

UNCERTAINTY, RISK RISK MANAGEMENT IN THE CONSTRUCTION INDUSTRY

RISK

RISK!

CONSTRUCTION PROJECTS HAVE LOTS OF
IT, CONTRACTORS MANAGE IT AND
PROJECT OWNERS PAY FOR IT.

RISK AND UNCERTAINTY

- RISK is associated with every human decision-making action, of which the consequences are uncertain.
- UNCERTAINTY arises as decision-making is oriented towards the future.
- Source of uncertainty is sometimes the lack of information.

RISK AND UNCERTAINTY

- RISK exists when a decision is expressed in terms of a range of possible outcomes and when known probabilities can be attached to the outcomes.
- UNCERTAINTY exists when there is more than one possible outcome of a course of action but probability of each outcome is not known.

DIFFERENT USES OF THE WORD “RISK”

- AS A SOURCE : Inflation risk
- AS A CONSEQUENCE: Cost overrun risk
- AS THE PROBABILITY OF OCCURRENCE OF A NEGATIVE EVENT: Risk of an earthquake

RISK

- SOURCE
- IMPACT/CONSEQUENCE
- PROBABILITY OF OCCURRENCE
- CONTROLLABILITY
- ACCEPTABILITY/ATTITUDE

RISK SOURCES AND EFFECTS

- SOURCES: Adverse weather conditions, inflation, labour productivity, availability of materials, political interferences, contract conditions etc.
- EFFECTS/IMPACTS: Failure to keep within the budget, within the target time frame, comply with the requirements of quality (technical performance, environment, health, safety, customer satisfaction etc.)

SOURCE

EVENT

EFFECT

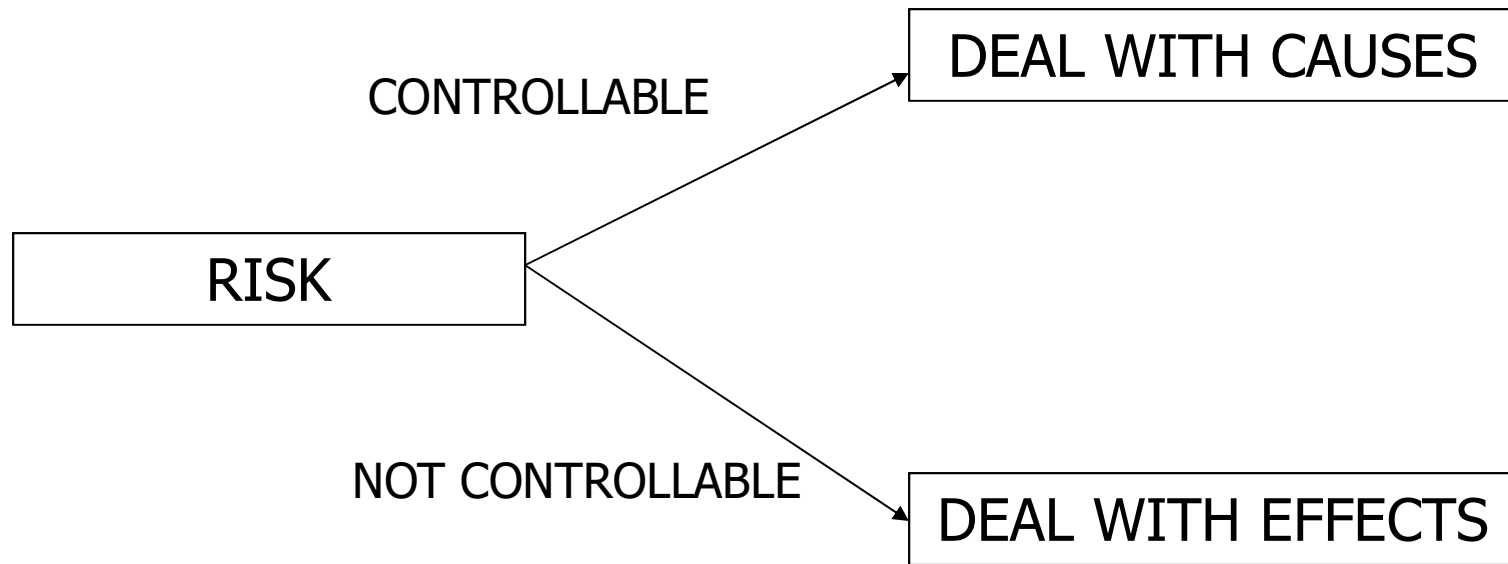
Lack of safety provisions
Defective equipment
Inexperienced workforce

Injury to workman on site

Death of workman
Project's stopped by Health
and Safety Officer
Delay
Prosecution and fine by
authorities
Loss of morale and
productivity

