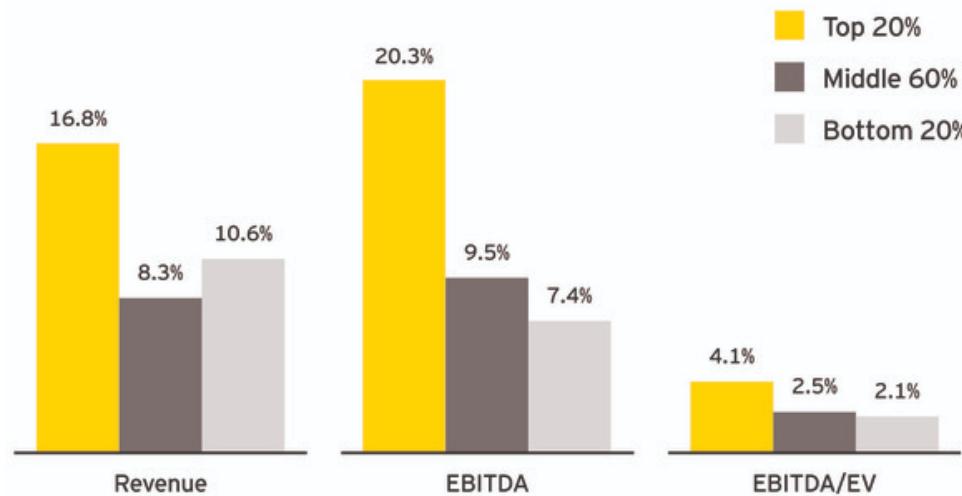


Risk Management



Organizations with greater risk management maturity outperform their peers financially

Compound annual growth rates 2004-11* by risk maturity level



* 2011 YTD reported as of 18 November 2011.

Top performers best practices:

Risk strategy setting

- Generate two-way open communications about risk with external stakeholders
- Adopt and implement a common risk framework across the organization

Embed risk management

- Use a formal method to define acceptable risk thresholds
- Stress-test to validate risk tolerances

Optimize risk function

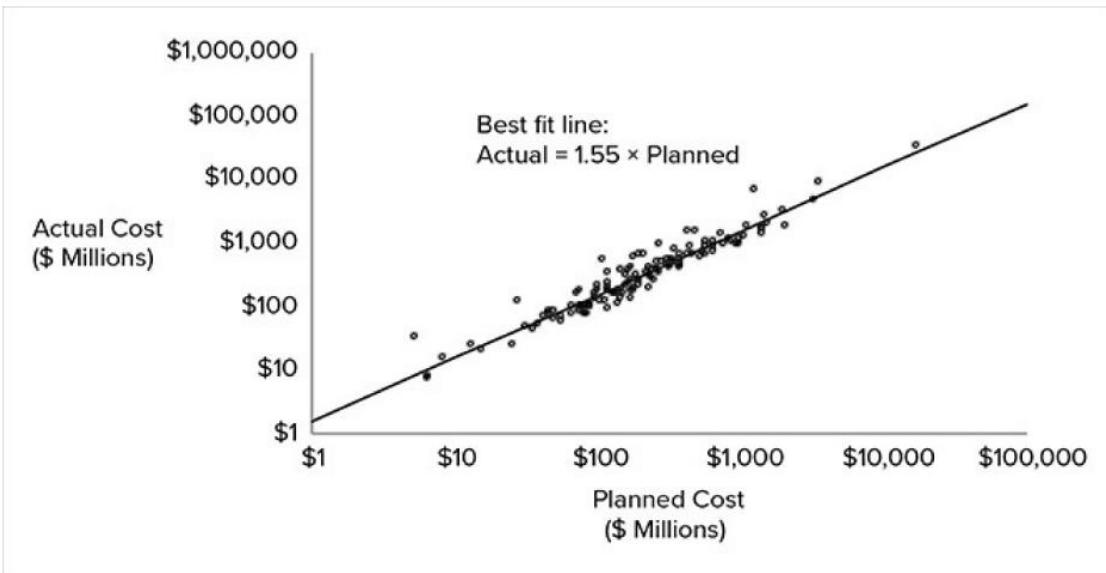
- Integrate technology to enable the organization to eliminate or prevent redundancy and lack of coverage

Improve controls & processes

- Establish key risk indicators (KRIs) within the lines of business that predict and model risk assessment

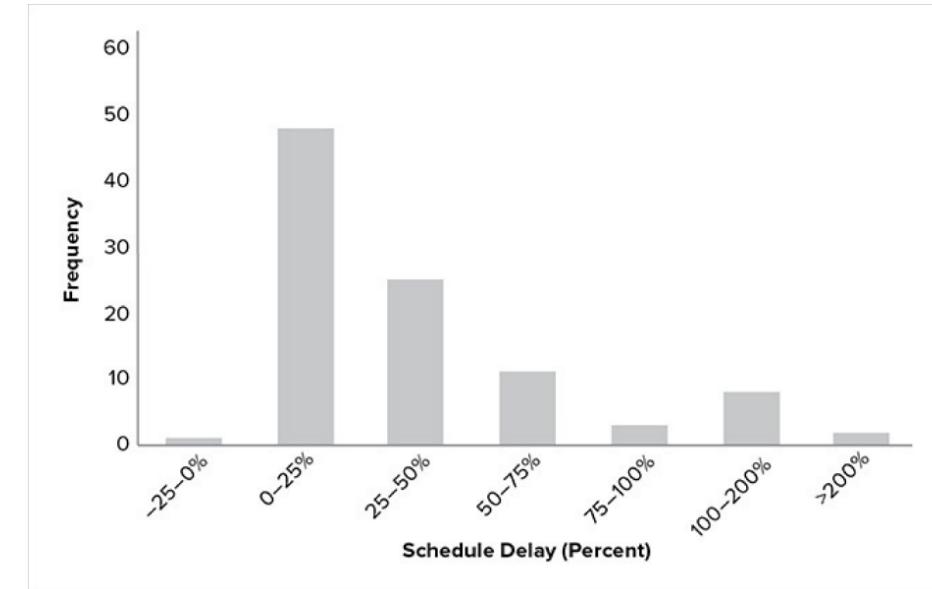
Cost increased & schedule stretched are commonplace

It always **costs** more than you think !



NASA study, 133 development programs

It always **takes longer** than you think !



NASA study, 98 NASA missions

Cost and schedule growth across several industries

	Olympics	Software/ IT	Dams	NASA/ DoD	Rail	Bridges/ Tunnels	Roads
Average Cost Growth	156%	43–56%	24–96%	52%	45%	34%	20%
Frequency of Occurrence	10/10	8/10	8/10	8/10	9/10	9/10	9/10
Frequency of Doubling	1 in 2	1 in 4	1 in 5	1 in 6	1 in 12	1 in 12	1 in 50
Average Schedule Delay	0%	63–84%	27–44%	27–52%	45%	23%	38%
Frequency of Schedule Delay	0/10	9/10	7/10	9/10	8/10	7/10	7/10

Which movie would you pay to watch ?*

Plot A



Ship running into iceberg
Captain rescues all the passengers

Plot B

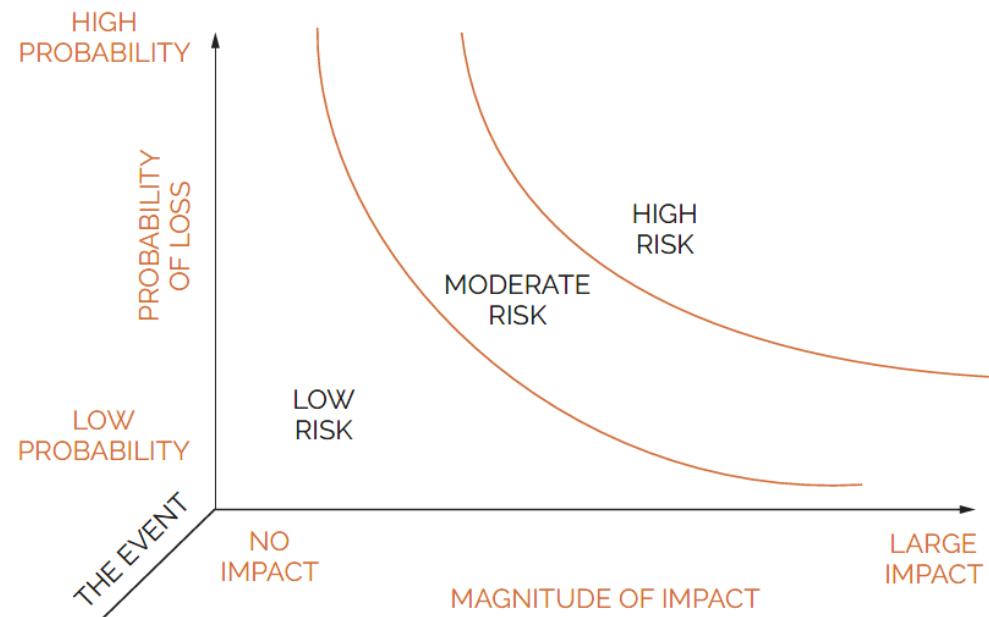


Captain steers the ship around the iceberg,
keeping a sensible distance

Definition of risk*

Risk: an uncertain event or condition that, if it occurs, has a positive or negative effect on one or more project objectives

- Threats
- Opportunities

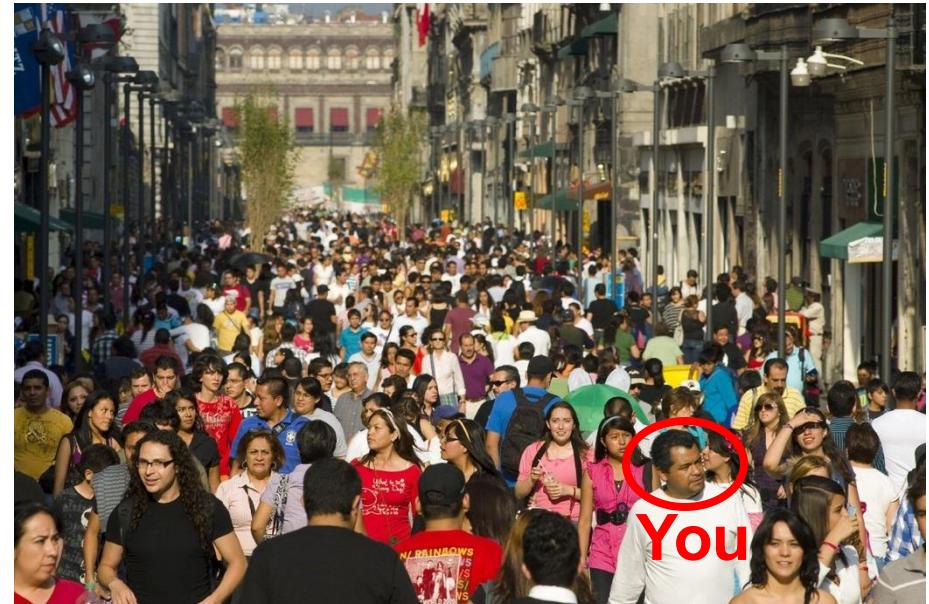


Individual with a handgun...*

Situation 1



Situation 2

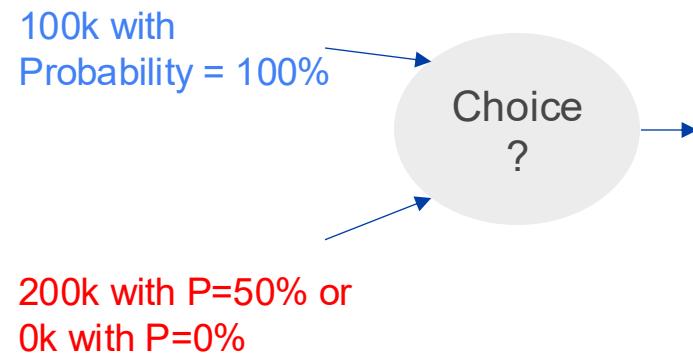


How do you assess the risk ?

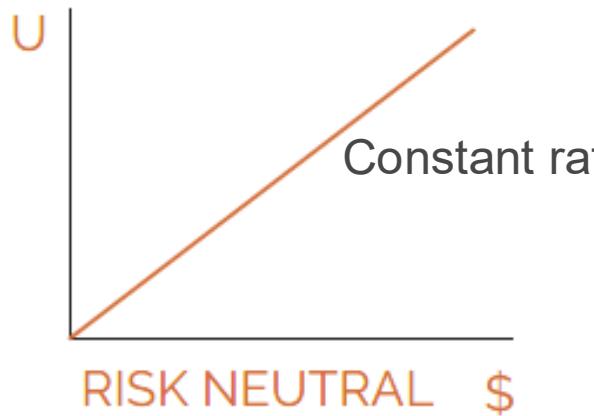
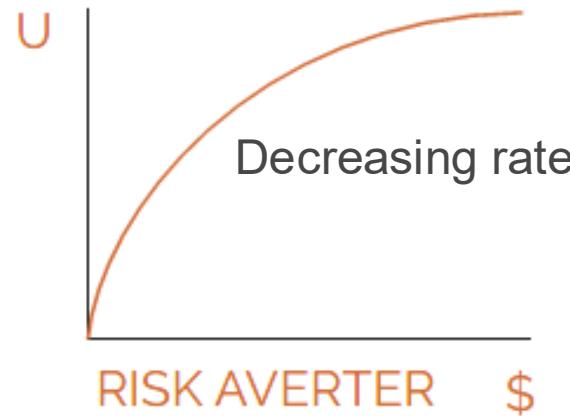
O2 = overlooked opportunities*

- Opportunities are often overlooked because of:
 - Pessimism & predisposition to find errors
 - External locus of control
 - Strength of negative rewards
 - Absence of positive rewards
 - ...

Make your choice ...*

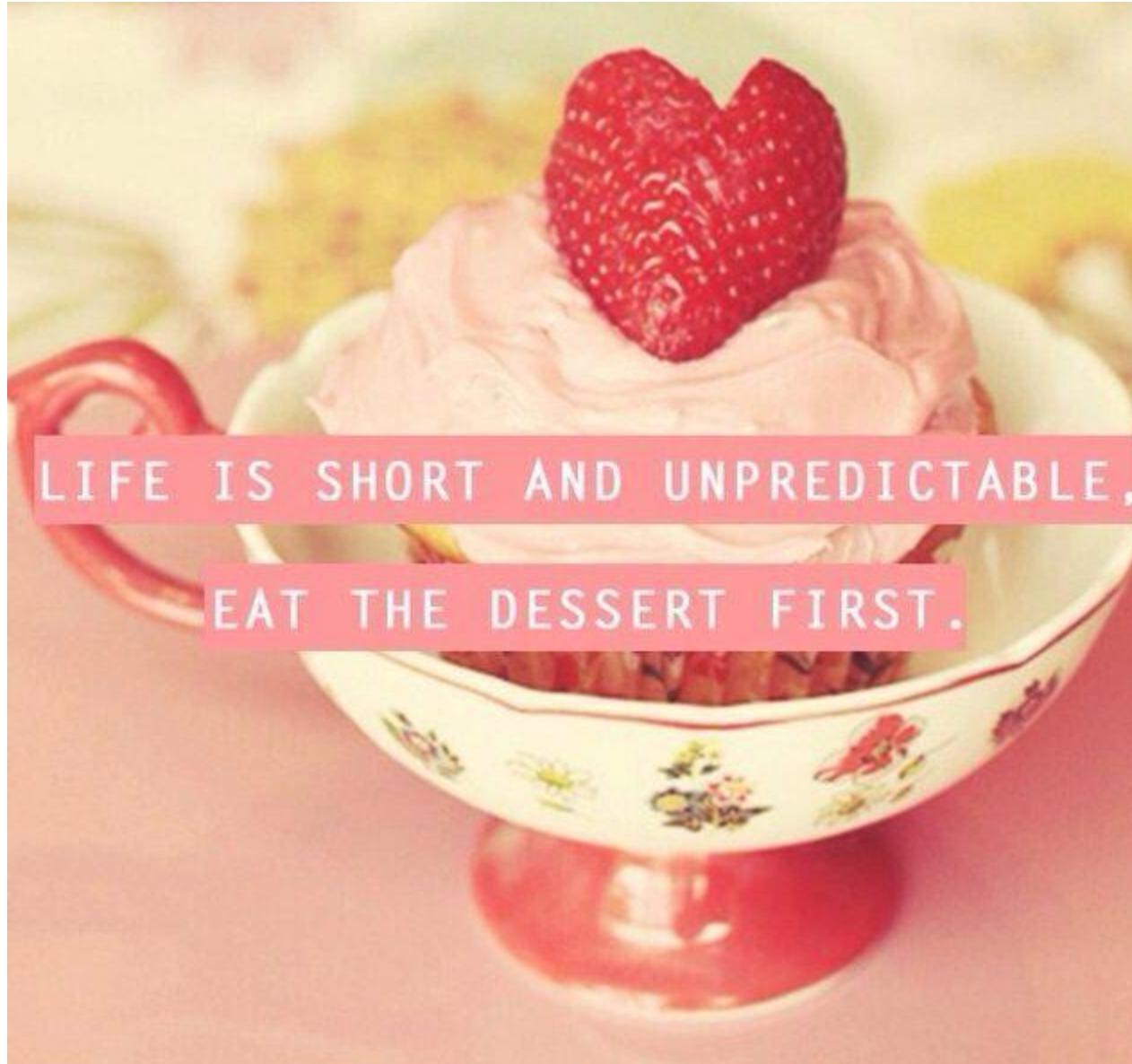


Risk tolerance*

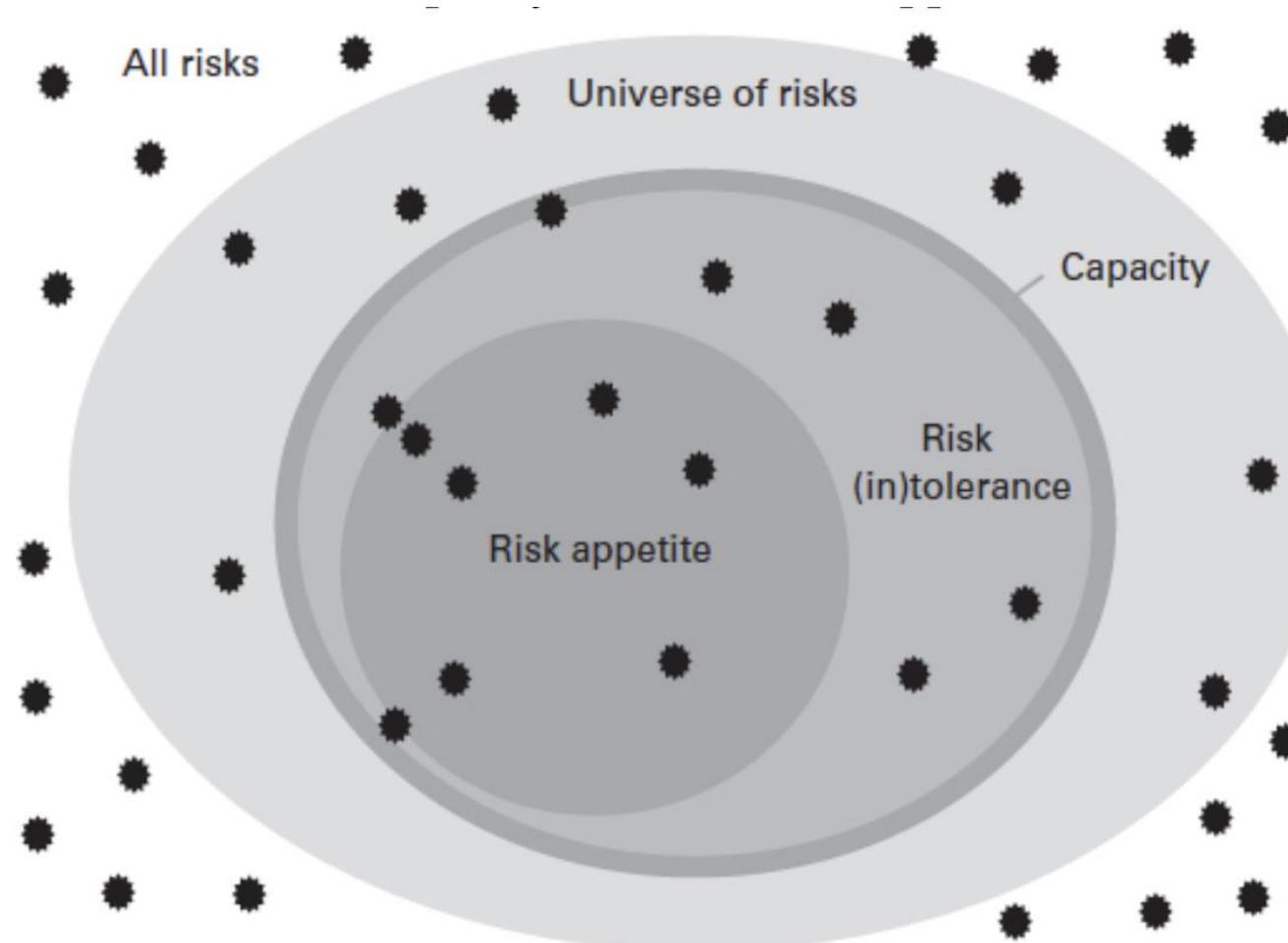


- U = Utility
- \$ = amount of money at stake

Risk tolerance .. a risk-adverse approach



Risk universe



Definitions

Risk universe: the full range of risks which could impact, either positively or negatively, on the ability of the organization to achieve its long-term objectives

Risk capacity: an organization will not have the capacity or capability to take all the risks in its risk universe (e.g. capital, resources, constraints from external stakeholders)

Risk in(tolerance): the boundaries of risk taking outside of which the organization is not prepared to venture in pursuit of its long-term objectives

Risk appetite: ‘the amount of risk an organization is willing to seek or accept in the pursuit of its objectives’

Roulette wheel: What is the risk to bet on black ?*



Stock: if I am long on IBM stock, what is the risk for me ?*



Key take aways

- Successes achieved through prevention are **invisible** ... avoidance isn't sexy !
- It is our ability to prevent, avoid, or mitigate a threat that determines to what extent it constitutes a risk
- Risk is in the **eye of the beholder** .. risks only exist in relation to defined objectives
- The amount of risk an organization is willing to seek or accept depends on the **risk appetite**
- Effective risk management must **keep the underlying uncertainties visible** to the relevant stakeholders so they may behold the risks in the own eyes
- **Opportunities are often overlooked** !

