2	3	4	5

There are many other ways to assess risks besides probability/impacts

Proximity – duration until risk has an impact on project objectives

Dormancy – duration that a risk can stay hidden, before being discovered

Controllability – ability for a risk owner to control its outcome

Detectability – how easy it is to detect if the risk has occurred

See PMBOK 11.2.3.2 for many more...

Risk Response Development

Now that the risk event has been identified and assessed.

We need to make a decision on what type of response is appropriate for the specific event.



Stanton, D. "[Identify & escalate issues](#)" video in course [Leading Projects](#) accessed 16/02/2021, LinkedIn Learning accessed through [UNSW](#)

Risk Management Strategies

Mitigating/Reducing/Controlling Risk

- Reducing the likelihood an adverse event will occur.
- Reducing impact of adverse event.

Avoiding Risk

- Changing the project plan to eliminate the risk or condition.

Transferring Risk

- Paying a premium to pass the risk to another party.
- Requiring Build-Own-Operate-Transfer (BOOT) provisions.

Accepting/Retaining Risk

- Making a conscious decision to accept the risk.

Rogers, J. "[Methods of Controlling Risk](#)" video in course [Construction Management: Managing Risk](#) accessed 16/02/2021, LinkedIn Learning [accessed through UNSW](#)

Contingency Planning

An alternative plan that will be used if a possible foreseen risk event actually occurs

A plan of actions that will reduce or mitigate the negative impact of a risk event

Potential disadvantages of not having a Contingency Plan

- Having no plan may **slow managerial response**
- Decisions made under pressure can be potentially **dangerous** and **costly**

Contingency Funding

Funds are established to **cover project risks**, both **identified** and **unknown**.

Size of funds often reflects **overall risk of a project**

Typical rules of thumb for funding levels:

- 1-10% for similar projects
- 20-60% for unique and high tech projects

Project owners are often **reluctant** to set up **project contingency** funds that seem to imply the **project plan** might be a poor one.