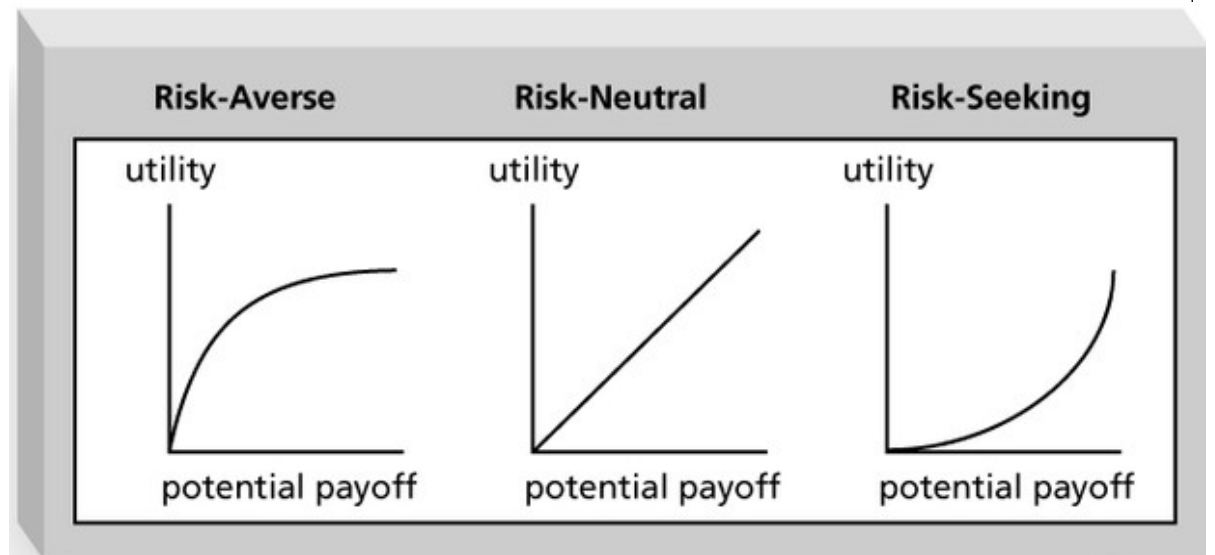
TYPES OF RISK IN TERMS OF CONTROLLABILITY

- Those factors that are within your control
- Those in the control of others with whom you will interact
- Those that are results of government actions
- Those factors that are outside control of parties involved in the project



RISK ATTITUDE

- RISK SEEKING
- RISK NEUTRAL
- RISK AVERSE



RISK

- THE TERM RISK DOES NOT NECESSARILY REFER TO THE CHANCE OF BAD CONSEQUENCES, IT CAN ALSO REFER TO THE POSSIBILITY OF OPPORTUNITIES.
- RISK IMPLIES VARIATION: IT MAY BE IN THE POSITIVE OR NEGATIVE SIDE!

QUANTIFICATION OF RISK

$\text{RISK} = f(\text{probability, impact})$

Sometimes denoted as;

$\text{Risk} = \sum \text{probability} \times \text{impact}$

PROBABILITY

- Probability is the ratio of occurrence to the total number of equally likely cases.
- However, there is a much more subjective or judgemental view!
- Probability theory deals with events of a special kind, called random (stochastic) events, whose outcomes are affected by chance.

Two schools of thought about probability theory:

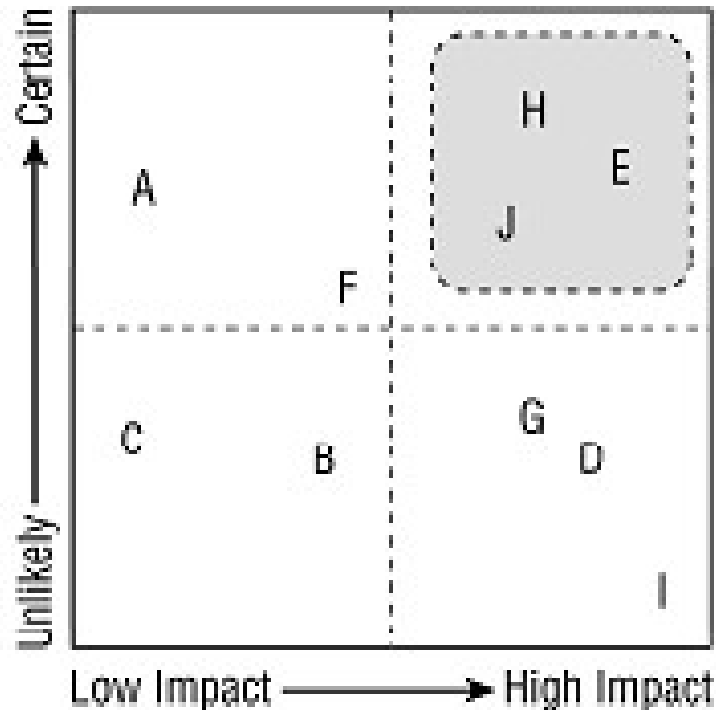
- Objective probability: Probabilities must relate to long term frequencies of occurrence. Only after repeated observations, we can speak of the relative frequency of events and associated probabilities.
- Subjective probability: Probability of an event is the degree of belief or confidence placed in its occurrence by the decision-maker on the basis of the evidence available (experience, intuition, gut feel, rules of thumb)

Simple Risk Diagram

Simple Risk Diagram

Risk Identification

- A. Weather
- B. Price escalation
- C. Slow payments
- D. Environmental issues
- E. Political fallout
- F. Scope creep
- G. Limited labor pool
- H. Slow review process
- I. Subcontractor default
- J. Excessive owner oversight