Question

Which of the following best defines "risk" in a project management context?

- A) A guaranteed event that negatively impacts a project.
- B) An uncertain event or condition that, if it occurs, has a positive or negative effect on project objectives.
- C) A task that must be completed to ensure project success.
- D) A mistake that has already caused problems in the project

Question

During a project kickoff meeting, a client states they are comfortable with minor cost overruns but not with any delays in the delivery schedule. This is an example of:

- A) Risk avoidance
- B) Risk tolerance
- C) Risk mitigation
- D) Risk transfer

Question

Which of the following best describes a risk-averse approach to risk tolerance in project management?

- A) Actively seeking out high-risk opportunities for greater rewards.
- B) Willingly accepting significant risks to maximize innovation.
- C) Preferring to avoid or minimize exposure to risks, even if it limits potential gains.
- D) Ignoring risks unless they directly impact project costs.

Question

In a software project, the development team sees adopting a new programming language as an exciting opportunity. The project sponsor, however, views it as a major risk. What does this situation illustrate?

- A) A lack of technical expertise among stakeholders
- B) That risk perception varies depending on stakeholder perspective
- C) That the new programming language must be abandoned
- D) That only the sponsor's opinion on risk matters

Question

During a large IT system rollout, the project team marks a key technical risk as "closed" after initial tests succeed. Months later, unforeseen technical failures occur because the underlying uncertainties were never fully resolved. What important risk management principle was neglected?

- A) Risks should be hidden once initial tests are positive.
- B) Uncertainties must remain visible and monitored until fully addressed.
- C) Once risks are logged, no further action is needed.
- D) Risk owners should transfer responsibility after initial testing.

Question

What major risk management mistake did Kodak make that contributed to its decline?

- A) It aggressively pursued digital photography, but the technology was too early for the market.
- B) It focused only on protecting its film business from threats and failed to recognize digital photography as an opportunity.
- C) It invested heavily in smartphone technology instead of improving its film products.
- D) It abandoned its core business too quickly without understanding the risks of digital transformation.

Kodak

- **What happened:** Kodak was extremely focused on the **threat** of losing market share in its traditional **film** business. They recognized the potential decline of film-based photography but primarily treated **digital photography** as a threat to their core business model rather than as an **opportunity** for innovation and growth.
- **Missed opportunity:** Kodak actually **invented** the first digital camera in 1975 but chose not to aggressively pursue it, fearing it would cannibalize their highly profitable film sales.
- **Result:** By focusing on protecting their existing business (threat management) and **failing to capitalize on the opportunity** that digital photography represented, Kodak eventually fell behind competitors like Canon, Sony, and later even smartphone manufacturers. They filed for bankruptcy in 2012.



Risk Management Approach – PMI framework



1. Plan risk management

Describe how Risk Management activities will be structured and performed

Risk Management Approach – PMI framework



Plan risk management – key elements

- Risk strategy – approach to managing risk on the project
- Methodology (approaches, tools, data sources)
- Roles and responsibilities
- Funding
- Timing (when and how often the Project Risk Management process will be performed)
- Risk categories (e.g. RBS)
- Shareholder risk appetite
- Definition of risk probability & impacts
- Reporting formats

Risk Breakdown Structure (RBS)

- Hierarchical representation of potential sources of risk
- Helps the project team consider the full range of sources from which individual project risks may arise

RBS LEVEL 0	RBS LEVEL 1	RBS LEVEL 2	PROJECT RISK	COMMERCIAL RISK	EXTERNAL RISK
0. ALL SOURCES OF PROJECT RISK	1. TECHNICAL RISK	1.1 Scope definition 1.2 Requirements definition 1.3 Estimates, assumptions, and constraints 1.4 Technical processes 1.5 Technology 1.6 Technical interfaces Etc.	PROJECT RISK	3.1 Contractual terms and conditions 3.2 Internal procurement 3.3 Suppliers and vendors 3.4 Subcontracts 3.5 Client/customer stability 3.6 Partnerships and joint ventures Etc.	4.1 Legislation 4.2 Exchange rates 4.3 Site/facilities 4.4 Environmental/weather 4.5 Competition 4.6 Regulatory Etc.
	2. MANAGEMENT RISK	2.1 Project management 2.2 Program/portfolio management 2.3 Operations management 2.4 Organization 2.5 Resourcing 2.6 Communication Etc.			

Question

A construction company is managing the risks of building a new skyscraper. They categorize risks into groups like "technical risks" (e.g., material failure), "external risks" (e.g., regulatory changes), and "project management risks" (e.g., scheduling delays). Which risk management tool are they using?

- A) Risk Probability Matrix
- B) Risk Breakdown Structure (RBS)
- C) Risk Register
- D) Risk Impact Assessment

Exercise

You are managing a project to develop a **new mobile app** for a healthcare company. The app must comply with strict regulatory standards (like HIPAA), integrate with several hospital IT systems, and be ready for launch within 8 months.

Your job is to **identify risks** using a **Risk Breakdown Structure**, grouping risks into logical categories.

1. Build a **Risk Breakdown Structure** for the project.
2. Group risks into at least **4 major categories**
3. List **2–3 specific risks** under each major category.
4. Highlight which risks you believe are **most critical**.

Level 1: Risk Category	Level 2: Specific Risks
Technical Risks	<ul style="list-style-type: none"> - App may have security vulnerabilities (data breaches, hacking). - Integration with hospital IT systems may fail or cause data errors. - App performance issues under heavy user load.
External Risks	<ul style="list-style-type: none"> - Regulatory changes (HIPAA or healthcare laws) could delay or block the launch. - Negative media coverage about data privacy could hurt adoption. - Supplier/vendor delays (for APIs or third-party services).
Organizational Risks	<ul style="list-style-type: none"> - Lack of skilled mobile developers or turnover in key technical staff. - Internal political conflicts between IT and compliance departments. - Resource reallocation if company priorities shift mid-project.
Project Management Risks	<ul style="list-style-type: none"> - Poor communication between development, legal, and marketing teams. - Delays in meeting key project milestones (requirements, testing, deployment). - Underestimation of the project budget leading to funding shortages late in the project.

Critical risks

Risk	Reason
App security vulnerabilities	Direct legal and financial consequences (HIPAA).
Integration failures with hospital systems	Core functionality risk — app becomes unusable.
Regulatory changes	Could block the entire app from entering the market.
Developer turnover	Delays and knowledge gaps would cripple progress.

2. Identify risks

Process of identifying individual project risks as well as sources of overall project risks and documenting their characteristics

Benefit: documentation of existing individual project risks & the sources of overall project risk

Risk Management Approach – PMI framework



<< The surgeons I like best diagnose carefully – before they start cutting>>



Risk identification techniques

Brainstorming

Cause and
effect
diagram

Pre-mortem

Affinity
diagrams

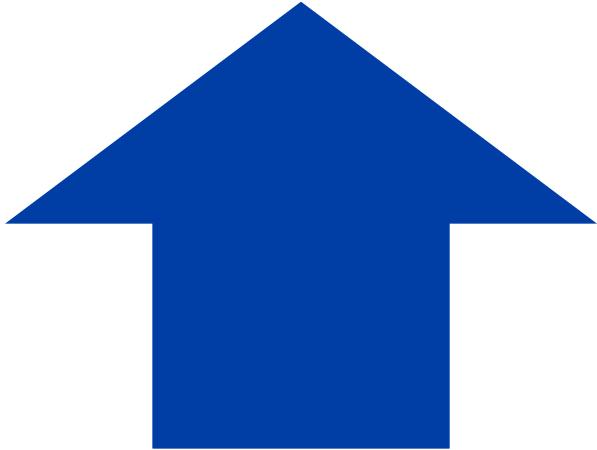
Delphi
technique

Expert
Interviews

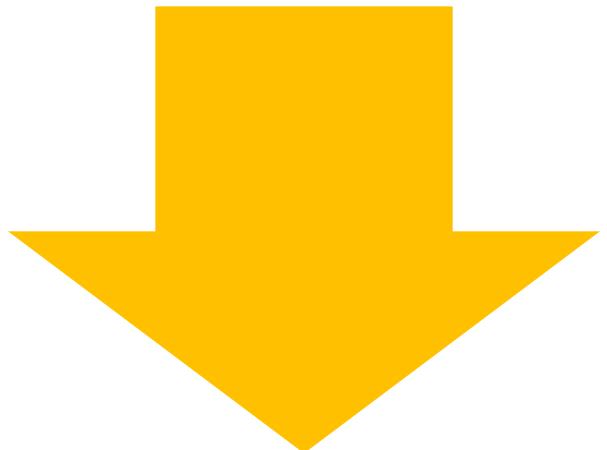
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AI

Brainstorming



- It is familiar
- Most people already understand many of the rules for brainstorming sessions
- It can generate many risks quickly
- One idea will bounce off another



- It can be boring
- Not everyone will contribute (quieter attendees or overshadowed by other attendees)
- There will be unequal contribution
- The output is “groupthink” – not necessarily individuals’ thoughts

Pre-mortem

- The assembled group is asked to imagine that the project is completed or has been terminated.
- The project has failed to meet one or more of its objectives.
- The group is asked to describe why the project has failed.
- Then to find the opportunities the group is asked to imagine the project is a success



Affinity diagrams

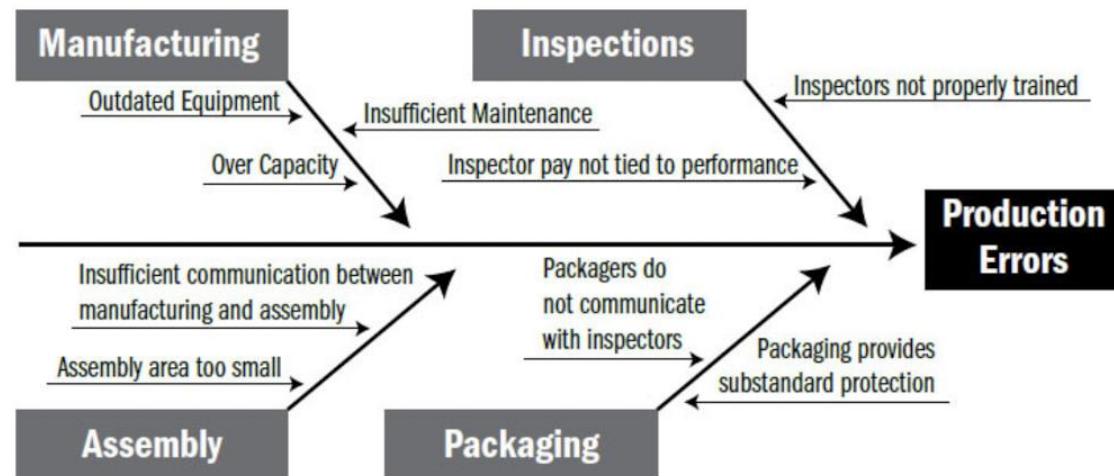
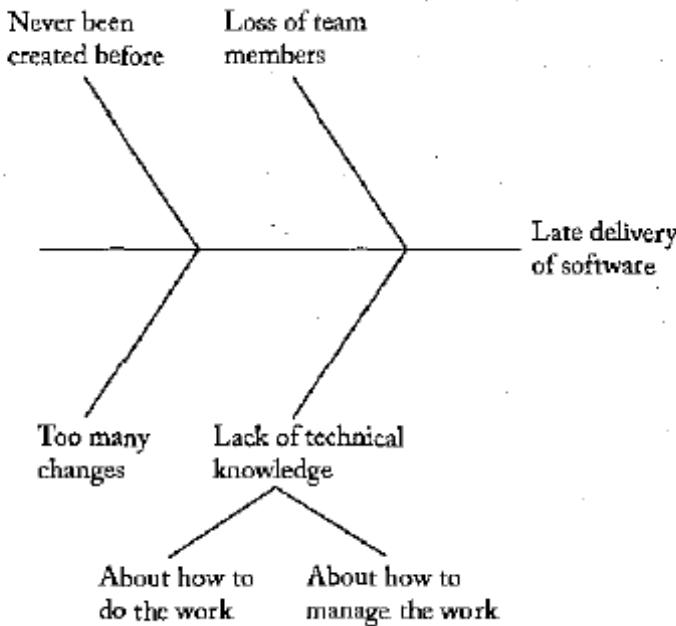
- Idea is to look for missing categories
- The ideas generated from any other risk gathering techniques are sorted into groups by categories.
- Each group of risks is then given a title
- The sorting makes it easier to see additional risks that have not been identified

Delphi technique

- Determine the list of experts but keep the list of names anonymous
- Collect all expert opinions
- Compile them into a list (keeping the names' anonymous)
- Try to reach consensus among the group

Cause and effect diagram

- Visual tool to help a person or group see the potential causes and identify new ones



“Cause-risk-effect” formulation

- As a result of [definitive cause], [uncertain event] may occur, which would/could/may lead to [effect]

As a result of the amount of work the customer is trying to accomplish on many projects during this project's completion, a delay in the customer's response to our requests for approvals may occur, which could result in a two-week delay in project completion.

“Cause-risk-effect” format – Exercises*

	Cause	Risk	Effect
1	The market research function stopped focusing on the product while doing marketing research	Thus missing a new trend in requirements	Resulting in scope changes
2	The system backup/disaster recovery mechanism may not work	Which could lead to a loss of programming code or data structures and test data developed to date	None provided
3	Because this contract is a time and material contract, unlike previous releases that were done under fixed price contracts and because the supplier is seldom critical of a customer-requested change	Scope could creep	Which could cause the project to be late and more costly

“Cause-risk-effect” format - Exercises

	Cause	Risk	Effect
4	We are not able to maintain a good relationship with customer	Causing lack of trust with customer	Which may require more meetings and extra hand-holding
5	Due to upper management not supporting the project	Resources will not be available	Resulting in not being able to complete the project on time
6	Because there is a lot of research and development in this area a competitor may release new technology	That could also be available for our project	Which could help save time on the project

Tricks for identifying more risks

- Equalize participation
- Use anonymity
- Virtual teams
- Use a combination of methods
- How do you know when you are finished ? Do it until it seems stupid !



*“An alien comes down from outer spaces
and steals all the computer hard drives
used on our project”*

Risk register

- It is the place where most of the risk information is kept
- “One document” for the whole risk management process that will be constantly updated with information

Risk ID	Cause	Risk	Effect	Category (RBS)
1				
2				
3				
....				

Key take-aways

- Establish a **risk breakdown structure** (RBS)
- Risk identification techniques
 - Brainstorming
 - Cause and effect diagram
 - Pre-mortem
 - Affinity diagrams
 - Delphi technique
 - Interviews
 - ...
 - AI
- Use the “**cause-risk-effect**” formulation
- Set-up a **risk register**

Question

A company is preparing to launch a new product. The project manager wants to imagine that the launch has failed and work backward to identify potential risks before they happen. Which risk identification technique is the best fit for this approach?

- A) Affinity Diagrams
- B) Delphi Technique
- C) Pre-mortem Analysis
- D) Brainstorming

Question

Which risk identification technique is best suited for each of the following situations?

- **Situation 1:** A project team wants to imagine the project has already failed to uncover hidden risks.
- **Situation 2:** A large number of risk ideas have been generated, and the team needs to organize them into logical groups.
- **Situation 3:** Expert opinions are needed, but the team wants to avoid groupthink and encourage anonymous input.