Types of Contingency funding

Contingency reserves

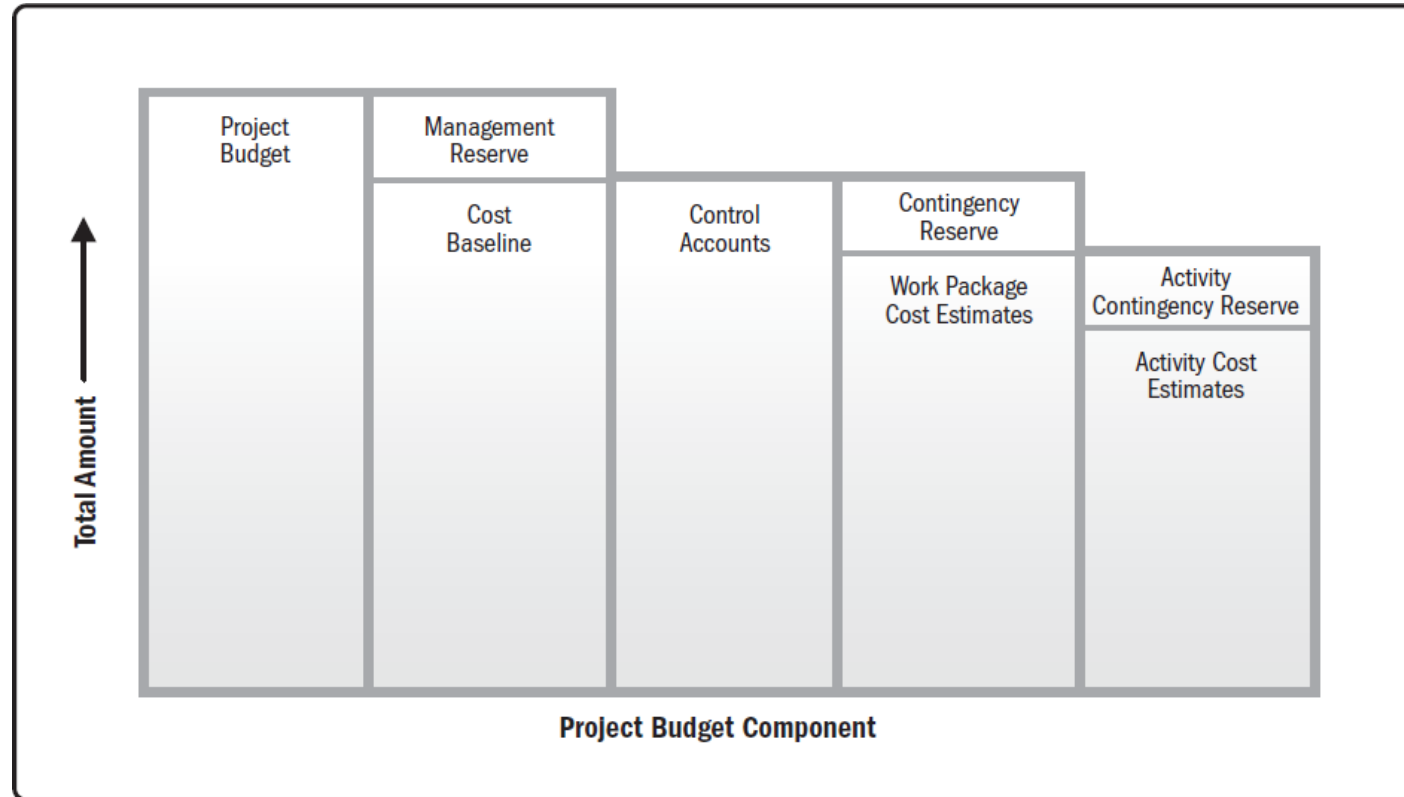
Are linked to the **identified risks** of specific work packages or cost accounts in WBS.

Management reserves

Are funds to be used to **cover major unforeseen risks** (e.g. change in project scope) of the total project

Are created **after contingency reserves** are identified

Contingency funding



PMBOK Guide (6th Ed.) 2017 Part 1 Sec. 7.3.3
Determine budget: outputs

Time Buffers

Are amounts of time used to **compensate** for unplanned delays in the project schedule