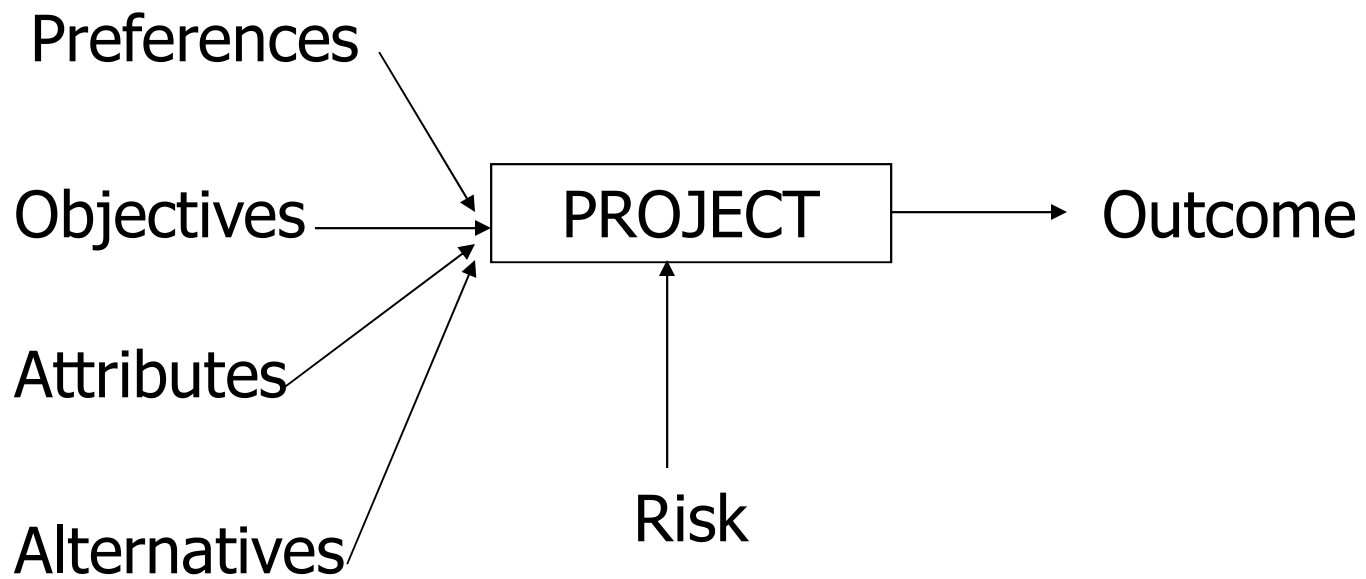


PROJECT RISK

Project risk is an activity, event or action which tends to cause a negative impact on the planned goals of project scope, quality, performance, execution time or cost.

Each decision making problem has the following steps:

- Objective setting
- Definition of criteria, decision variables and constraints
- Definition of alternatives
- Calculation of performance of each alternative
- Choosing the best alternative



- OBJECTIVES:

Objective function = $f(a,b,c, \dots)$

(an expected value of f)

- OUTCOMES:

(usually realised value of f is different than its expected value)

- RISKS

(the difference between expected and realised values of f is due to risks)

- What we need to do under risky situations is to construct a MODEL based on subjective/objective probabilities associated with risks, relationships between them and which maps past experience to future expectations.

RISK AND REWARD GO HAND IN HAND!

THE BASIC QUESTIONS TO BE ANSWERED ARE:

- Will the returns of the project justify the risks?
- What will be the loss if everything goes wrong?

RULES FOR RISK TAKING

- Do not risk a lot for a little
- Never risk more than you can afford to lose (place your waterline low- you can try everything as long as it is above the waterline).
- Devise alternative options as a contingency measure.
- Do not carry all risks in one basket.
- Consider the controllable and uncontrollable parts of the risk.
- Transfer risks to the party which can retain them with the minimum cost and is able to control them.
- Do not forget the residual and secondary risks.

MOST WIDELY USED PHILOSOPHY IN CONSTRUCTION:

AGAP (All Goes According to Plan)

REQUIRED WAY OF THINKING:

WHIF (What Happens IF)

4 WAYS TO TACKLE RISK IN THE CONSTRUCTION INDUSTRY:

- The umbrella approach: where you allow for every possible eventuality by adding a large risk premium to the price.
- The ostrich approach: where you bury your head in the sand and assume everything will be alright.
- The intuitive approach: Do not trust all the fancy analysis, trust your intuition and gut feel.
- The brute force approach: You focus on the uncontrollable risk and force things to be controlled.

RISK MANAGEMENT PHILOSOPHY:

- Risk management aims to ensure that all that can be done will be done to ensure the project objectives are achieved.
- Once a risk is identified and analysed, it ceases to be a risk and becomes a management problem.

RISK MANAGEMENT (RM)

RM is a formal process for *systematically identifying, analysing* and *responding* to risk events throughout the life of a project to obtain the optimum or acceptable degree of risk elimination or control.

RISK MANAGEMENT :

Risk Management should be

- Carried out by all of the parties (client, contractor, financial agency, consultancy etc.) and,
- At each stage construction (pre-feasibility, feasibility, design, contract/procurement, construction, operation).

WHY CONSTRUCTION INDUSTRY IS SUBJECT TO MORE RISK THAN MANY OTHERS?