Possible answers: Pre-mortem, Affinity Diagrams, Delphi Technique

3. Perform qualitative risk analysis

It is the process of **prioritizing** project risks for further analysis or action by assessing their probability of occurrence and impact as well as other characteristics

Benefit: It focuses efforts on high-priority risks

Risk Management Approach – PMI framework



Qualitative Risk Analysis

- Objective is to determine **which risks warrant a response**
- Some of the risks identified are not very probable or, if they occur, will not have a great impact – hence it does not make sense to plan responses to all risks
- Determine **frequency & timing**
- Be careful with:
 - Risks that occur later in the project
 - Risks that could impact an important part of the project
 - Risks that might occur more than once

Example of risk characteristics used to prioritize risks

Most common:

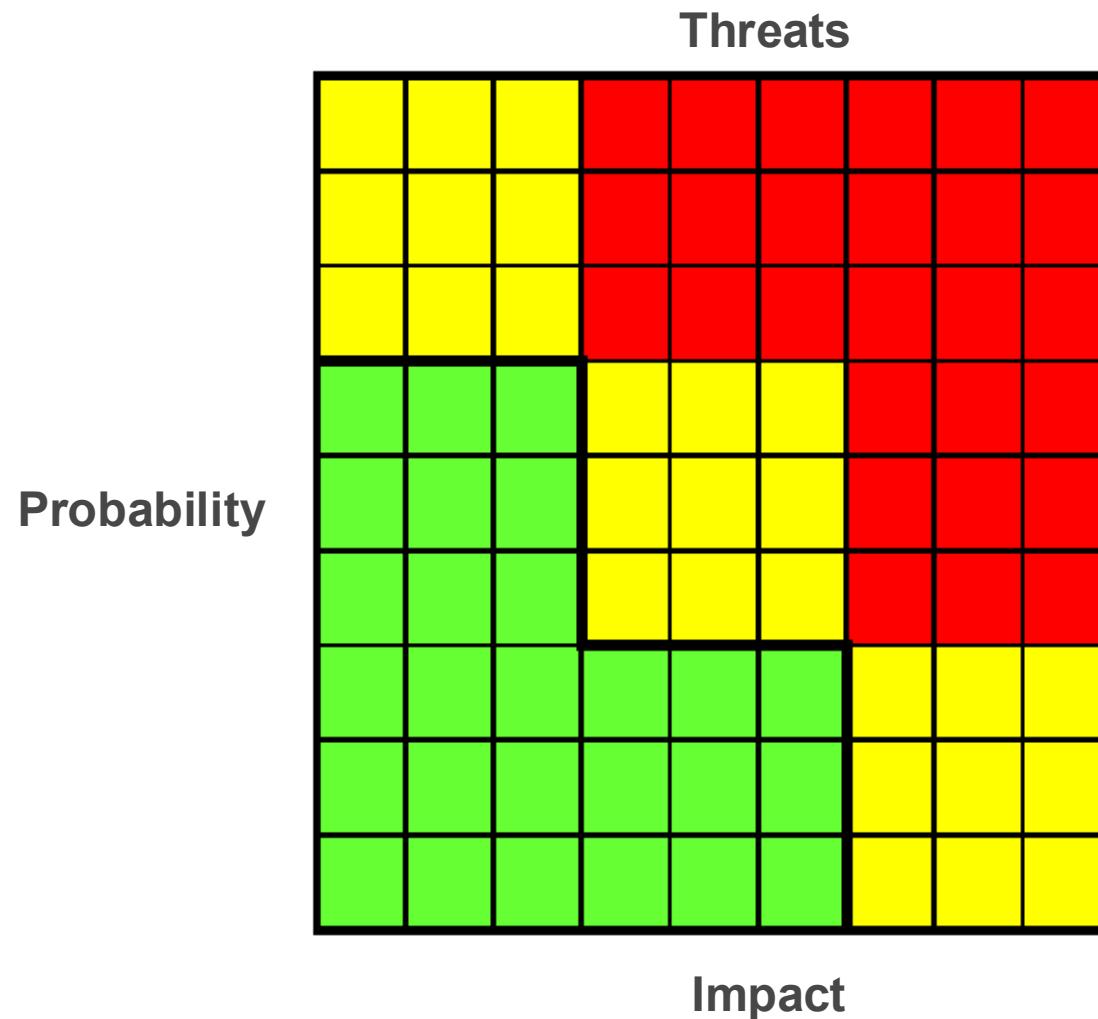
- **Probability:** how likely a risk event will occur
- **Impact/effect:** consequences, amount at stake

Others

- **Risk velocity:** urgency with which the risk should be addressed
- **Frequency:** how often a particular risk is expected to occur over a given period
- **Timing:** when a particular risk is likely to occur or when its impact might be felt

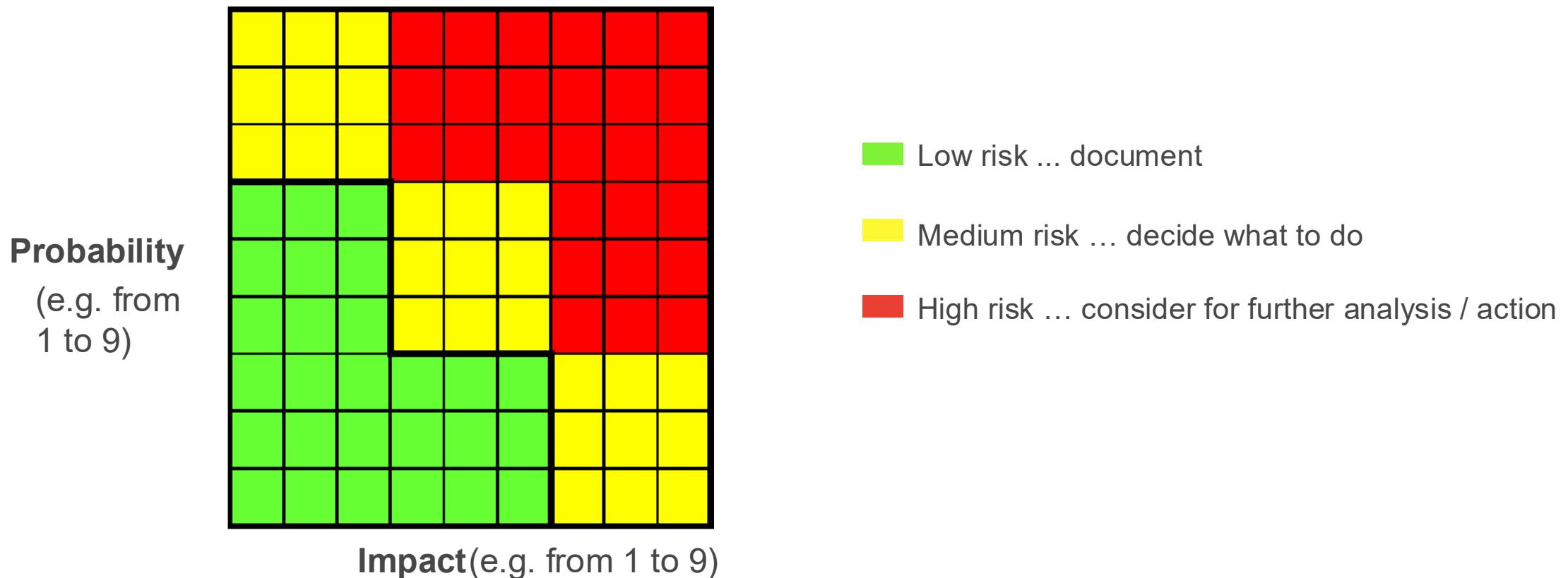
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Probability and Impact Matrix



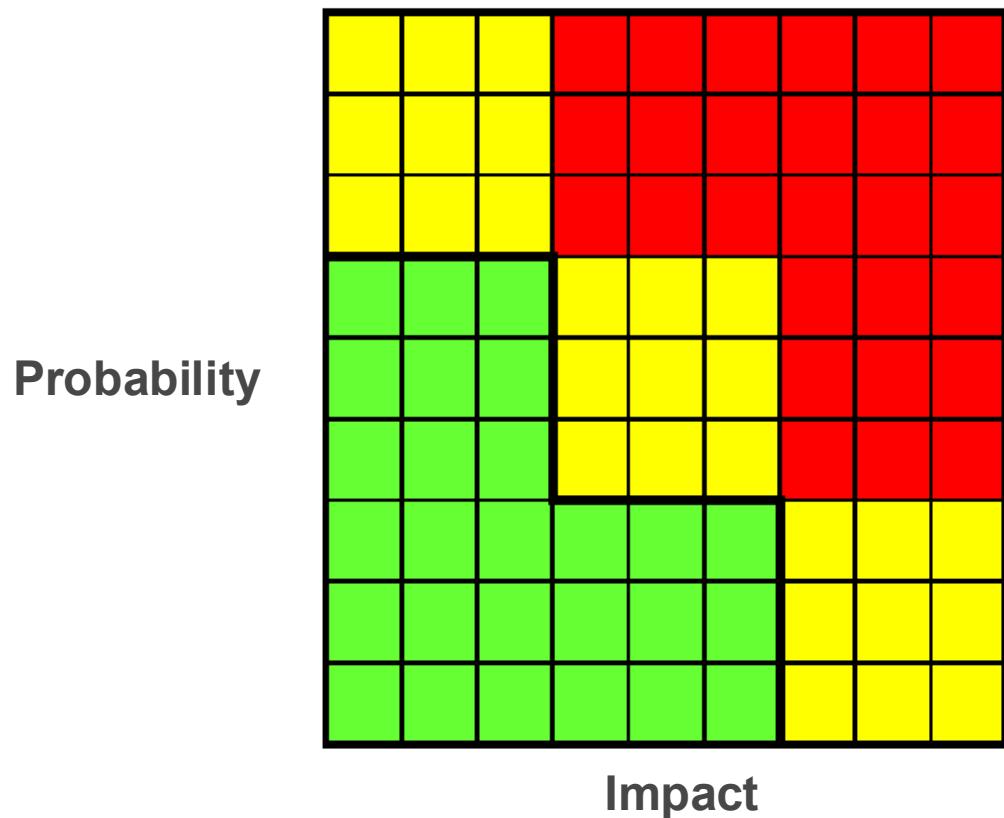
Probability and Impact Matrix

Approach 1



Probability and Impact Matrix

Approach 2



Risk score = probability * impact

All risks with a “score > X” →
consider for further analysis / action

Probability and Impact Matrix - Example

Probability	Threats					Opportunities					Probability
	Very Low 0.05	Low 0.10	Moderate 0.20	High 0.40	Very High 0.80	Very High 0.80	High 0.40	Moderate 0.20	Low 0.10	Very Low 0.05	
Negative Impact					Positive Impact						
Very High 0.90	0.05	0.09	0.18	0.36	0.72	0.72	0.36	0.18	0.09	0.05	Very High 0.90
High 0.70	0.04	0.07	0.14	0.28	0.56	0.56	0.28	0.14	0.07	0.04	High 0.70
Medium 0.50	0.03	0.05	0.10	0.20	0.40	0.40	0.20	0.10	0.05	0.03	Medium 0.50
Low 0.30	0.02	0.03	0.06	0.12	0.24	0.24	0.12	0.06	0.03	0.02	Low 0.30
Very Low 0.10	0.01	0.01	0.02	0.04	0.08	0.08	0.04	0.02	0.01	0.01	Very Low 0.10

Update risk register

Risk ID	Risk score (pre-mitigation)	Prioritized (Y/N)
1		
2		
3		
....		

Exercise

Threats and Opportunities	Probability	Impact
1T	8	7
2T	6	5
3T	5	7
4T	3	4
5T	5	1
6T	6	7
7T	4	8
8T	7	7
9T	8	8
10T	3	3
11T	5	3
12T	8	9
1-OOP	6	6
13T	3	8

T = threat, O = opportunity

- Given the list of risk and opportunities on the left hand-side, assume that all risks with a risk score ≥ 35 move forward in the risk management process
- Calculate the project risk score

Solution

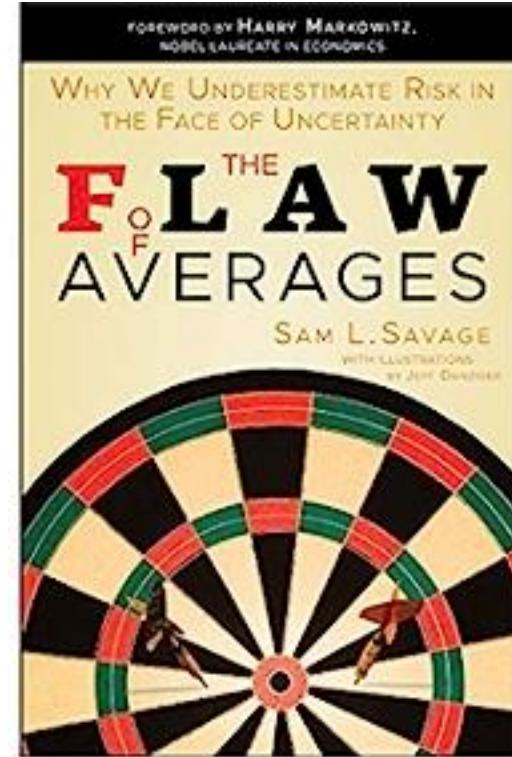
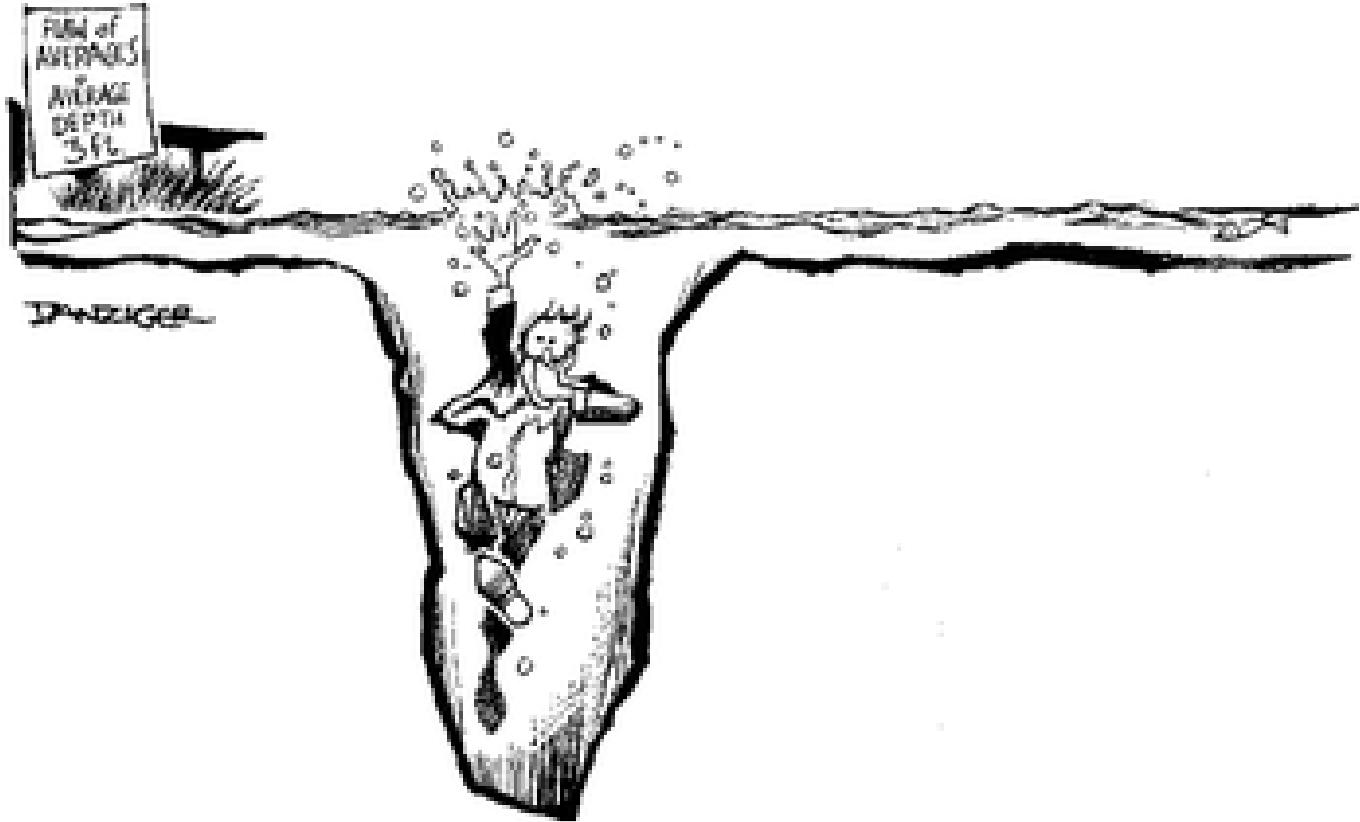
Threats and Opportunities	Probability	Impact	Risk Score (P x I)	Risk Ranking within the Project	Step 1	Step 2	Step 3	Step 4
1T	8	7	56	3	56			
2T	6	5	30	Non-top risk				
3T	5	7	35	7	35			
4T	3	4	12	Non-top risk				
5T	5	1	5	Non-top risk				
6T	6	7	42	5	42			
7T	4	8	32	Non-top risk				
8T	7	7	49	4	49			
9T	8	8	64	2	64			
10T	3	3	9	Non-top risk				
11T	5	3	15	Non-top risk				
12T	8	9	72	1	72			
1-OP	6	6	36	6	(36)			
13T	3	8	24	Non-top risk				
Total Risk Score for the Project (282 divided by 7 risks)					40.3	Step 5		

- Step 1: calculate risk score for each risk (probability * impact)
- Step 2: identify non-top risks
- Step 3: determine risk ranking for top risks
- Step 4: calculate project risk score for each risk
- Step 5: calculate overall project risk score (average)

Who would swim in a swimming pool on average 1.5 meters deep ?



Beware the flaw of averages !



Risk scoring ... be careful in using single numbers

Probability

*

Impact

=

Risk score

= A single average number

= The flaw of averages

Risk scoring ... be careful*

$$\text{Probability} * \text{Impact} = \text{Risk score}$$

10% annual chance
of an industrial
accident that
caused a single
fatality



	Probability	Impact	Risk score
Risk 1	1/10	1 fatality	0.1 (fatalities)
Risk 2	1/100	10 fatalities	0.1 (fatalities)
Risk 3	1/1000	100 fatalities	0.1 (fatalities)

... and don't forget that risk is in the eye of the beholder !*

1 chance in 1000
of losing \$1m over
the following year



$$\text{Probability} * \text{Impact} = \text{Risk score / impact}$$

1/1000

\$1m

\$1000

Take away

- Identify the **risk characteristics** to prioritize risks
- Use "**Probability and Impact**" Matrix
- Risk scoring ... be aware of the "**flaw of averages**"

Question

A construction company is assessing project risks. One identified risk is that heavy rainfall could delay foundation work. They rate the probability as "high" and the impact on cost and schedule as "moderate." According to the Probability and Impact Matrix, what should they most likely do with this risk?

- A) Ignore it because the impact is only moderate.
- B) Monitor it passively since it's unlikely to happen.
- C) Prioritize it for proactive mitigation because of the high probability.
- D) Transfer the risk immediately by buying expensive insurance.

Question

An airline company is assessing project risks for introducing a new fleet of aircraft. One identified risk is a critical software failure during the first flights. The probability is rated as "low," but the potential impact on safety and reputation is "very high." According to the Probability and Impact Matrix, what is the best approach?

- A) Ignore the risk because it's unlikely to occur.
- B) Actively plan mitigation and contingency strategies despite the low probability.
- C) Transfer the risk completely to the software vendor without further action.
- D) Wait until the first flight tests before taking any action.

Question

A tech startup is launching a new mobile app. One risk identified is that a competitor might release a similar feature within six months. The probability is rated as "moderate," and the potential impact on market share is also "moderate." According to the Probability and Impact Matrix, what would be the most appropriate action?

- A) Accept the risk and monitor it with no immediate action.
- B) Immediately launch a lawsuit against potential competitors.
- C) Ignore the risk because neither probability nor impact is high.
- D) Develop a response plan to differentiate their app while monitoring competitor actions.

Question

A project team is preparing the timeline for building a new warehouse. They find that similar past projects took between 8 and 14 months to complete, but the average duration was 10 months. The client asks when they can expect completion. Based on good risk management practices, how should the team respond?

- A) Promise delivery exactly at 10 months, since that's the average.
- B) Provide a single date based only on the fastest past project (8 months).
- C) Explain the full range (8–14 months) and plan contingencies for early or late completion.
- D) Ignore past data and assume this project will be different.

Question

A consulting firm tracks how long it usually takes to complete client reports. They find that most reports are finished between 19 and 21 days, with an average of 20 days. However, in rare cases (2% of projects), unexpected legal reviews delay delivery to over 40 days. If a new client project is starting, what is the most responsible planning approach?

- A) Plan for exactly 20 days, because the data is tightly clustered around the average.
- B) Focus only on the most common range (19–21 days) and ignore rare delays.
- C) Acknowledge that while most cases take 19–21 days, there is a small but critical chance of major delays, and prepare contingency plans.
- D) Assume the rare delays won't happen again since they're unlikely.

NASA and the Challenger Disaster

O-ring seals under cold temperatures

- Under normal temperatures, the O-rings worked fine
- At colder temperatures, performance declined sharply — but failures were rare
- **NASA resigned on overall averages of O-ring performance**

Result

- Challenger launched on a cold morning (below freezing).
- The O-rings failed shortly after launch, leading to the destruction of the shuttle and the death of all seven crew members.