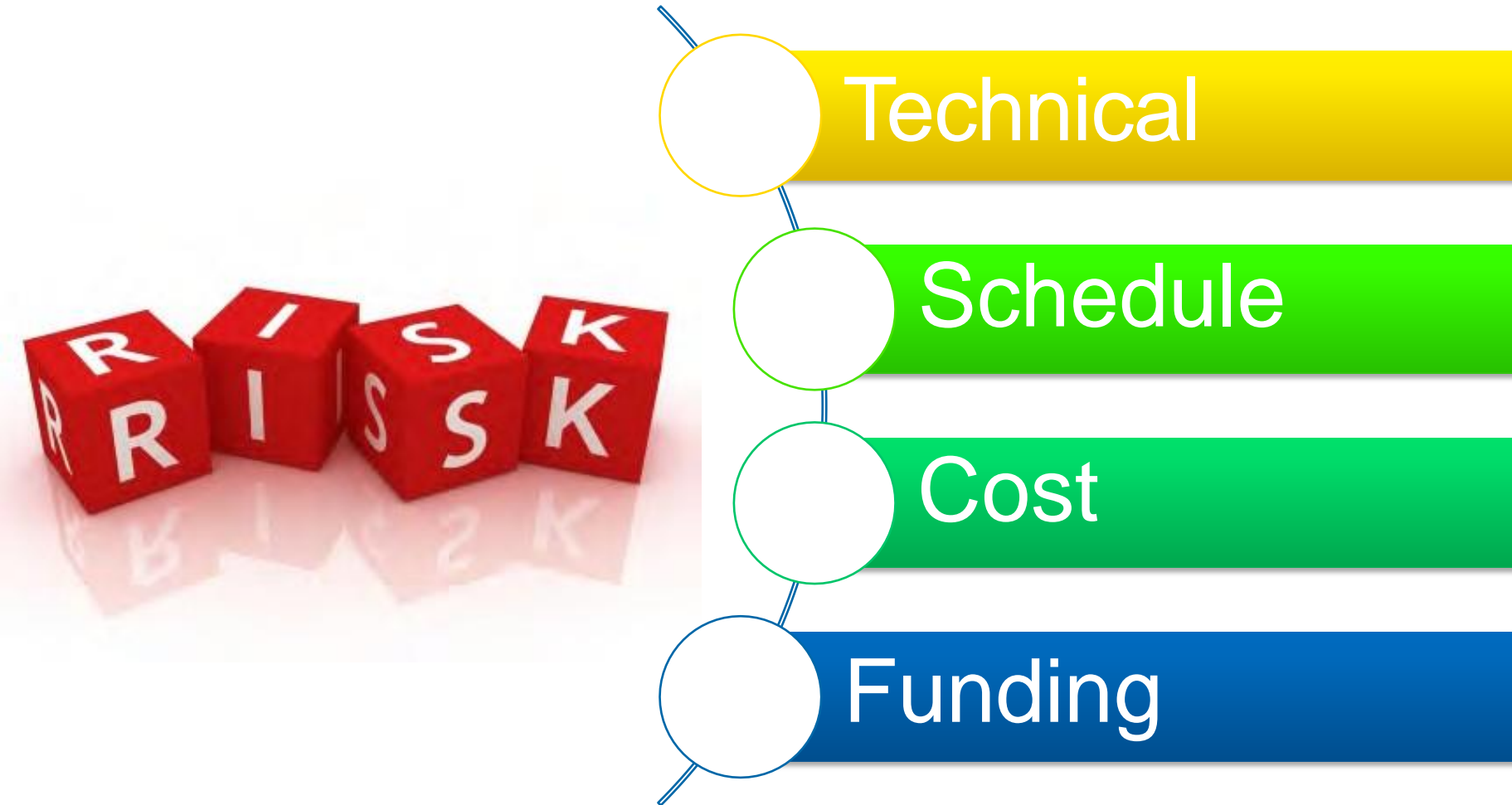
Time buffers are often added to:

- Activities with **severe risk**
- Merge activities that are **prone to delays** due to one or more preceding activities being late
- **Noncritical activities** to reduce the likelihood that they will create another critical path
- Activities that require **scarce resources** to ensure resources are available when needed

Note: *result of time buffers and risk contingencies need to be included back into schedule/budget.*



Types of project risks



Technical Risks

Technical risks are often **difficult** to manage



Mitigation Strategies:

- Backups/Alternatives
 - Different solutions can be implemented if a chosen technology fails
- Testing and modeling
 - Assessing whether technical uncertainties can be resolved through the use of:
 - CAD systems
 - Build models/prototypes
 - Experiments

Schedule Risks

Is the **threat** of a project not finishing on time

Mitigation Strategies:

- Time **Buffers/Project** Slack
- **Compression**/Crashing of project schedules by running activities in parallel or changing relationships (e.g. start- to-start lag relationships)



Cost Risks

Projects of **long duration** often need some **contingency for price changes**.

Mitigation Strategies:

- Contingency funding
- Cost **sensitive projects** should be evaluated **item by item**



Funding Risks

Changes in the supply of funds for the project can dramatically affect the likelihood of implementation or successful completion of a project

Mitigation Strategies:

- **Contingency** funding
- **Modularisation** of project



Opportunity Management tactics

Exploit

- Seeking to **eliminate the uncertainty** associated with an opportunity to ensure that it definitely happens.