- Physical nature of the product: large size, technical complexity, high capital requirement, wide geographical range, made specifically according to the requirements of each customer, most parts are manufactured elsewhere, one-off type of projects etc.
- Parties: high number of parties involved, contractual complexity, subcontracting, partnering, client is usually the government etc.
- Structure of the industry: many contractors of various sizes, fragmented industry, competitive bidding, selection criteria based on cost factors etc.
- Determinants of demand: derived demand
- Price factors: priced before construction, cost-time tradeoff, progress payments system etc.
- Vulnerability to environmental factors: weather conditions, legal, political, economical factors etc.

Remote environment (macro environment)

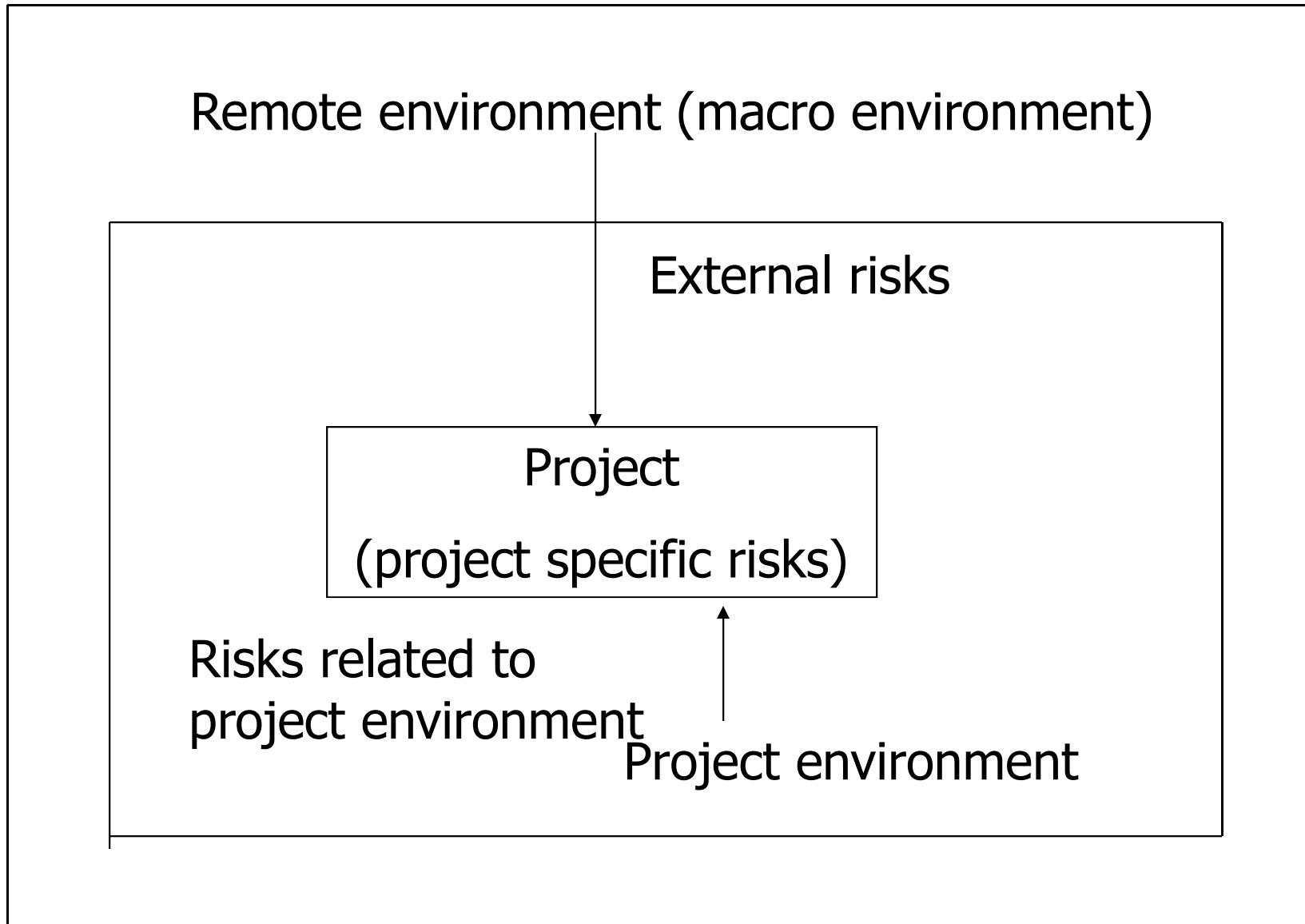
External risks

Project

(project specific risks)

Risks related to
project environment

Project environment



- **Project specific**: design changes, technical problems etc.
- **Remote environment**: Unforeseen weather conditions, inflation etc.
- **Project environment**: Poor information flow between the parties, inexperience of subcontractor etc.

Definitions, assumptions and decisions are also sources of risk!