4. Perform quantitative risk analysis

- Process of numerically analyzing the combined effort of identified individual project risks and other sources of uncertainty on overall project objectives
- Benefit: it quantifies overall project risk exposure

Risk Management Approach – PMI framework



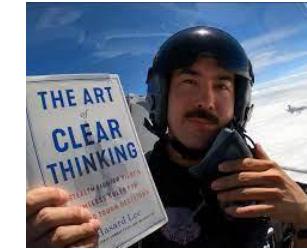
Quantitative analysis

Expected monetary value & Decision Tree

Afghanistan, 17:30 local time



- Primary runway closed for construction works
- Smaller runway left but damaged
- Mortar shell impact near the middle of the runway
- Base under attack



Hasard Lee
– US
Airforce

- F16
- Below bingo fuel
- Added weight due to unexpected bombs
- Night !

Option 1: land on the damaged runway



- Mortar shells might have created large potholes in the concrete runway
- Low chance of hitting one but at night impossible to avoid
- If hit one, jet would be cartwheeled → fatality
- 97% survival rate
 - 2% of the runway is affected (runway is 100 meters, 1 or 2 mortar shells had hit, each 1 square meters crater)
 - 3 wheels
 - 50% probability of hitting a crater

Option 2: wait and hope that the runway opens before running out of fuel



- Worst case scenario would be to eject
- Ejection data: 98% survival rate, > 50% probability of injury
- 100% prob of loosing the aircraft
- High chance of getting captured or killed by the enemy
- .. too much downside !

Option 3: meet midway an airborne tanker



- Tanker flying at max speed towards us; it was at 80 kms away and likely flying at 8 km per minute → would get overhead in 10'
- If we fly toward the taken at similar speed, we could rejoin in 5'
- No fuel to go back if something goes wrong – 95% prob of being able to refuel
- If it fails, force to eject far away from the base

Option 4: fly 1/3 distance to meet an airborne tanker

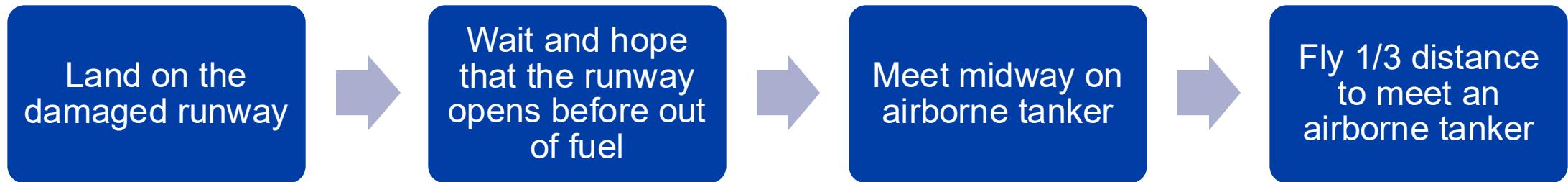


- If we couldn't refuel, we would have just enough fuel to make it back
- One shot at refueling while preserving the fail-safe option of landing

Thinking process

- Expected value of a decision
- Additional options / alternatives created during the evaluation process

Thinking process



Expected monetary value of risks

- EVM = expected monetary value of risks
- EVM (risk) = Probability * Impact
- EVM (project) = sum of EVM (risk)

Example

Risk A has a probability of 60% and estimated cost impact of \$60,000

$$\text{EVM (risk A)} = 60\% * \$60,000 = \$36,000$$

Exercise

● ● ● ● **Exercise 1** You are planning the manufacture of a new product. Your project estimate results in a project cost of US \$600,000. In addition, your analysis has come up with the following:

- A. A 5 percent probability of a delay in receiving parts with a cost to the project of \$75,000
- B. A 55 percent probability that the parts will be \$60,000 cheaper than expected
- C. A 75 percent probability that two parts will not fit together when installed, resulting in an extra \$100,000 cost
- D. A 5 percent probability that the manufacture may be simpler than expected, resulting in a \$25,000 savings
- E. A 15 percent probability of a design defect causing \$8,000 of rework

Question 2: Assuming that these are the only risks on the project:

- 1. What is the best case cost (only good things happen)?
- 2. With no further risk analysis, how much will management expect the project to cost?
- 3. What is the expected monetary value of the project?
- 4. What is the worst case cost (only bad things happen)?

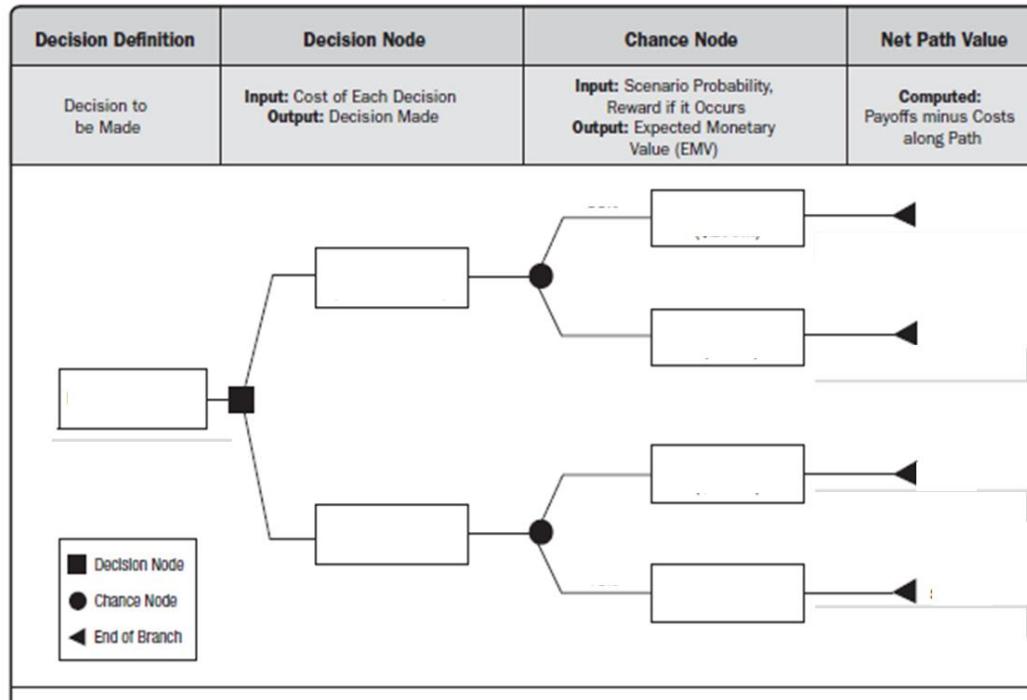
Solution

Project cost = \$600,000

	Positive (Opp)	Negative (Risk)	EVM
A		5% probability of a delay receiving parts - \$75,000 impact	$5\% * \$75,000 = \3750
B	55% probability that parts will be \$60,000 cheaper		$55\% * \$60,000 = (\$33,000)$
C		75% probability that 2 parts will not fit together - \$100,000 impact	$75\% * \$100,000 = \$75,000$
D	5% probability that the manufacturer may be simpler - \$25,000 savings		$5\% * \$25,000 = (\$1,250)$
E		15% probability of a design defect - \$8000 rework	$15\% * \$8000 = \$1,200$

- Best case (only good things happen)
 - Cost = $600,000 - (60,000 + 25,000) = \$515,000$
- No further risk analysis: \$600,000
- EVM (project) = $600000 + (3750 - 33000 + 75000 - 1250 + 1200) = \$645,700$
- Worst case (only bad things happen)
 - Cost = $600000 + 75000 + 100000 + 8000 = \$783,000$

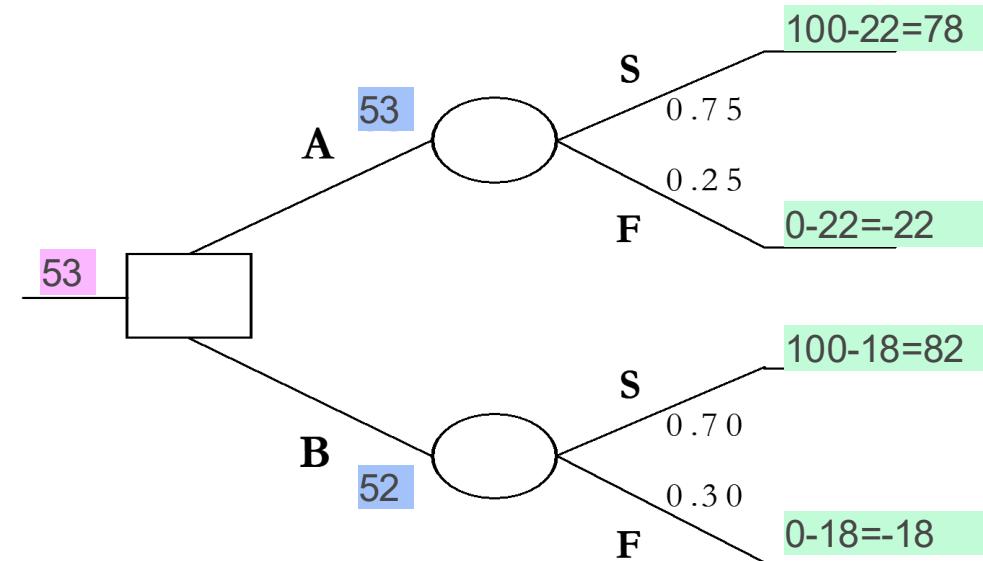
Decision Tree analysis*



- Mutual exclusivity
- The decision tree is evaluated by calculating the **expected monetary value of each branch**

Exercise*

- A company is assessing a consulting service from 2 companies (Company A and B)
- Price from Company A = 22,000, Price from Company B = 18,000
- The consulting service could generate savings of 100,000 or nothing
- Company A has 75% probability of success, Company B has 70% of success
- **Which company do you choose ?**



- Step 1: draw tree
- Step 2: assign probabilities
- Step 3: start right to left and calculate EVM

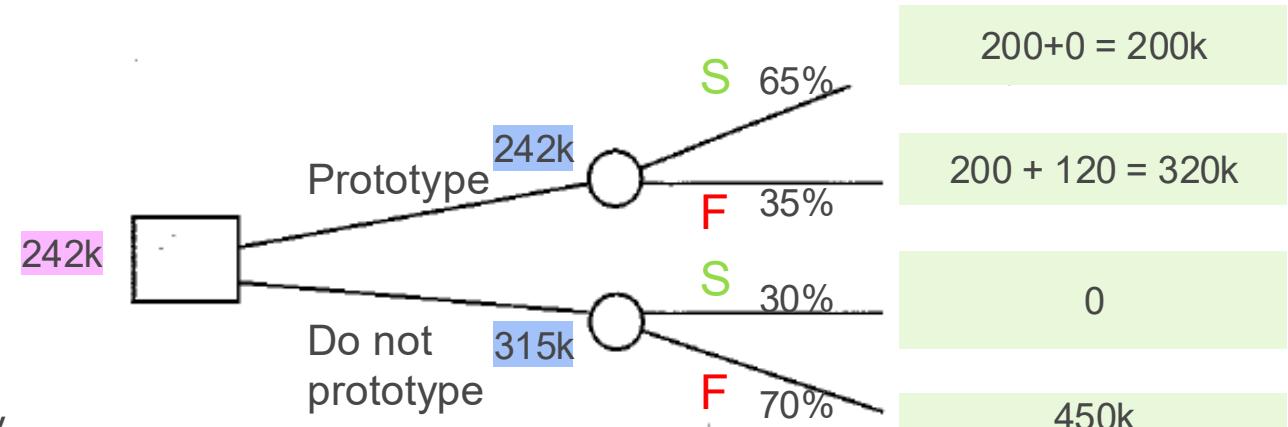
3A $EVM(A) = 78 * 0.75 - 22 * 0.25 = 53$

3B $EVM(B) = 82 * 0.7 - 18 * 0.3 = 52$

3C $EVM = \max(53, 52) = 53$

Exercise*

- A company is trying to determine if prototyping is worthwhile on the project.
- The prototype cost is \$200,000
- In case of prototyping & failure: 35% probability of failure and \$120,000 additional cost
- In case of not prototyping & failure : 70% probability of failure and \$450,000 additional cost
- **What would you do ?**



- EVM (Prototype) = $200k * 65\% + 320k * 35\% = \$242,000$
- EVM (Do not prototype) = $70\% * 450k = \$315,000$
- $EVM = \min(\$242k, \$315k) = \$242k \rightarrow \text{prototype !}$

EMV – applications

Project Risk management: project delays, cost overruns, scope changes

Product launch and marketing: new product development, pricing strategies, market expansion

Supply chain risk management: supplier risk, logistics and distribution, inventory management

Strategy decision making: mergers and acquisitions, business continuity planning, regulatory and compliance risk

Cybersecurity risk management: cyberattack response, vulnerability assessment

Legal and compliance risk: litigation risk, regulatory compliance

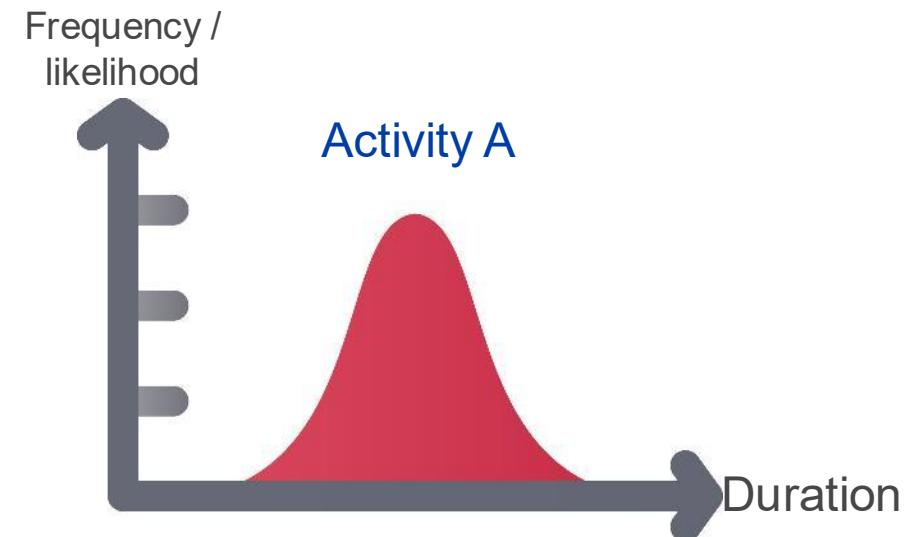
Quantitative analysis

Simulation

From “average values” to distributions

Activity A

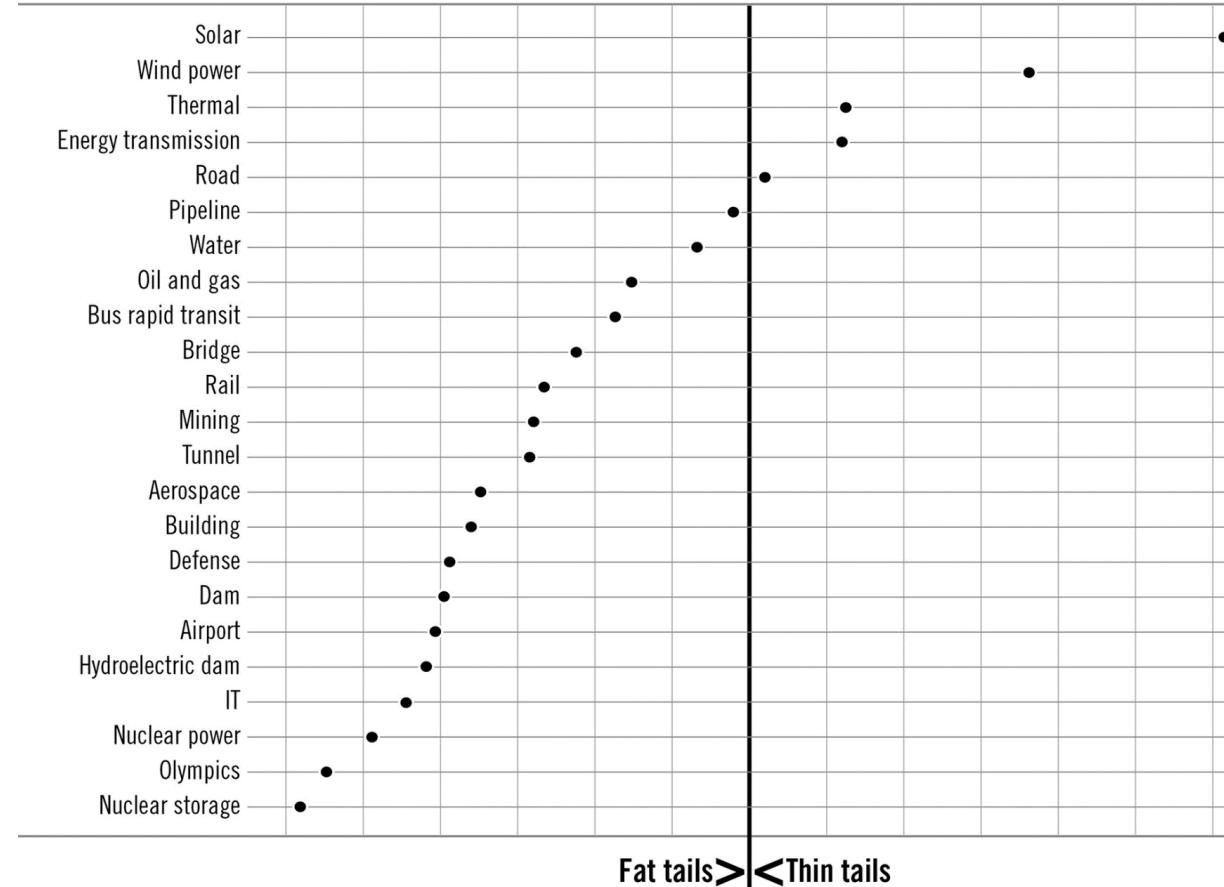
Average duration = 5 weeks



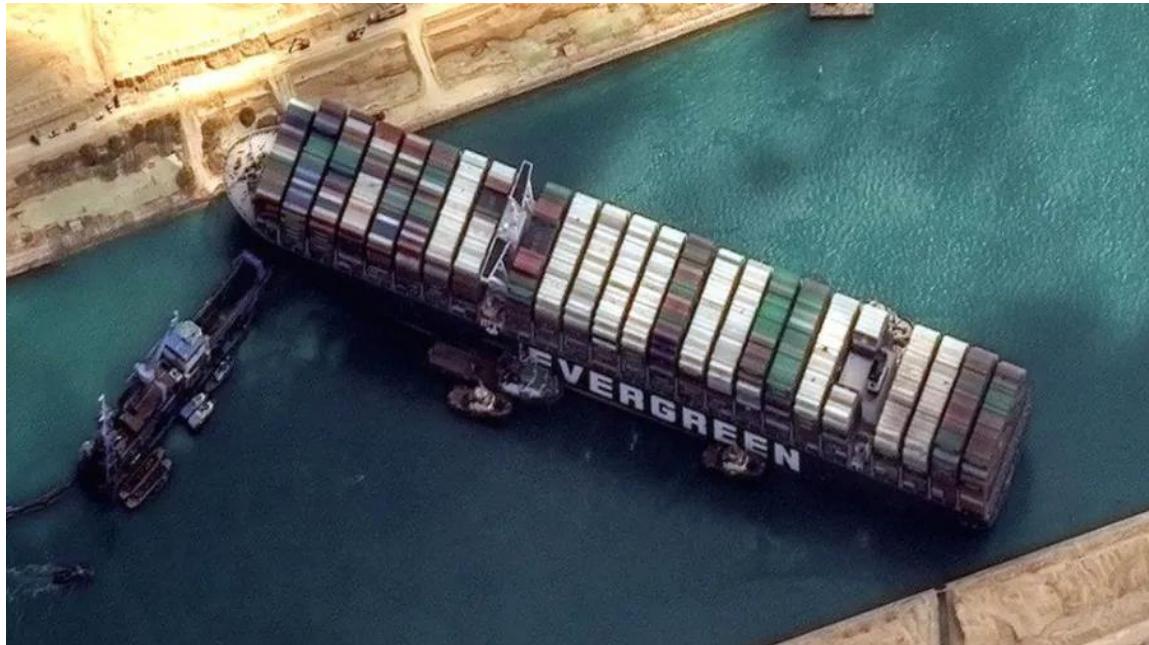
Single number /
deterministic estimate

Shapes, probability distributions,
ranges of outcomes

“Tail” type by industry



Still not convinced ?