Share

- **Allocating** some or all of the ownership of an opportunity to another party who is best able to capture the opportunity for the benefit of the project.

Enhance

- Taking **action** to increase the **probability** and/or the positive impact of an opportunity.

Accept

- Being willing to take **advantage** of an opportunity if it occurs, but **not taking action** to pursue it.

Risk Register

Contains the following information:

- All **identified** risks and **descriptions**
- **Probability** of occurrence
- **Impact**
- **Responses** (mitigations / contingencies)
- Owners
- Current Status

McGannon, B. “[Risk records and registers](#)” video in course [Leading Projects](#) accessed 16/02/2021, LinkedIn Learning [accessed through UNSW](#)



Example of a Risk Register:

Category	ID	Description	Impact	Likelihood	Overall Score	Risk	Response	Contingency	Owner
Technical - Hardware	1	Assets are vandalized and damaged by the general public	3 - Moderate	3 - Possible	9	High	<u>Mitigate</u> <ul style="list-style-type: none">- Ensure correct mechanical equipment (e.g. hose clamps, etc) are used to secure equipment from being stolen.- Ensure equipment is protected (e.g. out of reach, enclosed, security, etc) to secure equipment from damage.	Use up to an allocated \$25,000 contingency budget and 6 weeks float to perform repairs on damaged asset. Time float is only required if the damage occurs during the installation window or during a task with a dependency on the asset, meaning it can be concurrently fixed with other activities.	John Smith

PMP Bad Examples - Risk Register

Risk Class	Risk Statement	Severity			Risk value	Response	Mitigation or Avoidance	Action by	Feed			
		Impact	Time	Cost					Severity impact	time	cost	
technical	Not having enough big data set	0.80	0.40	0.30	0.24	Avoid	Use open-source data, create own database by data and AI	Technical team	0.4	0.8	0.1	0.08
	Critical bugs and system errors	0.40	0.40	0.30	0.12	Mitigate	Third party contract to make database for the project itself		0.2	0.8	0.1	0.08
	unsuitable data set for the project	0.80	0.80	0.10	0.08	Avoid	Third party contract to make database for the project itself	Management	0.2	0.8	0.1	0.08

Unclear description of the event.

The avoid strategy should make the risk never happen (possibility = 0)

If the risk event still could happen, what would be the contingency plan to solve it if it happens?

Action not reflecting the strategy, third party contract should be a transfer strategy but not avoid

PMR Examples – Risk Register

Clear risk description of the risk event, including:

- Timing
- Consequences

Proper response
proactive action with
strategy

Proper contingency as
guideline for employees to
follow after risk occurs with
detailed contingency time
and budget

Risk ID	Risk Description	Risk Category	Owner	Severity	Likelihood	Risk Assessment	Overall Rating	Response Strategy	Response Action	Contingency (Time)	Contingency (Budget)	Contingency Details
1	Delay Document delivery may lead to project to be delayed due to bad influence on communication with stakeholders for incomplete documents.	Management Risk	PM	3	3	9	Moderate	Mitigate	Having frequent progress check to ensure the delivery of documents	3	\$400	Allocate 2 days time buffer and \$400 contingency budget to review and complete the documentation, reschedule the meeting with stakeholders, proceed the project as planned with completed documents if necessary.
2	Skilled HR shortage in the labor market, may lead to development time overrun or product quality issue.	External Risk	HR Manager	4	2	8	Moderate	Accept	-	-	-	Escalate to PM, allocate 1 day time buffer to adjust the employment requirement and allow junior roles to work if needed, allocate 2 extra days time buffer to ensure desired labor after adjustment could be hired. \$600 contingency budget allocated for extra necessary adjustment and employment

PMP Good Examples – Risk Register (Cont.)