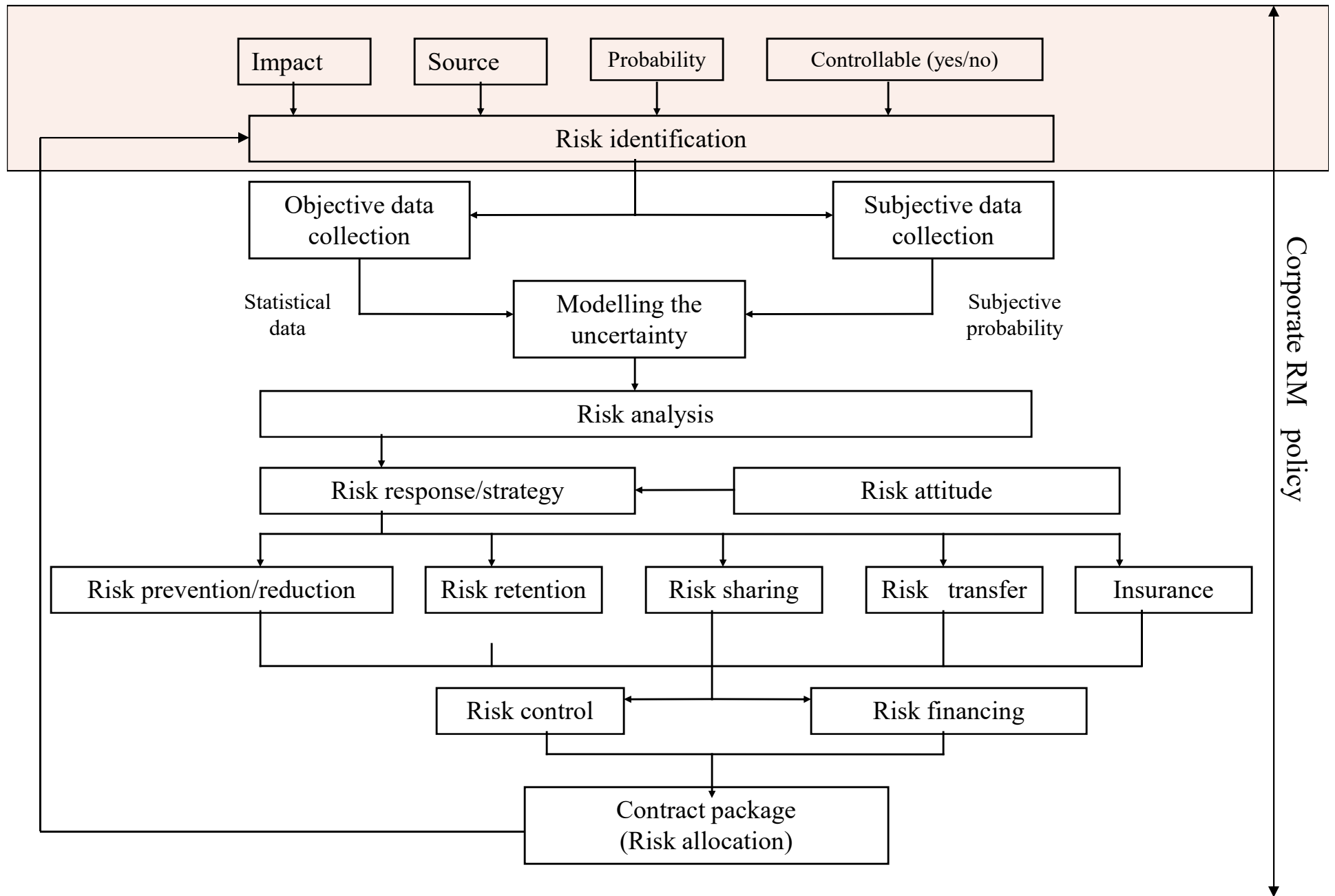
In addition to these risk factors, decisions given at each stage of project realisation create new risks for the forthcoming parts of the project.

PROJECT RISK MANAGEMENT METHODOLOGIES

- **PRAM** - Project Risk Analysis and Management – *Association for Project Management*, UK, 1997
- **RAMP** – Risk Analysis and Management for for Projects – *Institution of Civil Engineers (ICE)*, UK, 1998
- **PMBok** – Project Management Body of Knowledge – *Project Management Institute (PMI)*, USA, 2000