Ever Given – Suez Canal blockage (March 2021)

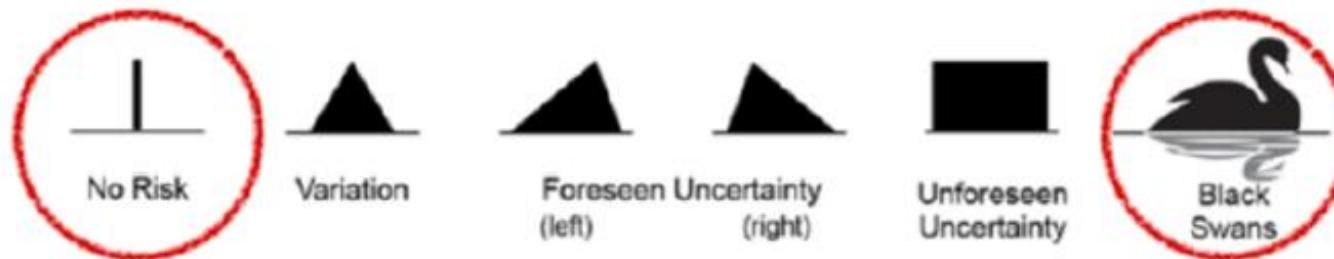
- Trivial event: gusts of wind from the Egyptian desert
- Ship got stuck for 6 days freezing around \$10B in trade each day
- Dynamic interdependencies among the parts of the system created non-linear responses and amplification

Project Management example

- What is the probability of completing the project on time ?
- Schedule analysis based on activity duration

Typical distributions for schedule analysis

Variation

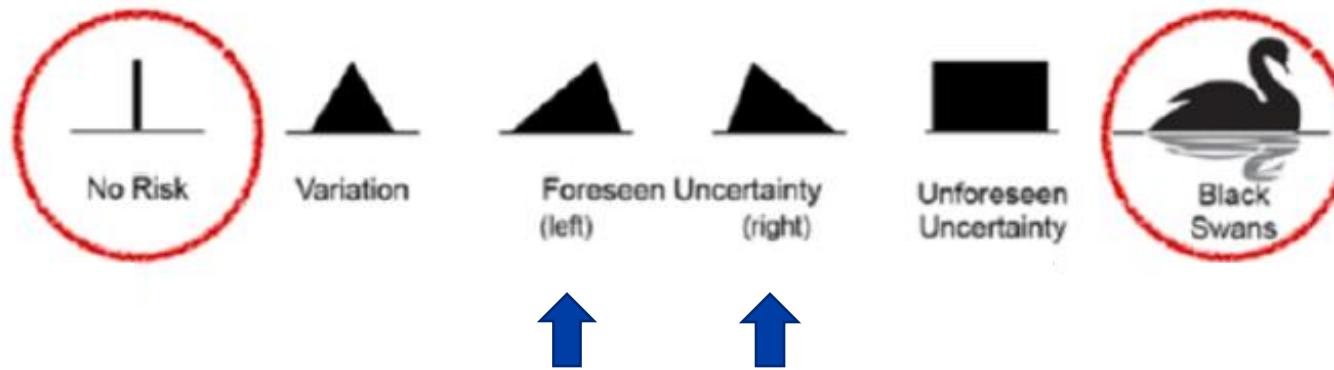


Variation

- Symmetrical triangular distribution

Typical distributions for schedule analysis

Foreseen uncertainty

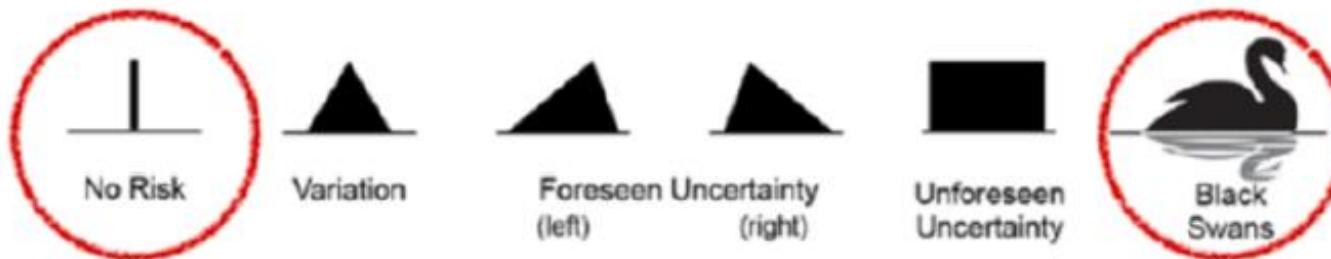


Foreseen Uncertainty

- Asymmetrical distribution with a skewed tail

Typical distributions for schedule analysis

Unforeseen uncertainty

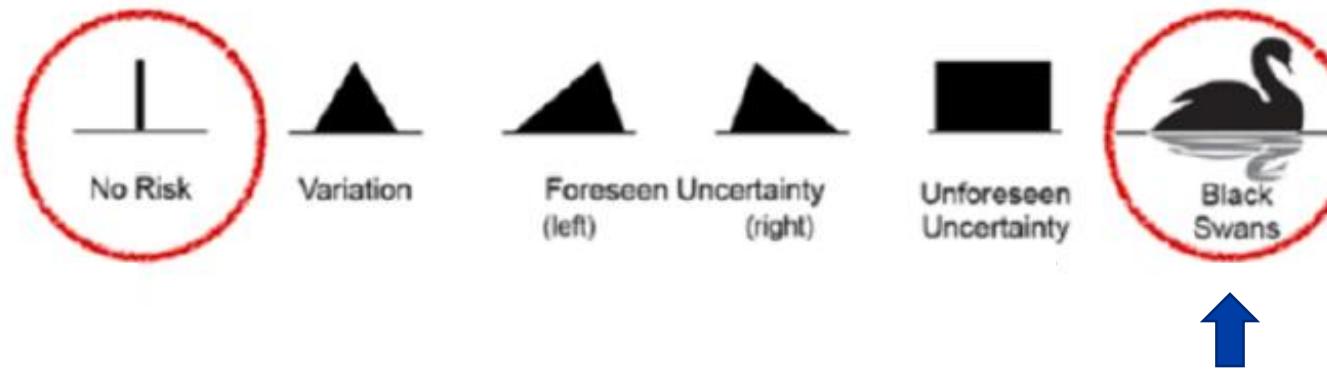


Unforeseen Uncertainty (Chaos)

- Uniform distribution

Typical distributions for schedule analysis

Black Swans



Black Swan

- Event very unlikely to happen but it does happen, might have a huge damaging impact

Black Swan



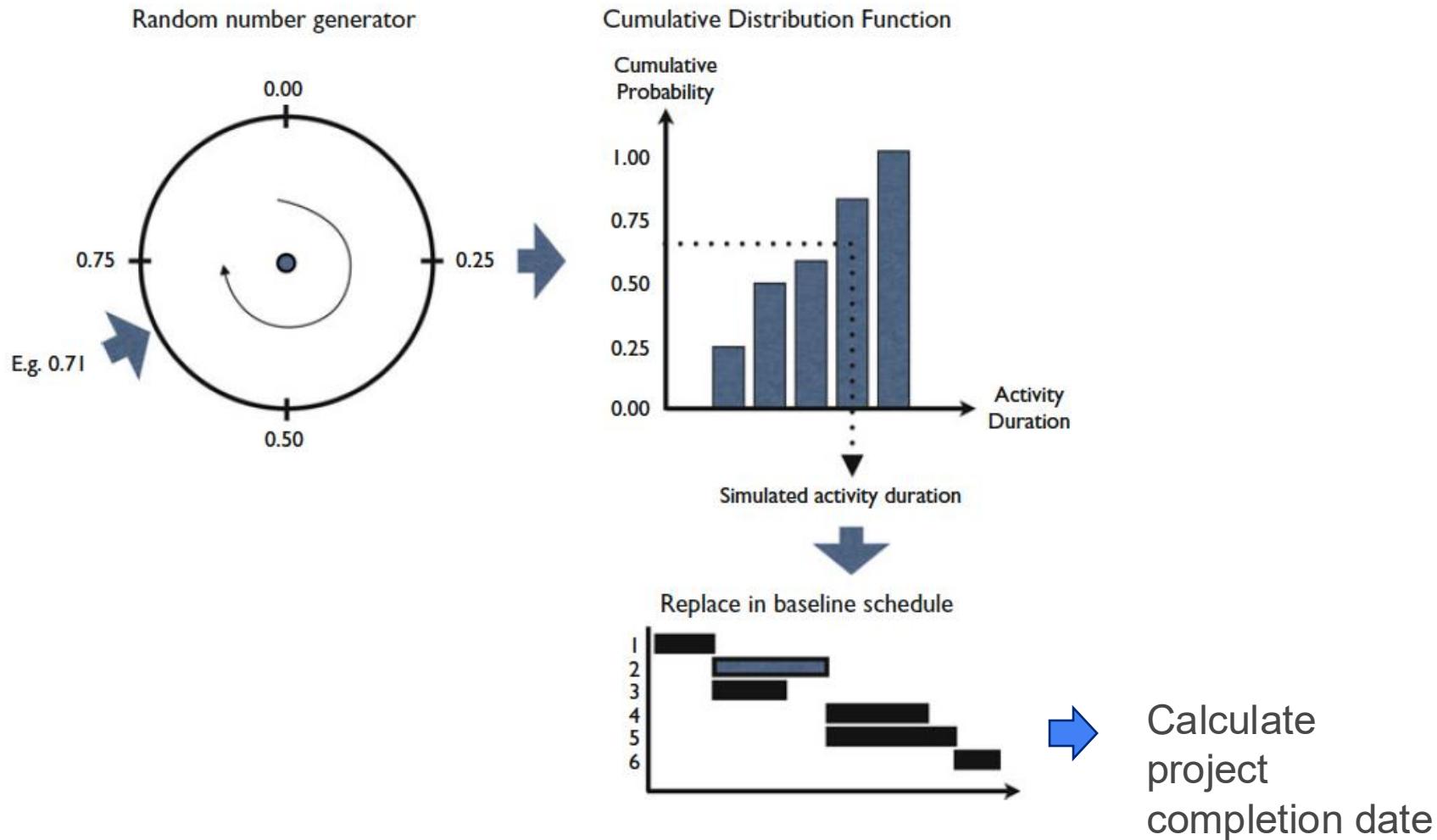
- **Black Swan:** unpredictable, rare event that has severe consequences
- Characteristics of a Black Swan event
 - Rarity (unpredictable)
 - Severe impact
 - Retrospective predictability (hindsight bias)
- Examples
 - 2008 financial crisis
 - 9/11 terrorist attack
 - COVID-19 pandemic

Simulation

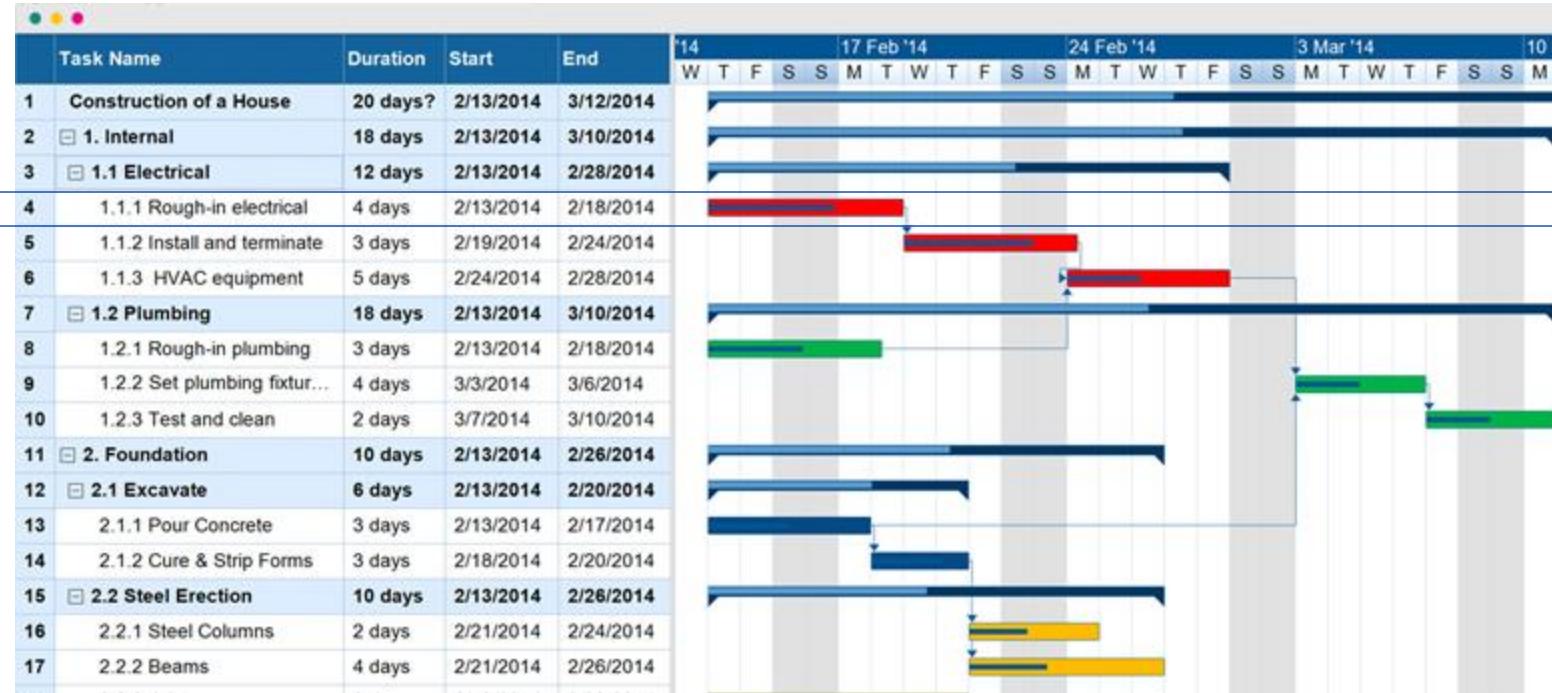
- Computer software is used to iterate the quantitative risk analysis. Input values are chosen at random for each iteration. Outputs represent a range of outcomes



Monte-Carlo simulation (schedule example)



Monte-Carlo simulation (schedule example)



Distribution type

Distribution parameters

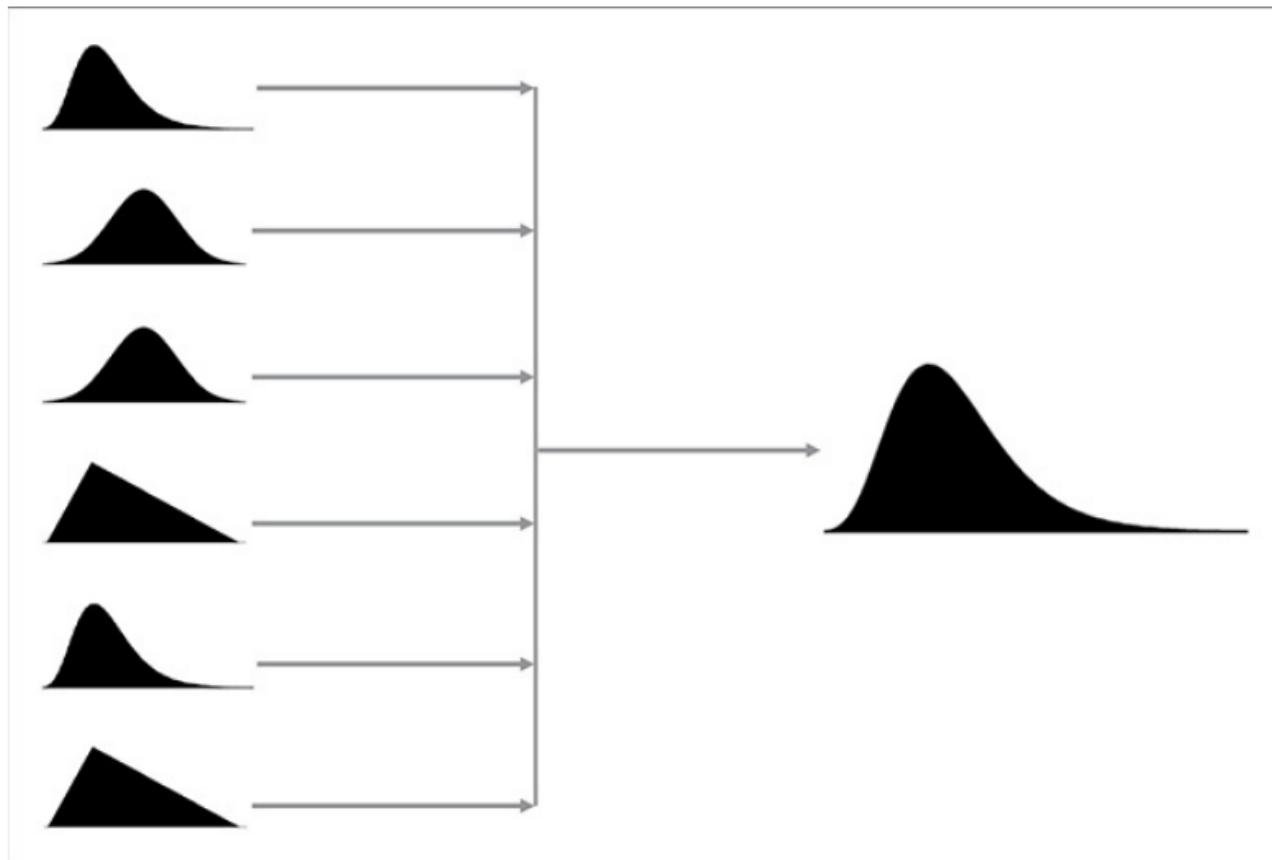


simulation

Completion
time
distribution

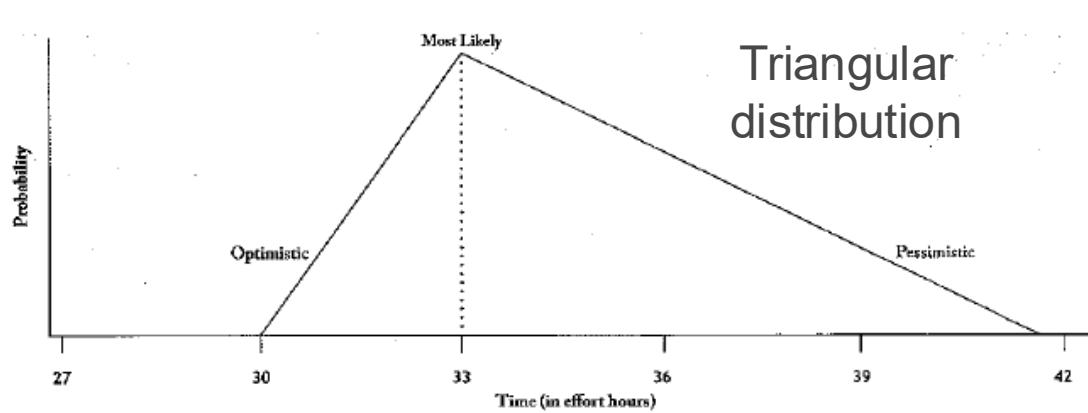


Why you need simulation ...