Risk ID	Description	Risk Category	Owner	Severity	Likelihood	Risk Assessment	Overall Severity	Response Strategy	Response Action	Severity (After)	Likelihood (After)	Contingency Plan
3	Delay Transportation, may cause the prototype to be delayed, may occur after hardware design.	Schedule and Management Risk	PM	5	2	10	Moderate	Avoid	Seek for domestic material provider in Sydney or surrounding areas as alternative, in case there's covid pandemic during project execution	5	0	-
4	Equipment Failure, may cause unreliable testing result, influencing the quality of product, may occur during testing procedures.	Internal Risk	Technical Team, PM	4	1	4	Low	Transfer	Transfer the responsibility of equipment maintenance and repairs to an external vendor with expertise in the field.	2	1	Escalate to PM, contact third party repairment company for equipment repairment. Allocate 5 days time buffer to ensure the repairment completion. Allocate \$2,000 budget for repairing equipment. Conduct other testing procedures during repairing period to minimize the influence to schedule.

Risk Response Control

Involves the following:

- **Execution** of the risk response **strategy**
- **Monitoring** of triggering events
- Initiating **contingency plans**
- Watching for **new risks**
- Establishment of a **Change Management System**
 - Monitoring, tracking, and reporting risk
 - Fostering an open organization environment
 - Repeating risk identification/assessment exercises
 - Assigning and documenting responsibility



Probabilistic Vs Deterministic Assessments

Probabilistic Risk Assessment (PRA)

- Is **omnipresent** in industry, business, PM, (academia!).
- Most **easily recognized** in the impact/likelihood risk matrix.
- **Readily extended** to quantitative methods (see PMBOK Ch. 11)
- Always includes the **assumption** that probability of occurrence is predictable

The problem with PRA

- For **low frequency** events, the probability is (almost) **never accurately** known
- Even if you know the probability, a low probability does not preclude the event happening to you.
- The **black swan effect** says that the most significant changes are usually caused by such low probability events.