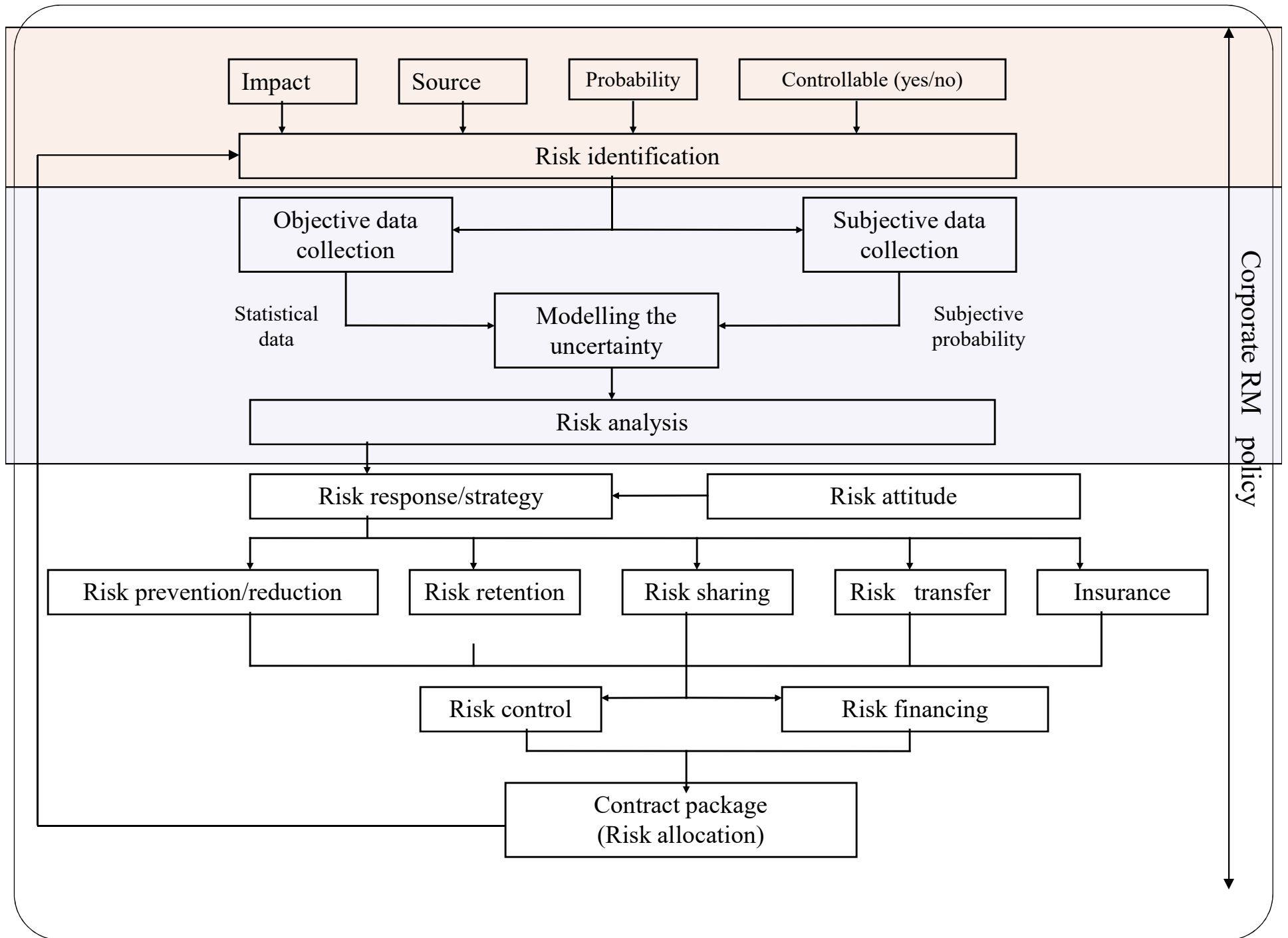
PROJECT MANAGEMENT KNOWLEDGE AREAS

- **PROJECT RISK MANAGEMENT**
- PROJECT INTEGRATION MANAGEMENT
- PROJECT SCOPE MANAGEMENT
- PROJECT TIME MANAGEMENT
- PROJECT COST MANAGEMENT
- PROJECT QUALITY MANAGEMENT
- PROJECT HUMAN RESOURCE MANAGEMENT
- PROJECT COMMUNICATIONS MANAGEMENT
- PROJECT PROCUREMENT MANAGEMENT



Risk identification

PLC		PHASE NO	TYPE OF RISK
Pre-project phase	Identifying business opportunity	1	misunderstand the client
			Miscalculation [1]
	Choosing delivery system		Miscalculation [2]
	Choosing contract type		choosing not the right consultants [1]
			choosing not the right consultants [2]
Planning and design phase	Establishing project objectives and draw up of project brief	2	lack of cooperation between actors in the project
			Shortage in resources
	Actual design		cheap, not efficient solutions which can be more expensive over time
			problems with design
			users do not take decisions necessary for work progress
	Preparing contract documents		not achieve a good final result
			gap of knowledge
Contractor selection phase	Setting tender conditions by the owner	3	Not finding the right contractors [1]
	Contractors decisions whether to bid or not		Not finding the right contractors [2]
	Submitting offers		
Contract mobilisation phase	Preparation for construction phase		Not finding the right contractors [3]
Project operation phase	Monitor and control	4	contractor has not enough knowledge or experience
			moisture
	Resource management		losing control over the project
	Documentation and management		Delays in construction schedule
			Delays in construction schedule
Project closeout and termination phase	Final inspections	5	
	Project summary		



Risk assessment – Probability Impact Matrix

Clasificare probabilitate	Score	Impact classification	Score
Low	1	Major	3
Medium	2	Medium	2
High	3	Easy	1

Likelihood level	Score
Very low	0-20
Low	21-40
Medium	41-60
High	61-80
Very high	81-100

IDENTIFIED RISK	PROJECT OBJECTIVE	Very low (0.05)	Low (0.10)	Moderate (0.20)	High (0.40)	Very high (0.80)
RISK A	COST	Insignificant cost increase	<10% cost increase	10-20% cost increase	20-40% cost increase	>40% cost increase
	TIME	Insignificant time increase	<5% time increase	5-10% time increase	10-20% time increase	>20% time increase
	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