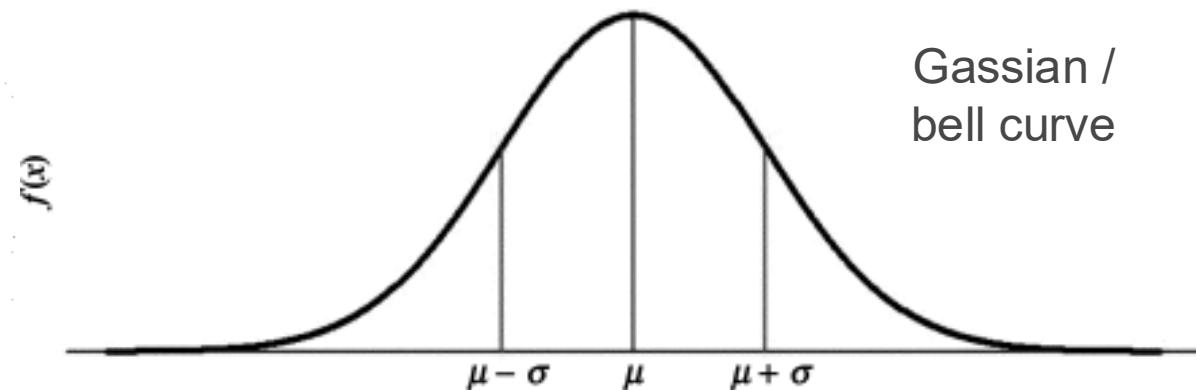


- Uncertainty is rarely applied at the system level
- Cost estimates for WBS (Work Breakdown Structure) are added to obtain a total system cost
- There is no formula to add probabilities !

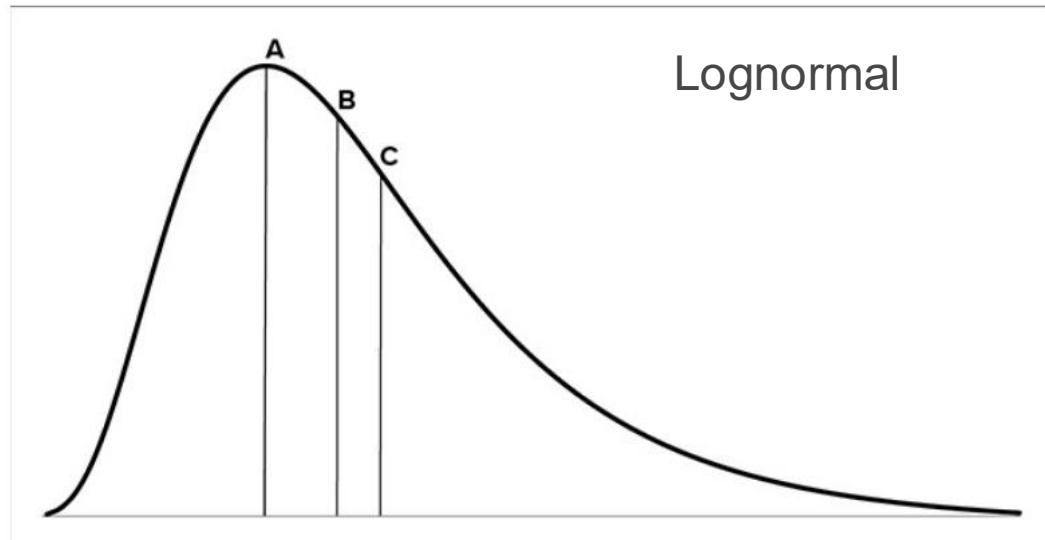
Which distribution to use ?*



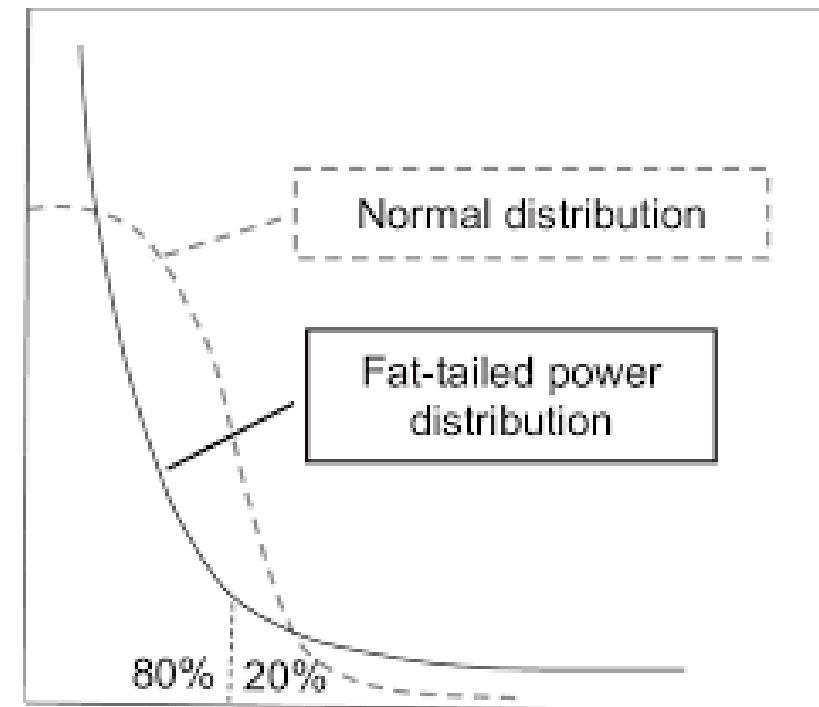
Triangular distribution



Gaussian / bell curve

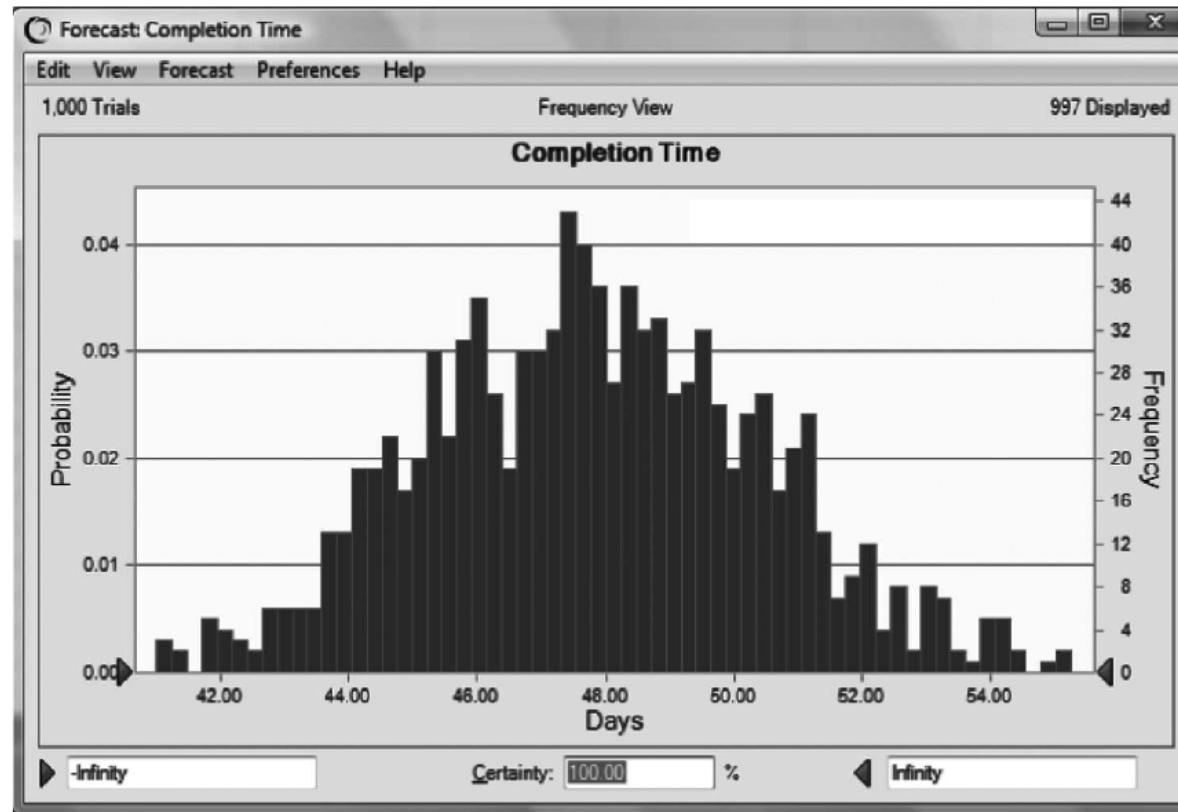


Lognormal



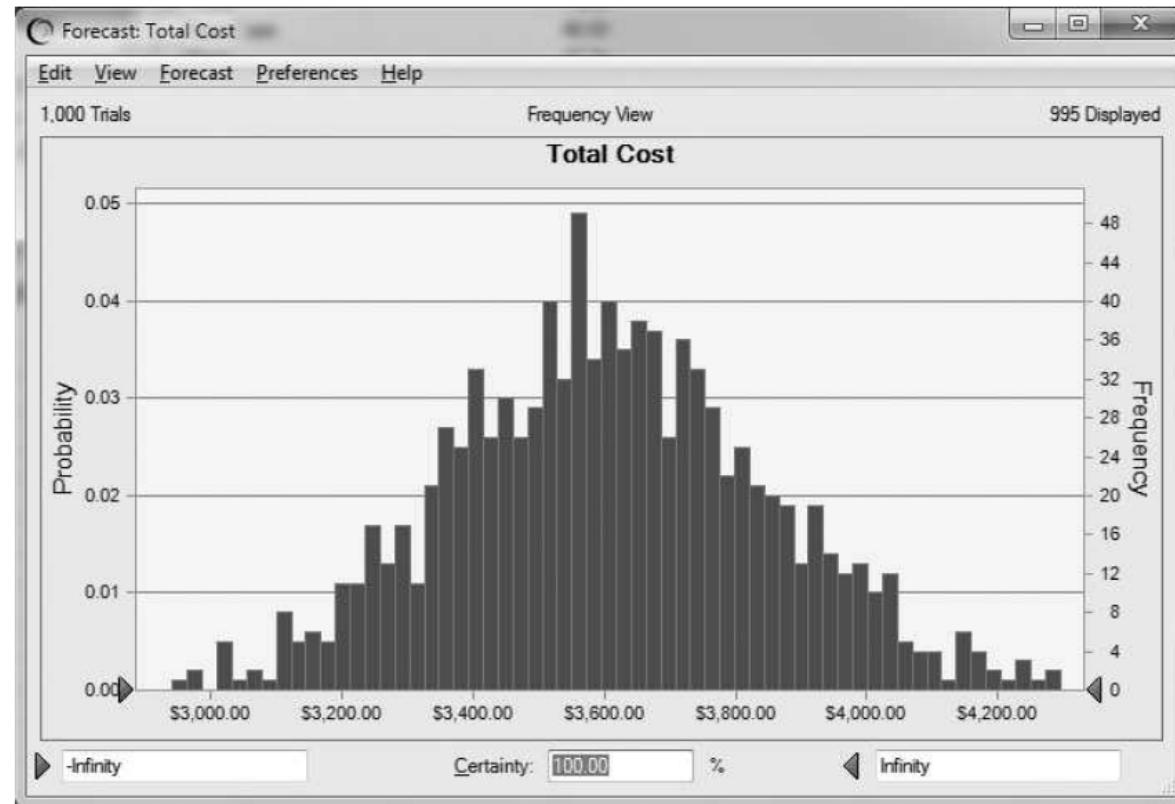
Simulation

Output example – Completion time



Simulation

Output example – Cost at completion



Risk analysis software's

- Commercial
 - @Risk (Palisade) : <https://www.palisade.com/risk/>
 - Crystal Ball (Oracle): [Crystal Ball | Oracle](#)
 - Risk Solver (Frontline): <https://www.solver.com/risk-solver-platform>
 - ChanceCalc MonteCarlo: <https://www.probabilitymanagement.org/montecarlo>
 - The plan minder <https://theplanminder.com/>
- Free
 - Monte Carlo Simulations: <https://sourceforge.net/projects/mcsimulations/>
 - SIPmath Modeler Tools: <https://www.probabilitymanagement.org/montecarlo>

Simulation - applications

Project Management: Estimate the likelihood of completing a project within a certain time frame or budget by modelling potential delays or cost overruns

Operational Risk: Evaluate the impact of supply chain disruptions, production delays, or demand fluctuations on business operations

Financial Risk: Simulate potential market scenarios to assess the volatility of investment portfolios, including the impact of interest rate changes or stock price fluctuations

Update risk register

Risk ID	Action required ? (Y/N)
1	
2	
3	
....	

Take away

- Use qualitative analysis (e.g. Probability-Impact matrix) to **determine which risks warrant a response**
- Explore the **combined effect of risks on objectives** through quantitative analysis (e.g. simulation)
- Use quantitative analysis (e.g. EMV) to **evaluate the potential outcomes of risks** and their financial impact on a project or decision

5. Plan risk response

- Process of developing options, selecting strategies, and agreeing on actions to address overall project risk exposure, as well as to treat individual project risks
- Benefit: it identifies appropriate ways to address overall project risk and individual project risks

Risk Management Approach – PMI framework



Plan risk response

What shall we do?

Options

- Consider **radical action** (avoid threats or exploit opportunities)
- Attempt to **influence the level of risk exposure** (reduce threats or enhance opportunities)
- Decide **to do nothing** (accept the risk)
- **Involve other parties** in responding appropriately to the risks (transfer threats or share opportunities)

Driving a car – risk reduction



Risk: injury if there is a collision

- **Risk = Impact * Probability**
- **Impact**
 - Seat belt with 2 points of contact
 - Seat belt with 3 points of contact
 - Automated airbags
- **Probability**
 - Driver training
 - Speed limits
 - Stop lights

Pre and post event treatment - Exercise

Pre event treatment

- Speed limits
- Signs warnings (rain, snow)
- Programmes to reduce the likelihood that drive is impaired by alcohol or drug

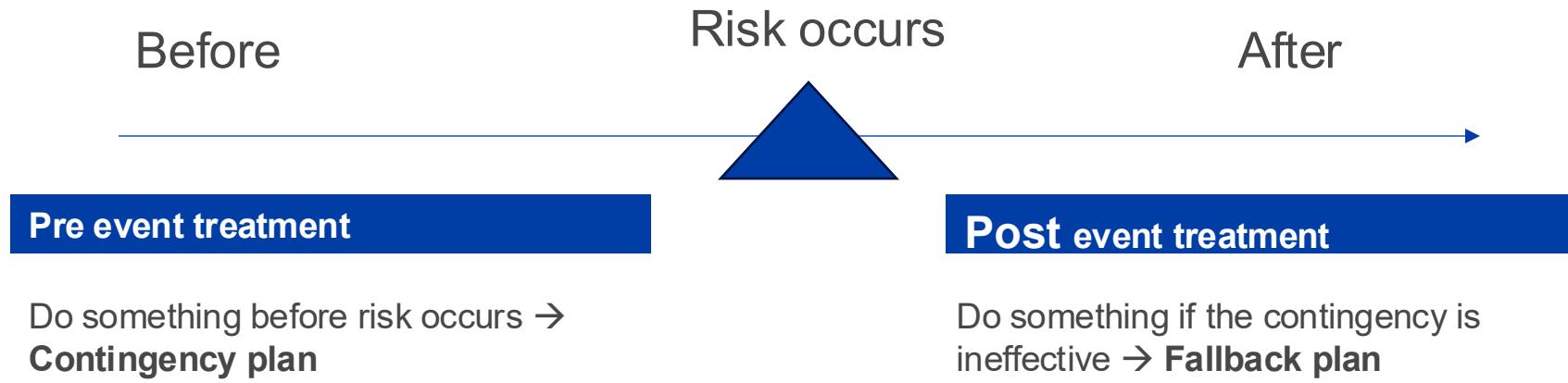


Risk that a vehicle loses tractions and skids

Post event treatment

- Guardrails at the side of the road
- Seat belts, air bags
- Ambulances
- Emergency hospital treatment

Risk treatment



Strategies for threats

The goal is to reduce the amount of negative risk

Avoid: eliminate threat by eliminating cause

Escalate: a threat is outside the scope of the project or that the proposed response would exceed the project manager's authority.

Transfer: shift ownership to a third party (e.g. subcontract, warranty, insurance etc) to manage the risk and to bear the impact if the threat occurs.

Mitigate: reduce the Expected Value. Reduce the probability of occurrence and/or impact of a threat. Early mitigation action is often more effective than trying to repair the damage after the threat has occurred.

Accept (defer). “If it happens, it happens”. No proactive action is planned. Can include developing a **contingency plan** that would be triggered if the event occurred

Strategies for opportunities

The goal is to maximize the positive impact

Exploit: “Make the cause more probable? Act to ensure that an opportunity occurs.

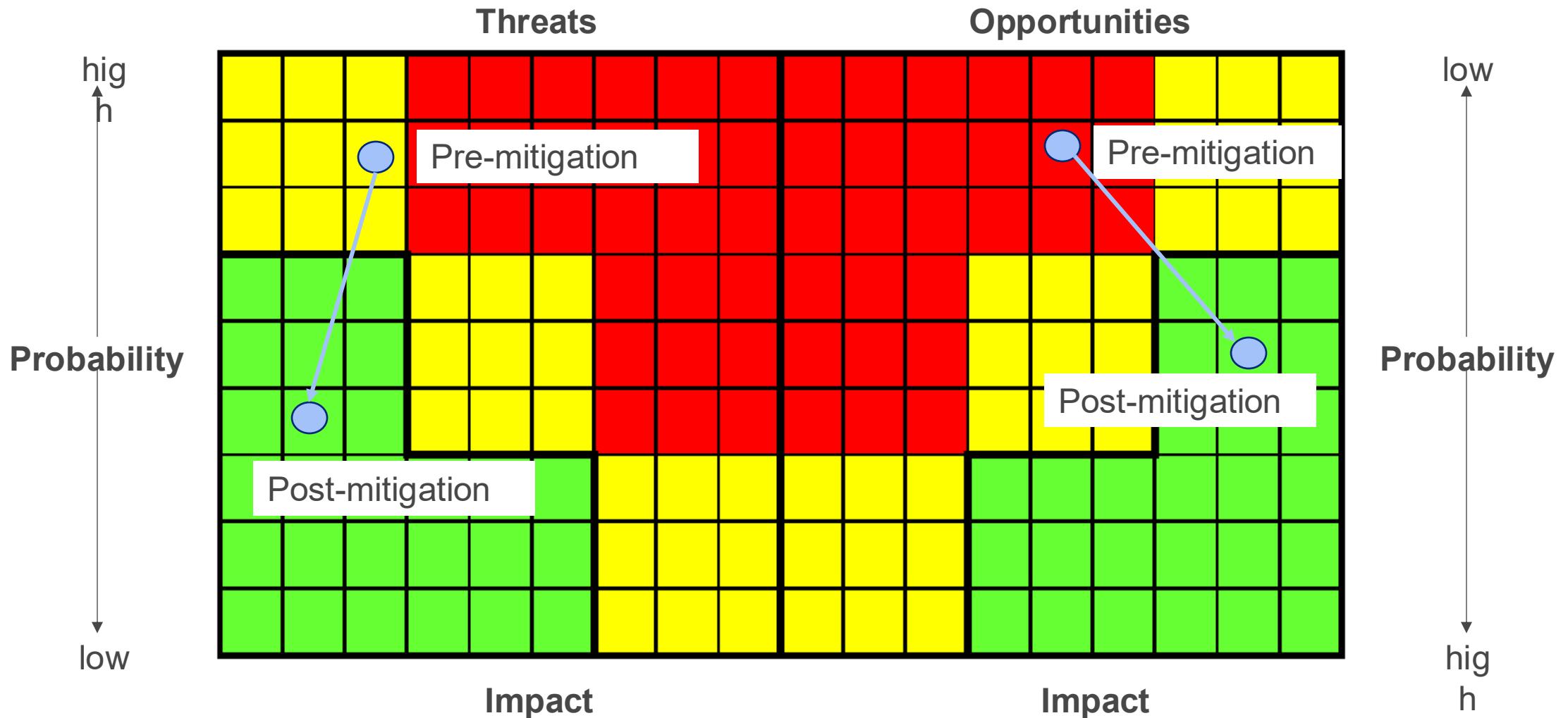
Escalate: an opportunity is outside the scope of the project or that the proposed response would exceed the project manager’s authority.