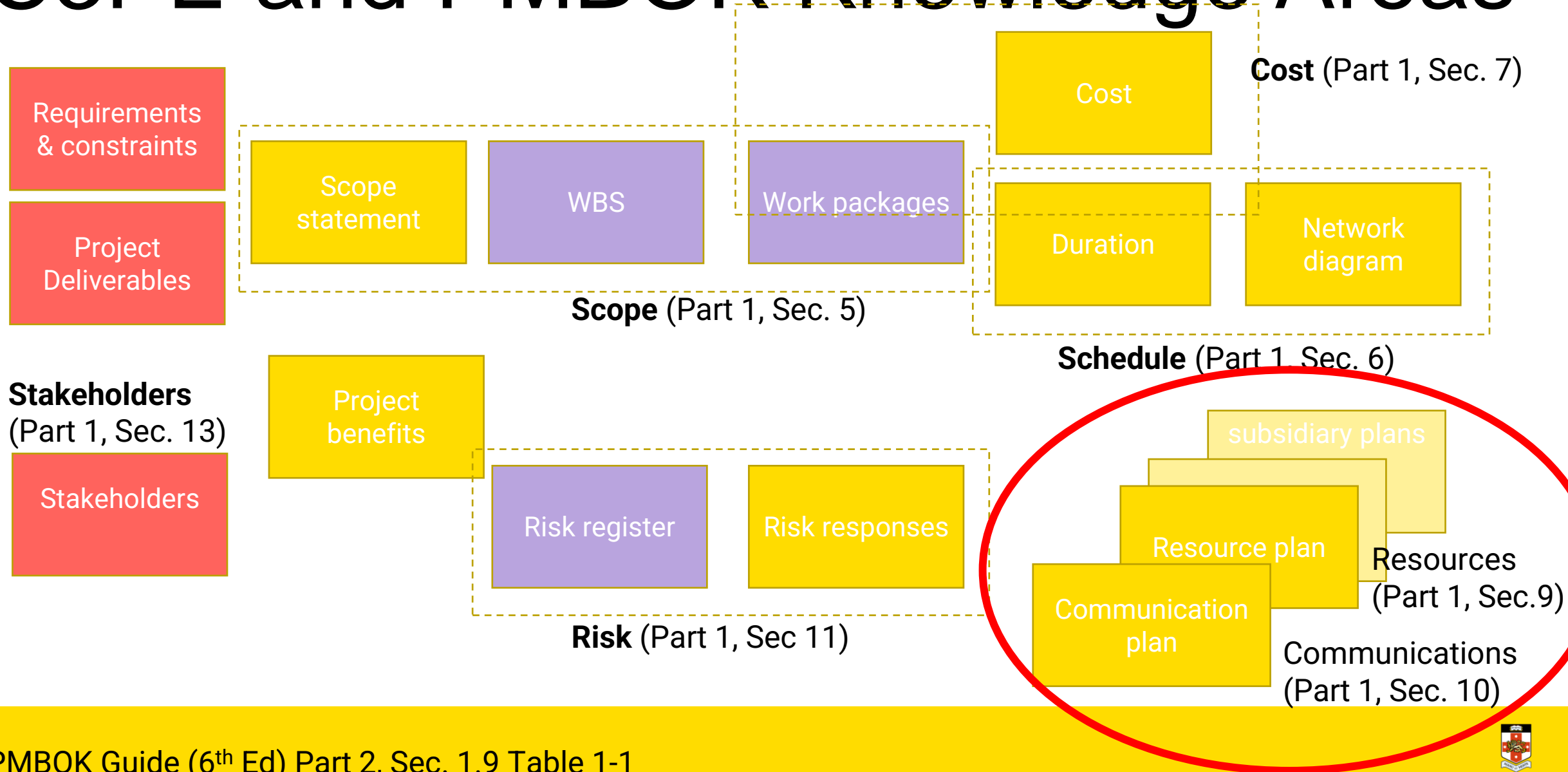
Deterministic Risk Assessment

- Any/all adverse events are **assumed** to **occur**, regardless of probability
- Objective is to **demonstrate** that adequate contingencies are in place, for any combination of these impacts.
- **Drawback:** result in expensive treatment of very unlikely and unimportant events.
- **Advantage:** by planning contingencies, you are in fact developing a range of responses that can be modified for an emerging scenario (the essence of emergency plans)

Summary of PRA Vs DRA

- **PRA** is demonstrating your **plan *can work***, while **DRA** is demonstrating **it *can't work***.
- Despite some weakness, **PRA is normal**, and widely **accepted**
- You might consider deterministic assessment for **unacceptable** events, such as crises and events that could result in injury
- **In a limited PM context, many major project risks are treated by escalation.**
- **Severe hazards** are a notable **exception**, because they cannot ever be delegated, or completely transferred.

C3PE and PMBOK Knowledge Areas



Communications Plan

GSOE9820 Engineering Project Management
Dr. Imrana Kabir

Communication plan needs to describe:

- Why are you telling them?
- What do you expect them to do?
- What information does the Stakeholder need?
- How often?
- What media (phone, email, video, chat...)
- How urgent is it? What latency is allowed?
- What is the risk if they don't know?

Developing your communications plan:

Tips from the change management discipline

- Who?
- Why and When?
- How?
- What?

Stanton, D. “[Project Communications](#)” video in course [Leading Projects](#) accessed 16/02/2021,
LinkedIn Learning [accessed through UNSW](#)

Who?

- Use stakeholder register
- Target individuals and groups with a tailored message



Example (W4 Lecture) : Why and when?

Engagement level of stakeholders – from stakeholder management

Name	Unaware	Resistant	Neutral	Supportive	Leading
Faculty Mgmt.	C →		D		
MME Mgmt.				CD	
Convener				C →	D
Demonstrators			C →	D	
Students		C →			D

C=Current position

D=Desired position

Stakeholders in '100% digital delivery and assessment in GSOE9820 T2 20'

Why (cont.)