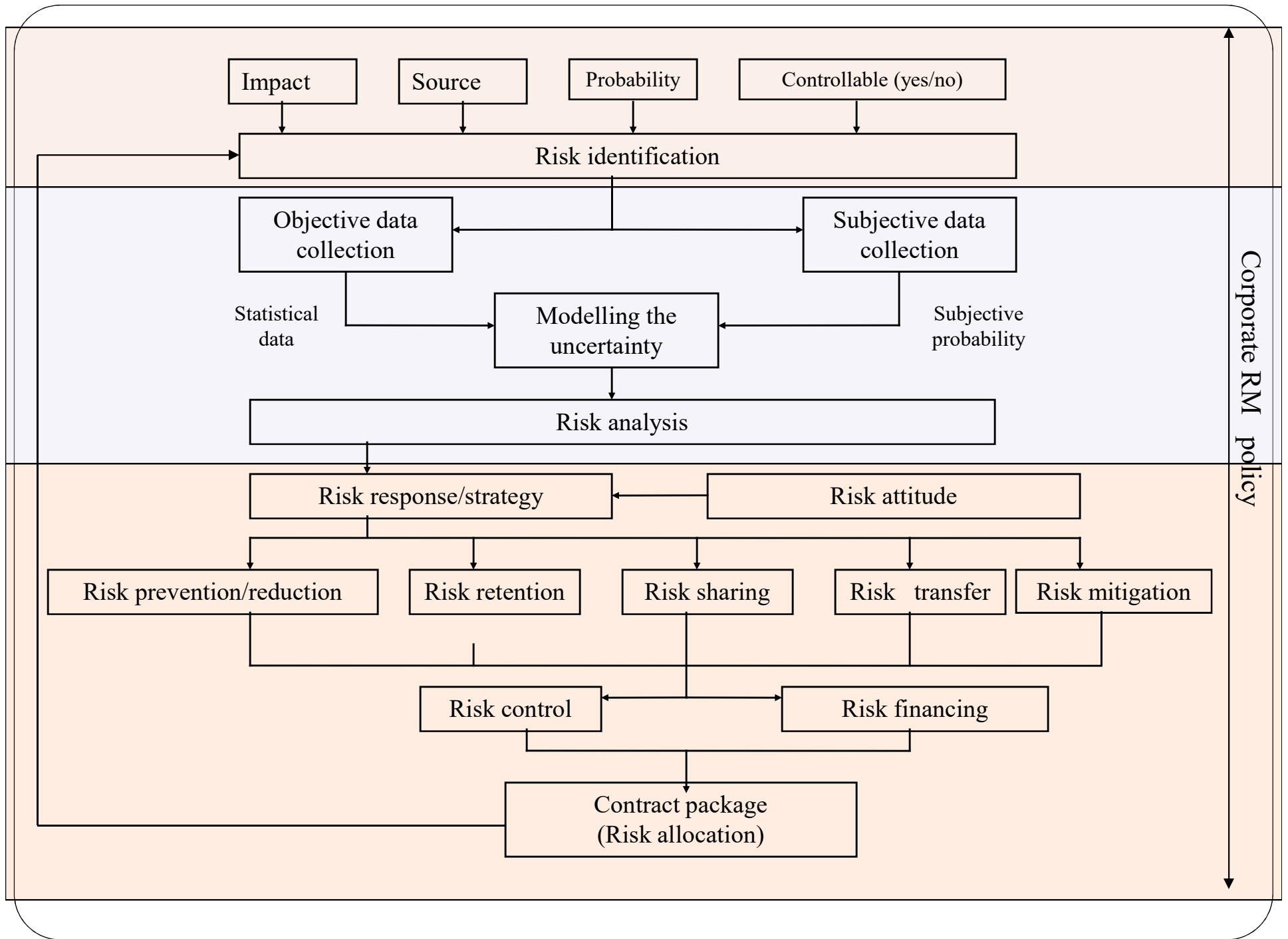
Probability Impact Matrix

	Risk Summary Chart			
Risk no.	Description	Probability rating	Impact rating	Risk owner