Share: allocate ownership of an opportunity to a third party who is best able to capture the benefit

Enhance: increase the probability of occurrence or impact of an opportunity. Early enhancement action is often more effective than trying to improve the opportunity after it has occurred

Accept (defer): “If it happens, it happens”

Updated “Probability and Impact” Matrix



Risk triggers

- Early warning sign – threat or opportunity is about to occur – launch contingency or fallback plans
- Consider
 - What will happen just before the risk occurs ?
 - What can we measure to discover if the risk is about to occur ?
 - How will we know when the risk will occur ?
- Document triggers as part of the Risk Response Plan

Update risk register

Risk ID	Trigger	Risk Response	Owner	Risk score (post mitigation)
1				
2				
3				
....				

Take away

- Think “Pre” and “post” event treatment
- Think about “risk triggers” & early warning signs
- Strategies: Avoid, Escalate, Transfer, Mitigate, Accept

Implement risk response

- Analysis → action
- Actions might introduce new risks for all of us to address

<<I have seen people correctly analyze a risk and then become paralyzed into action>>

Sam L. Savage

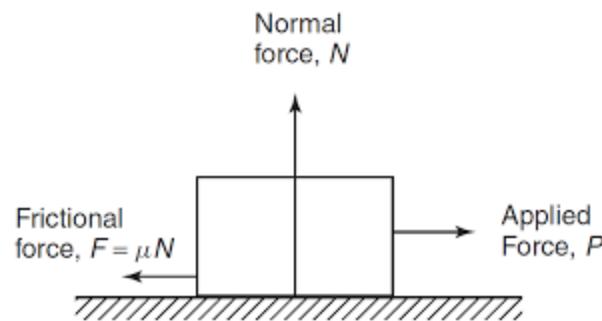
<< A risk without a decision is just a worry>>

Ron Howard
(thought leader of decision analysis)

Bias toward actions



- **Inertia:** <<A property of matter by which it remains at rest or in uniform motion in the same straight line unless acted upon by some external force>>



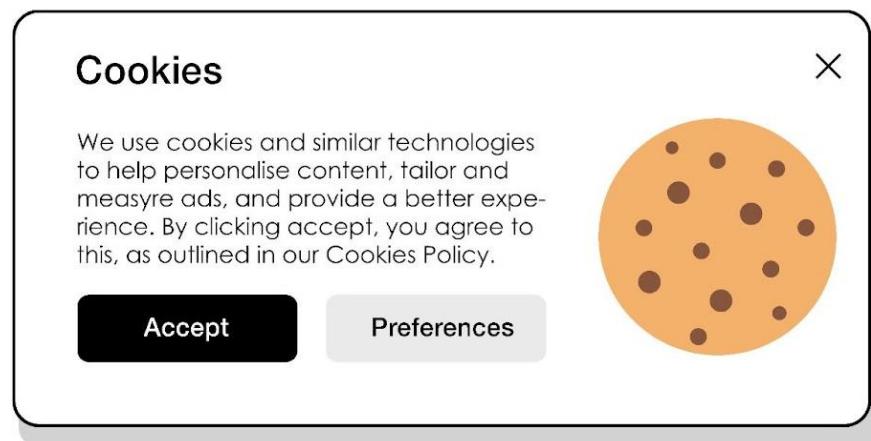
There is no action until inertia is overcome !

Is this risk response effective ?



- The Pentagon prescribed that every soldier leaving a secure base in both Afghanistan and Iraq wear body armour
- Wearing protective gear simply wasn't always realistic . Many activities , including climbing Afghanistan's towering mountains , were literally impossible in the heavy armour

Be aware of overmitigation - examples



Be aware of overmitigation

- Overmitigation skills mitigation
- Overmitigations create lots of false positives
- False positives create overprocessing and unproductive labor

Take away

- A risk without a decision is just a worry
- There is no action until inertia is overcome
- Beware of **secondary risks** - too often our efforts to manage risk create further risks
- Overmitigation skills mitigation

Question

You are managing an **outdoor music festival**, and the weather forecast predicts a moderate chance of rain on the day of the event. While rain could dampen the experience and cause minor equipment damage, it is not expected to become severe or dangerous. As the event manager, you need to decide how to handle this risk.

Which of the following strategies would be the *most appropriate*?

- A) Cancel the event to eliminate any chance of rain impacting it.
- B) Refer the decision to senior executives or city officials for further instructions.
- C) Purchase event insurance that covers weather-related financial losses.
- D) Set up additional tents and waterproof coverings to protect equipment and attendees.
- E) Proceed as planned, understanding that some minor disruptions may occur.

Question

Question:

You run a **small online store**, and you realize there's a small chance that a new competitor might undercut your prices, slightly reducing your sales over the next quarter.

How should you *most appropriately* respond?

- A) Avoid – Shut down the online store to eliminate competition.
- B) Escalate – Ask your investors to make the strategic decisions for you.
- C) Transfer – Buy a financial protection plan against market losses.
- D) Mitigate – Launch a loyalty program to retain your customers.
- E) Accept – Recognize that some loss is inevitable and continue operating normally.

Question

You are the IT manager for a healthcare company. A recent audit reveals that a minor vulnerability exists in your system, which could theoretically be exploited, but the risk is currently rated very low.
Which strategy would you most appropriately choose?

- A) Avoid – Shut down the system entirely until a new one is built.
- B) Escalate – Report the issue to the board of directors for their decision.
- C) Transfer – Purchase cyber insurance to cover potential breaches.
- D) Mitigate – Patch the vulnerability and strengthen monitoring.
- E) Accept – Document the vulnerability and monitor it without immediate action.

Question

You are overseeing the **construction of a new office building**. There's a known risk that the supplier for a crucial type of glass might face labor strikes, potentially delaying delivery. Without this glass, construction timelines will slip.

What is the most effective risk response?

- A) Avoid – Redesign the building to use entirely different materials.
- B) Escalate – Bring the issue to government regulators for intervention.
- C) Transfer – Include strict delay penalties in the supplier's contract.
- D) Mitigate – Find an alternate supplier now and pre-order materials.
- E) Accept – Wait and hope the strikes don't occur.

Question

You are a project manager at a software company that has just developed a new AI feature far ahead of your competitors. Early feedback from a pilot launch is overwhelmingly positive, and there's strong interest from several major clients. What is the **best strategy** to maximize this opportunity?

- A) **Exploit** the opportunity by immediately prioritizing the full launch and allocating additional resources to speed up delivery.
- B) **Escalate** the opportunity to upper management to get executive sponsorship and larger organizational support.
- C) **Share** the opportunity by partnering with another tech company to jointly market the feature.
- D) **Enhance** the opportunity by gathering more customer feedback to further improve the feature before a full launch.
- E) **Accept** the opportunity by acknowledging its benefits but making no changes to the current project plan.

Question

You work in R&D for a **pharmaceutical company**. During testing of a new medication for diabetes, researchers discover an unexpected, highly effective treatment for a rare autoimmune disorder. However, the company currently lacks the expertise and regulatory clearance to enter the autoimmune market quickly.

What is the best strategy to maximize this opportunity?

- A) **Exploit** it immediately by shifting the focus and budget to the new treatment.
- B) **Escalate** the opportunity to senior leadership to secure broader organizational support and investment.
- C) **Share** the opportunity by licensing the discovery to a company already specialized in autoimmune diseases.
- D) **Enhance** the opportunity by conducting additional studies to strengthen the case before acting.
- E) **Accept** the opportunity and continue focusing only on diabetes treatments as originally planned.

Question

You lead an engineering team at a **startup** that has just accidentally created a new material that's ultra-lightweight and heat-resistant while developing parts for electric cars. While promising, the material is still in early testing stages, and other applications (like aerospace or defense) are only speculative at this point.

What is the best strategy to maximize this opportunity?

- A) **Exploit** by immediately marketing the material to industries like aerospace and defense.
- B) **Escalate** to your company's investors and board for a decision on forming a new division.
- C) **Share** the opportunity by licensing the material's technology to companies in other industries.
- D) **Enhance** the opportunity by further researching and refining the material to broaden its applications and marketability.
- E) **Accept** the opportunity without changing the current product development plan.

6. Monitor risks

- Process of monitoring the implementation of agreed-upon risk response plans, tracking identified risks, identifying and analyzing new risks, and evaluating risk process effectiveness throughout the project
- Benefit: it enables project decisions to be based on current information about overall project risk exposure and individual project risks

Risk Management Approach – PMI framework



Monitor, review and report

- Having taken action, **did it work?**
- **What has changed ?** There are constant changes in the internal and external contexts of the organization and in the severity and number of risks faced.
- Many organizations use **key risk indicators** to track the performance of risks against risk appetite, and key control indicators to track the performance of the critical controls.
- **Who should tell ?** It is important to tell people with an interest in the objectives about the risks we have found and how we are addressing them (risk communication)
- **What did we learn ?** Risk lesson learned

Responding to a change in context



- Heavily taxed & regulated
- Smoking prohibited in some areas

Avoid that market

Develop a product where regulations do not apply

It can be challenging to stop once we've started a set course

Speed how fast you are travelling



Velocity "speed in a given direction"



- **Velocity:** the rate of change of position along a straight line with respect to time (or more simply, the speed of an object as it moves in a particular direction)
- An object in uniform motion will tend to remain in motion – in the same direction – unless something stops it

Once we are in motion, we must constantly surveil our actions to determine if they are contextually appropriate or if their intended effects backfire

Risk response reserve

- **Contingency Reserves**
 - Used for known “unknowns” identified in the risk plan
 - Usually managed and “owned” by the project manager
 - Usually derived via quantitative analysis methods
- **Management Reserves**
 - Used for unknown “unknowns” not identified in the risk plan
 - Usually help “owned” by the sponsor or company senior management
 - Derived via qualitative analysis methods

Risk Management Approach – PMI framework



- Think first, then do !
- Planning is a safe harbour
- Delivery is venturing across the storm-tossed seas

Best practises



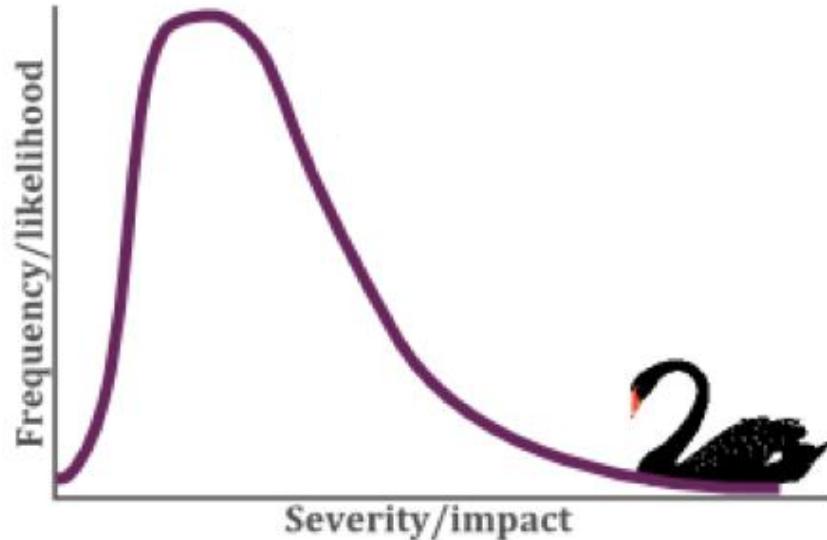
Think slow, act fast



<< If I had 5 minutes to chop down
a tree, I'd spend the first 3
sharpening the ax >>

Abraham Lincoln

Black Swan management*



- Some tails are simple to cut !
- Narrow the time window that the Black Swans can crash through – finishing is the ultimate form of prevention

Best practises

1. Design controls **proportionate** to the risks at stake
2. Analyse the **lessons from success** (not only from failures)
3. **Vigilance** is key, and **rapid intervention** reduces impact
4. Use risk management to boost and **protect business performance**

1. Risk management is proportionate



“carelessness”, too little control

- Accidents
- Instability
- Remediation costs

Proportionate risk
management reduces
inefficiencies

Too much control, too cautious

- Slowness
- Rigidities
- Opportunity costs

- Small risks → small fuss
- Big risks → extreme care
- Daily risks are acceptable

2. Risk management celebrates success

Looking back to the causes of failures is valuable, but it can create resistance through implied criticism

Reflecting on **success stories** is inspiring

- Why did we win ?
- Negative bias: negative experiences imprint on our memory more quickly and last longer than positive ones

3. Vigilance is key, and rapid intervention reduces impact

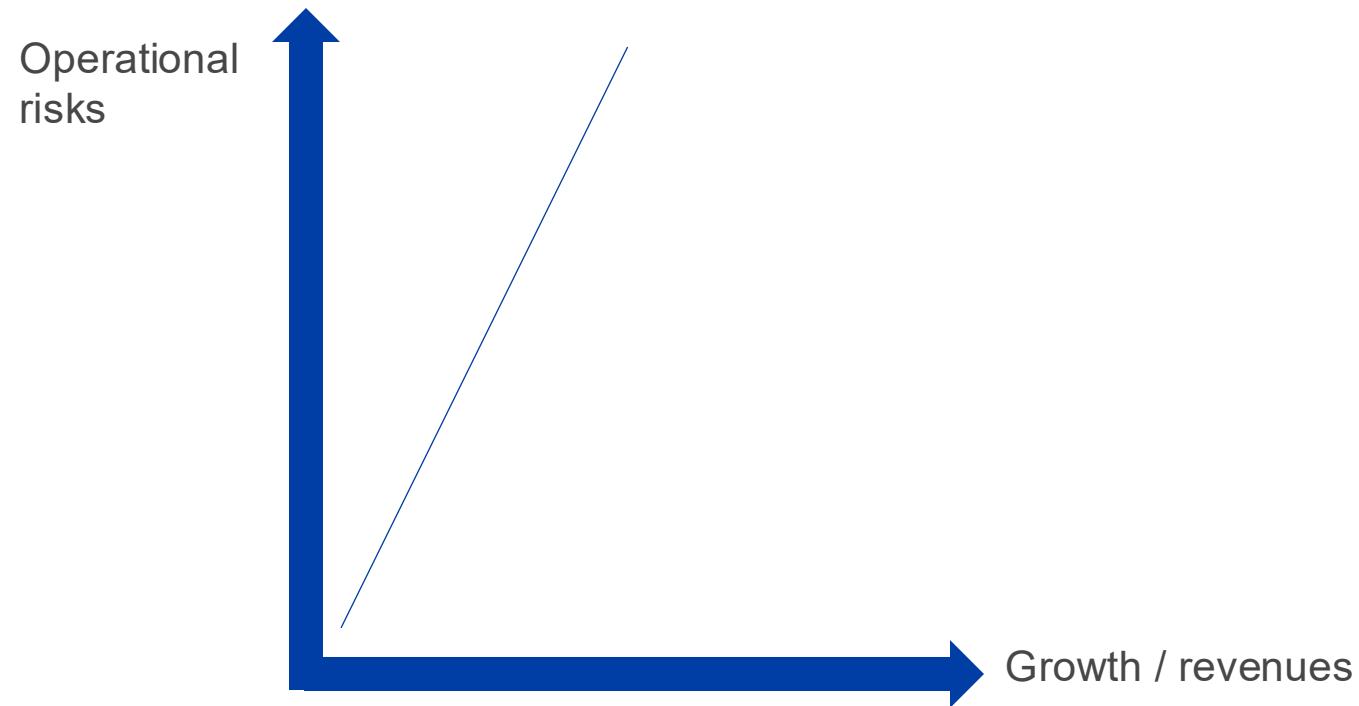


See it. Say it. Sorted

4. Risk management protects from performance

- Capture the upside of uncertainty, prevent the downside as much as possible
- Risk management is necessary even desirable but it takes method
- Risk management is a **condition for ambition**
 - “Dream big, risk big”
 - The more ambitious the objective, the more important risk management is to achieve it

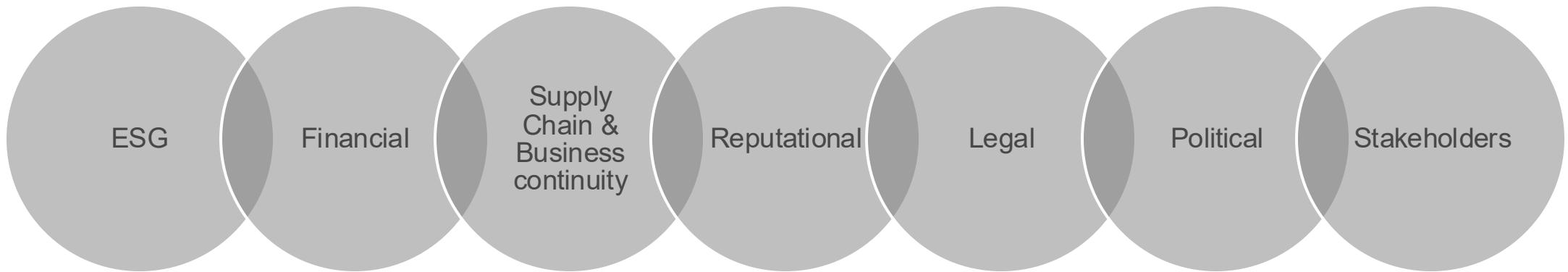
Complexity increases more rapidly than size !