- Attract users or customers
- Support the HR management plan
- To mitigate risks (e.g. resistance to change)
- If comms is a prerequisite to success criteria (remember - organizational strategy?)



What?

5 pressing questions for people undergoing organizational change:

1. What is changing?
2. Why are we changing?
3. How does it affect me?
4. How will I know if I'm going OK?
5. What kind of support is available to me?

Example of Project Information System Table

Key information to be delivered	Sender	Recipient	Method	Frequency	Owner
Project scope, value of project and progress updates	PM	Sponsor	Meetings or email	Once a week	PM
Requirements, constraints, and budget	Sponsor	PM	Meetings or email	As necessary	PM
Work performance reports	HR team	Dev team and PM	Meetings	Once a month	HR team
Software code, design features and implementation details	Dev team	Dev team	Meetings and repos	Once a day	Dev team
Existing software requirements, access codes and general enquiries	UNSW IT	Dev team	Meetings and emails	Once every 2 weeks	Dev team
Feedback and UI test results	UNSW students and staff	Dev team	Meetings and emails	As necessary	Dev team

Human Resources Planning

GSOE9820 Engineering Project Management
Dr Imrana Kabir

Things to include in a HR plan

- Acquiring resources – how will you find the team?
- Roles and responsibilities (use RACI chart)
- Project organization chart
- Position descriptions for project team members
- Training strategies for team members

(See PMBOK Ch. 9)

What do people cost?

- All the people in your project must be paid for their time.

Cost =

Work (time) x Base salary rate (\$/time) x [1 + oncost rate] x [1 + overheads]

UNSW salary and oncost rates:

<https://www.hr.unsw.edu.au/services/salaries/salrates.html>

Risks associated with HR

- Can't fill a position
- Recruit people with inappropriate skills/ can't do the job
- People take longer to train than you expect
- And others...

UNSW employment policy

Most roles need to be advertised. Some of the advantages are:

- Contracts can be extended in the future
- Wider selection pool, best candidate selected
- May be required if visa sponsorship is involved (labour market testing)

Professional roles require a minimum of **2 weeks advertising** and academic roles require a **minimum of 4 weeks**

Some instances where advertising may not be feasible as a first option and a nomination request can be submitted for approval as per the [UNSW nomination policy](#)

- Strictly short-term (under 12 months). If the role is required beyond 12 months, need to advertise again (no extensions).
- If the position and candidate are highly specialised (often senior appointments), there is a very limited pool of applicants and the appointment does not exceed 3 years.

Position Descriptions

Need to make it sound interesting! Have a look at some job profiles
<https://external-careers.jobs.unsw.edu.au/cw/en/listing/>