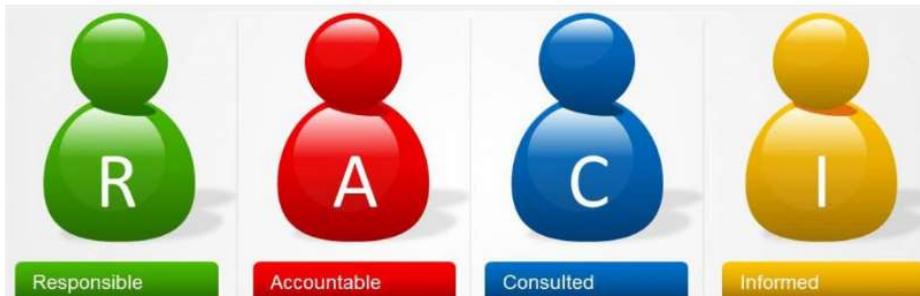
IDENTIFIED RISK	PROJECT OBJECTIVE	PROBABILITY	IMPACT	MATRIX
Misunderstand the client	COST	0,3	0,10	0,030
	TIME		0,10	0,030
	QUALITY		0,20	0,060
Lack of cooperation between actors in the project	COST	0,7	0,20	0,140
	TIME		0,20	0,140
	QUALITY		0,05	0,035
Not finding the right contractor [1]	COST	0,3	0,10	0,030
	TIME		0,40	0,120
	QUALITY		0,05	0,015
Contractor has not enough knowledge or experience	COST	0,1	0,10	0,010
	TIME		0,40	0,040
	QUALITY		0,05	0,005
Miscalculation [1]	COST	0,3	0,40	0,120
	TIME		0,20	0,060
	QUALITY		0,05	0,015
Shortage in resources	COST	0,5	0,20	0,100
	TIME		0,20	0,100
	QUALITY		0,05	0,025
Delays in construction schedule [1]	COST	0,5	0,80	0,400
	TIME		0,80	0,400
	QUALITY		0,40	0,200
Cheap, not efficient solutions which can be more expensive over time	COST	0,9	0,80	0,720
	TIME		0,80	0,720
	QUALITY		0,40	0,360
Delays in construction schedule [2]	COST	0,5	0,05	0,025
	TIME		0,40	0,200
	QUALITY		0,20	0,100
Gap of knowledge	COST	0,5	0,10	0,050
	TIME		0,10	0,050
	QUALITY		0,05	0,025
Miscalculation [2]	COST	0,5	0,20	0,100
	TIME		0,80	0,400
	QUALITY		0,10	0,050
Problems with design	COST	0,3	0,10	0,030
	TIME		0,10	0,030
	QUALITY		0,05	0,025
Choosing not the right consultants [1]	COST	0,5	0,40	0,200
	TIME		0,40	0,200
	QUALITY		0,80	0,400
Users do not take decisions necessary for work progress	COST	0,5	0,20	0,100
	TIME		0,80	0,400
	QUALITY		0,80	0,400
Not finding the right contractor [2]	COST	0,7	0,40	0,280
	TIME		0,80	0,560
	QUALITY		0,80	0,560
Moisture	COST	0,5	0,80	0,400
	TIME		0,40	0,200
	QUALITY		0,80	0,400
Choosing not the right consultants [2]	COST	0,3	0,20	0,060
	TIME		0,10	0,030
	QUALITY		0,20	0,060
Not achieve a good final result	COST	0,3	0,20	0,060
	TIME		0,10	0,030
	QUALITY		0,20	0,060
Not finding the right contractor [3]	COST	0,1	0,20	0,020
	TIME		0,10	0,010
	QUALITY		0,10	0,010
Losing control over the project	COST	0,1	0,05	0,005
	TIME		0,05	0,005
	QUALITY		0,10	0,010

Probability vs. Impact Matrix

Probability	Very High	Very Low / Very High	Low / Very High	Medium / Very High	High / Very High	Very High
	High	Very Low / High	Low / High	Medium / High	High	Very High / High
	Medium	Very Low / Medium	Low / Medium	Medium	High / Medium	Very High / Medium
	Low	Very Low / Low	Low	Medium / Low	High / Low	Very High / Low
	Very Low	Very Low	Low / Very Low	Medium / Very Low	High / Very Low	Very High / Very Low
		Very Low	Low	Medium	High	Very High
		Impact				



Responsibility Assignment Matrix



R	<ul style="list-style-type: none">• Responsible• Who is/will be doing this task?• Who is assigned to work on this task?
A	<ul style="list-style-type: none">• Accountable• Who's head will roll if this goes wrong?• Who has the authority to take decision?
C	<ul style="list-style-type: none">• Consulted• Anyone who can tell me more about this task?• Any stakeholders already identified?
I	<ul style="list-style-type: none">• Informed• Anyone whose work depends on this task?• Who has to be kept updated about the progress?

Responsible – Who is completing the task.

Accountable – Who is making decisions and taking actions on the task(s).

Consulted – Who will be communicated with regarding decisions and tasks.

Informed—Who will be updated on decisions and actions during the project.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
RACI Matrix Template																				
Project Deliverable (or Activity)	Project Leadership					Project Team Members					Project Sub-Teams					External Resources				
	Executive Sponsor	Project Sponsor	Steering Committee	Advisory Committee	Role #5	Project Manager	Tech Lead	Functional Lead	SME	Project Team Member	Developer	Administrative Support	Business Analyst	Role #4	Role #5	Consultant	PMO	Role #3	Role #4	Role #5
Initiate Phase Activities																				
- Submit Project Request	A/C	R/A				R/A	A/C	A/C	C											
- Request Review by PMO						R											A			
- Research Solution	I	C				R/A	A/C	A/C	C				C			C	A/C			
- Develop Business Case	I	A/C	I	I		R/A	C	C	C				C			C	C			
Plan Phase Activities																				
- Create Project Charter	C	C				R/A	C	C	C				C			C				
- Create Schedule	I	I	I	I		R/A	C	C	C	C	C	C	C			C	I			
- Create Additional Plans as required	I	I	I	I		R/A				I	I	I	I			C	I			
Execute Phase Activities																				
- Build Deliverables	C/I	C/I	C/I	C/I			R/A	R/A	R/A	R/A	R/A					A/C				
- Create Status Report	I	I	I	I		R/A	R/A	R/A	R/A							C	I			
Control Phase Activities																				
- Perform Change Management		C	C	C		R	A	A	A	A						C	I			
Close Phase Activities																				
- Create Lessons Learned	C	C	C	C		R/A	C	C	C	C	C	C	C			C	C			
- Create Project Closure Report	I	I	I	I		R/A	I	I	I	I	I	I	I				I			

Risk mitigating strategies

- Risk retention
- Risk avoidance
- Risk mitigation
- Risk transfer
- Risk allocation

RISK MANAGEMENT TIMELINE