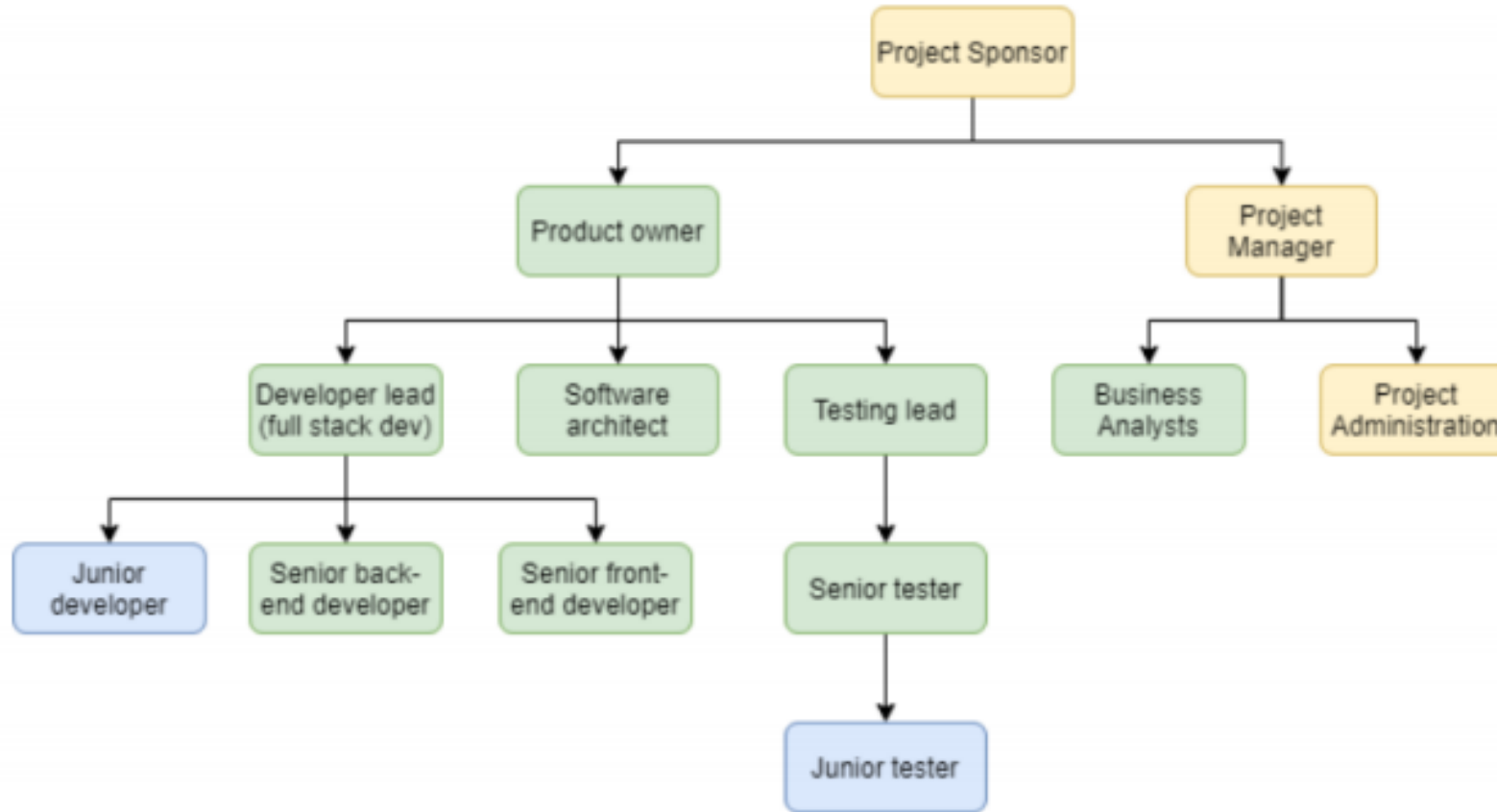
- Position title:
- Background surrounding the position:
- Responsibilities:
- Essential/Desirable attributes of the applicant:
- Appointment duration:
- Level:
- Full time/ Part time / casual:

Training strategies

- Take existing UNSW courses
- Go to conferences
- Attend industrial training, e.g. by manufacturers
- Self study (reading, online learning etc.)

Note: all require duration, work hours and resources!

Organization Chart Example:



RACI Matrix Example (partial)

RACI: 4 key roles assigned to project participants.

R:Responsible; **A:** Accountable; **C:** Consulted; **I:** Informed

RACI: a project management tool used to clarify the roles and responsibilities of individuals or teams involved in a project.

Activity	Project manager	Project admin	Product Owner	Business Analyst	Software Architect
Project Orientation and Induction	A	R	C		
Stakeholder Correspondence	A	R			
Budget and Time management	A	R			
Software Requirement Gathering and documentation	I		A	R	C
Software Requirement Sign off	A		R	I	
Acquisition of back end infrastructure (server vs cloud)	R	I	R		C
Construction of required hardware in UNSW carparks	R		R	I	C