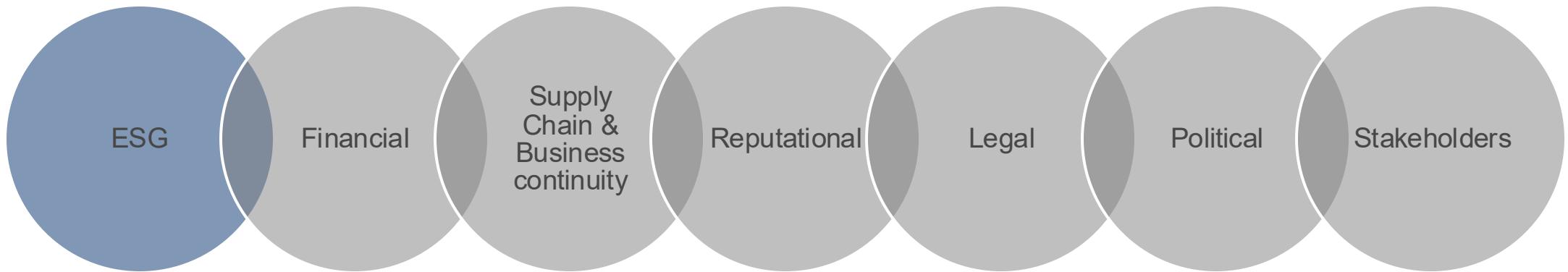
Risk dimensions



Risk dimensions



Risk dimensions



ESG

ESG (Environmental, Social and Governance)

CSR (Sustainability, Corporate Social Responsibility)

PPP (People-Planet-Profit/Prosperity)

Company optimized to deliver not only financial value, but also value to the
people and planet

ESG

SUSTAINABLE DEVELOPMENT GOALS



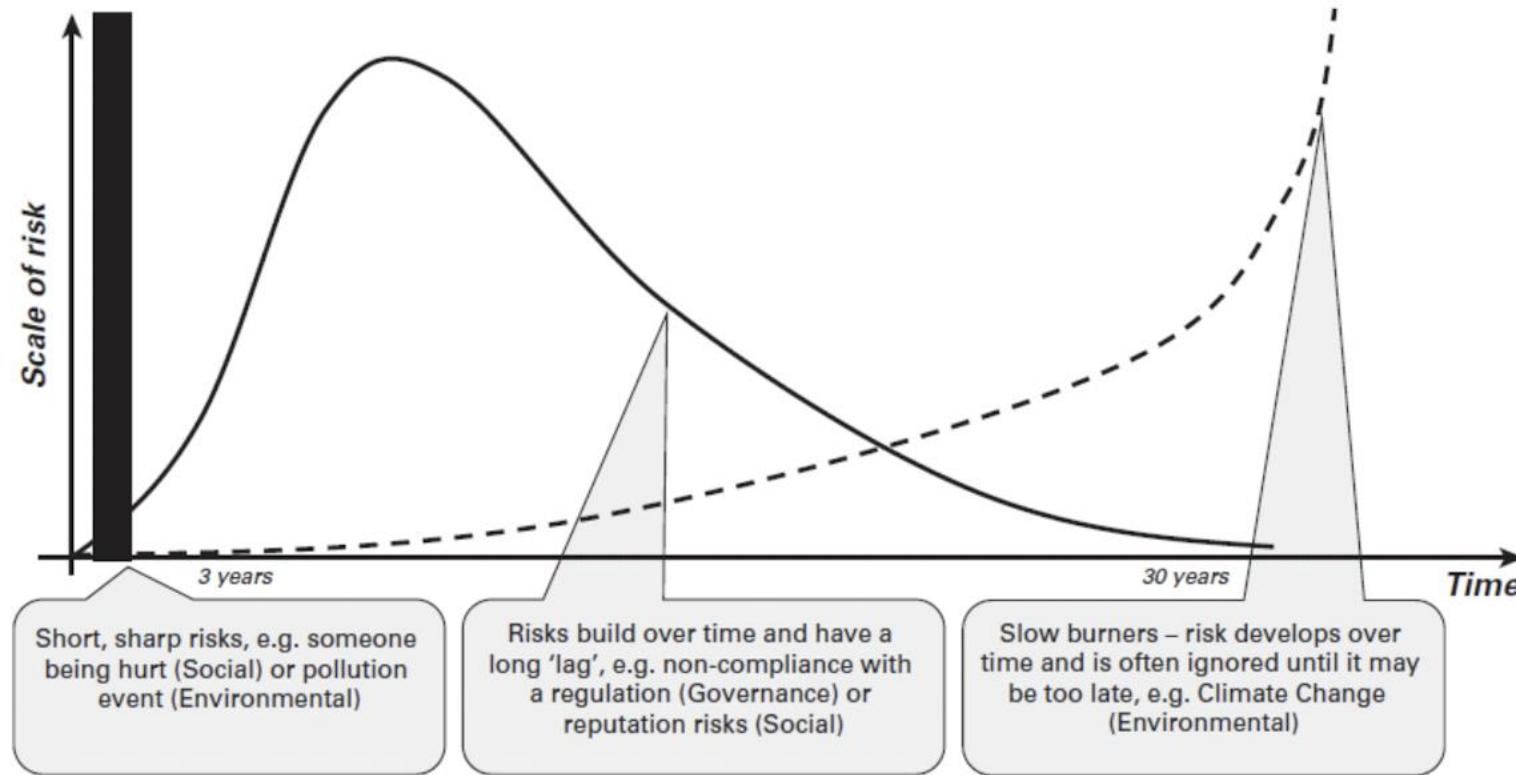
Data source: United Nations' Sustainable Development Goals, 2015

It is very tempting for organizations to treat their E, S and G separately



Source: Gordon (2022a), Satarla Ltd with influence from Jeroen Kraaijenbrink (2019)

The time horizons considered in ESG risk management tend to be longer



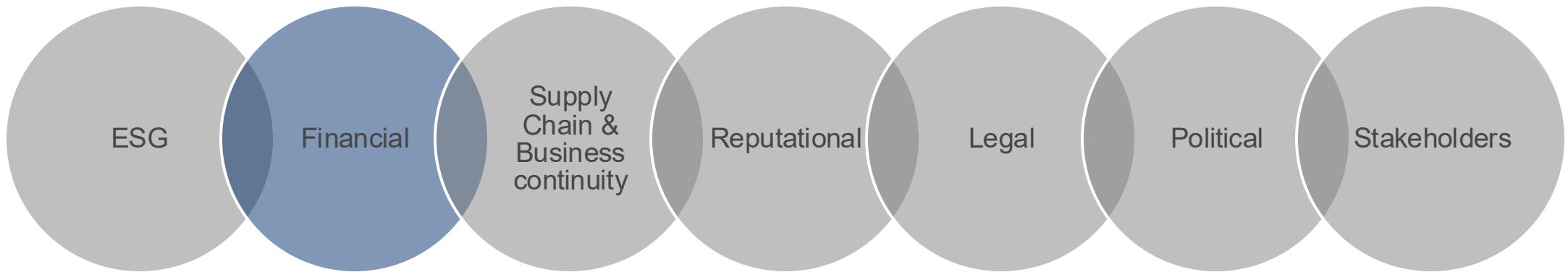
Source: Gordon (2022c), Satarla Ltd

What is now required for climate-related risks is valid for all types of business exposures

Example: lithium battery producer



Risk dimensions



Financial risk

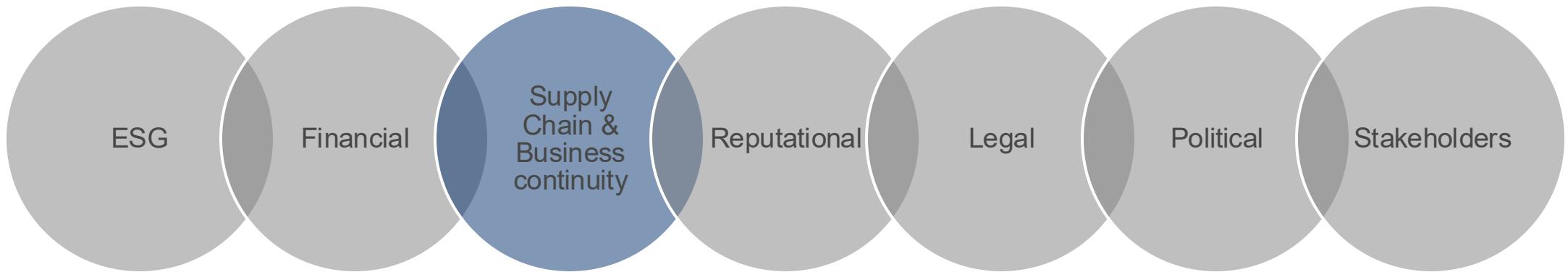
Financial risk: possibility of losing money or facing financial instability due to various factors, both internal and external

Examples: market risk, credit risk, liquidity risk, operational risk (system failure, fraud, failed internal process), foreign exchange risk, interest rate risk etc

Strategies

- Hedging and financial instruments
- Diversification (investments, customers, suppliers, markets)
- Insurance
- Liquidity management

Risk dimensions



Definitions

Supply chain risk: the likelihood and consequence of events at any point in the end-to-end supply chain, from sources of raw materials to end use of customers

Business continuity risk: any incident (large, small, natural, accidental or deliberate) that has the potential to cause a degree of disruption to an organization's operations and its ability to deliver products and services'

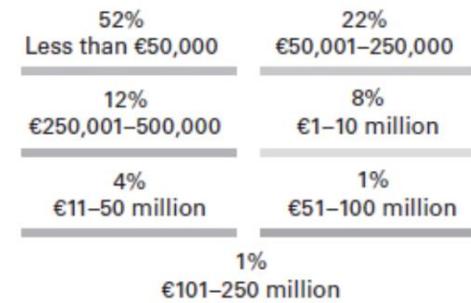
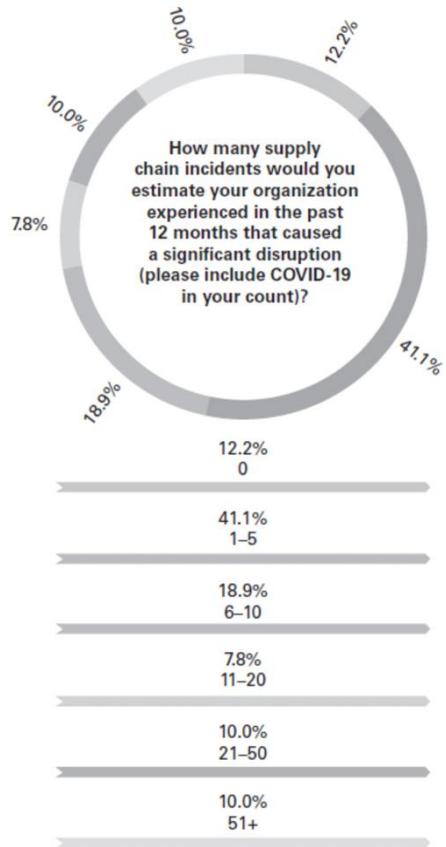
Ever Given – Suez Canal blockage



Ever Given – Suez Canal blockage (March 2021)

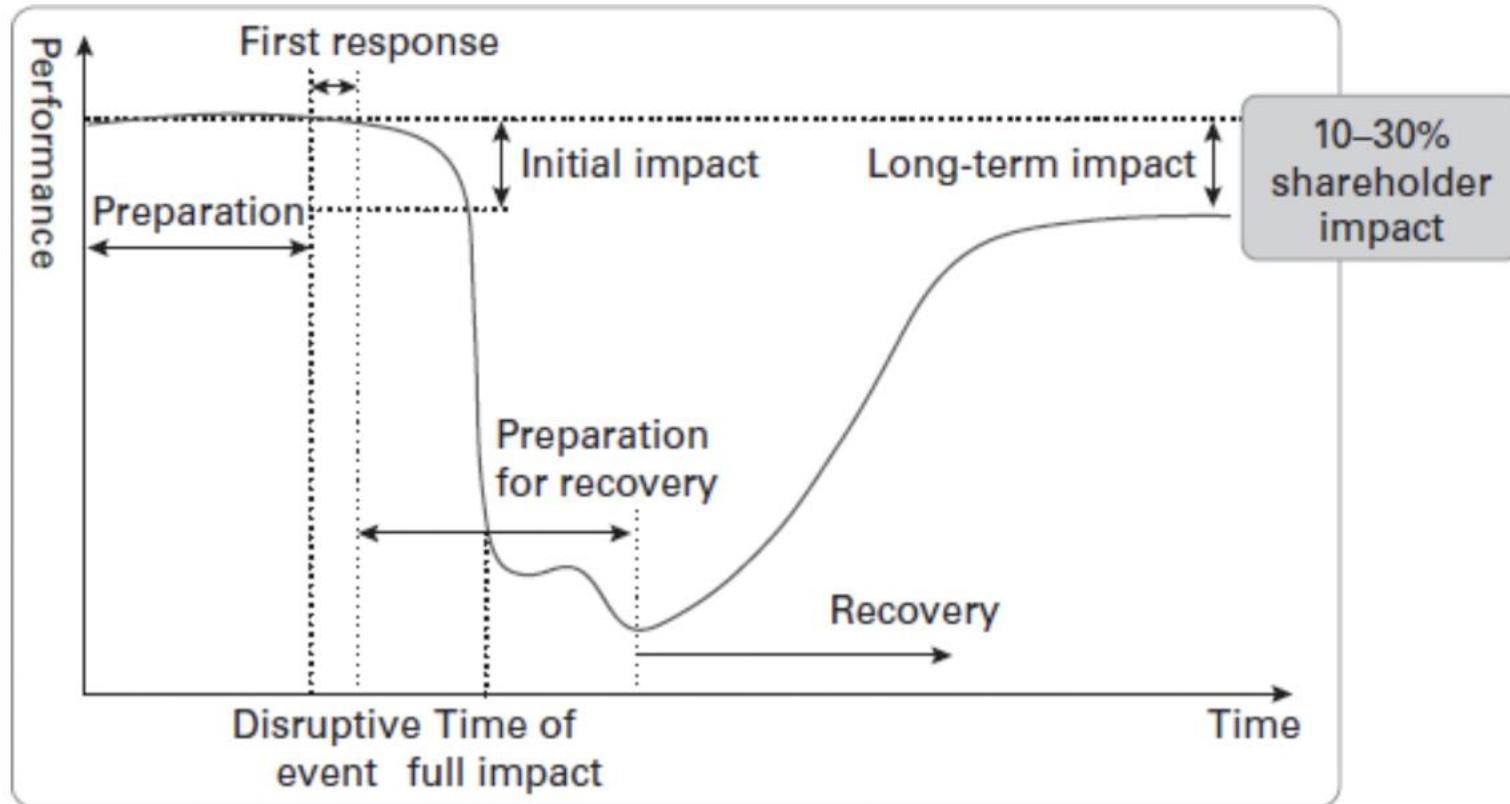
- Trivial event: gusts of wind from the Egyptian desert
- Ship got stuck for 6 days freezing around \$10B in trade each day
- Dynamic interdependencies among the parts of the system created non-linear responses and amplification

Supply chain disruption & financial impact



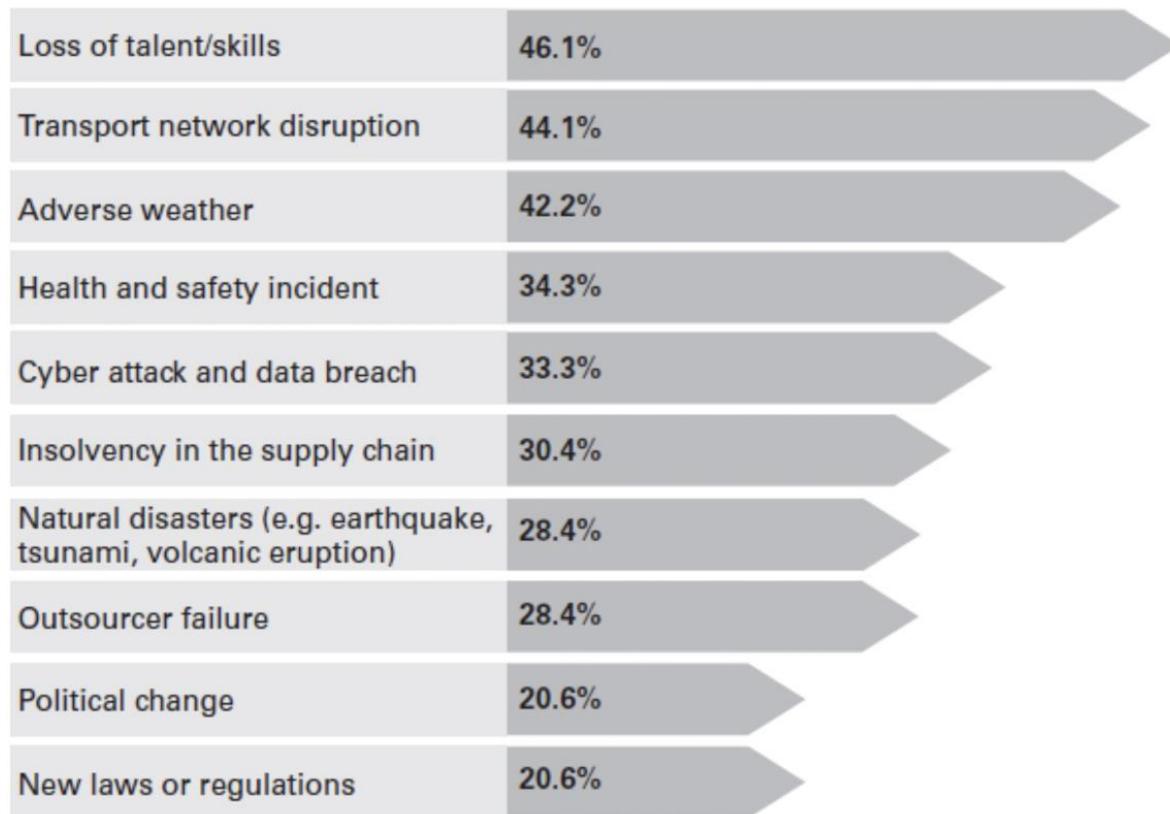
Source: Business Continuity Institute (2021), SOURCE Business Continuity Institute (2018)

Supply chain disruptions impact financial performance



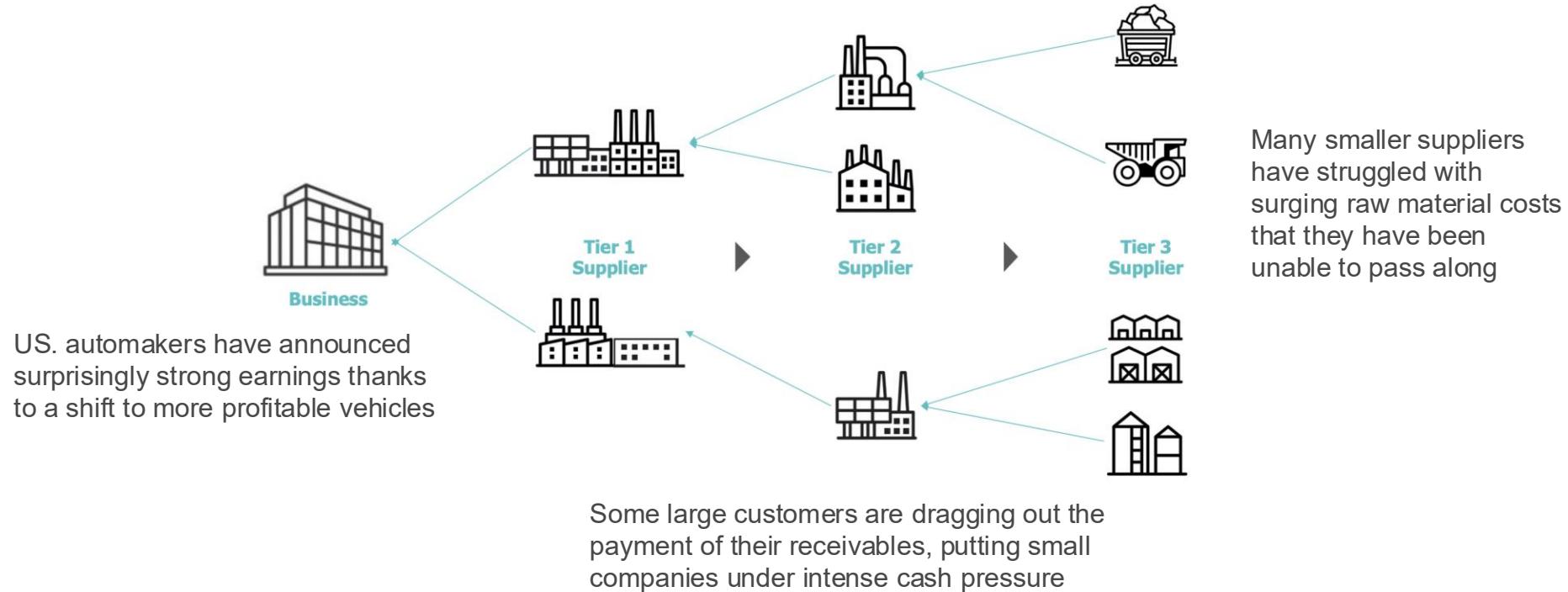
Source: Sheffi & Rice (2005)

Causes of supply chain disruptions



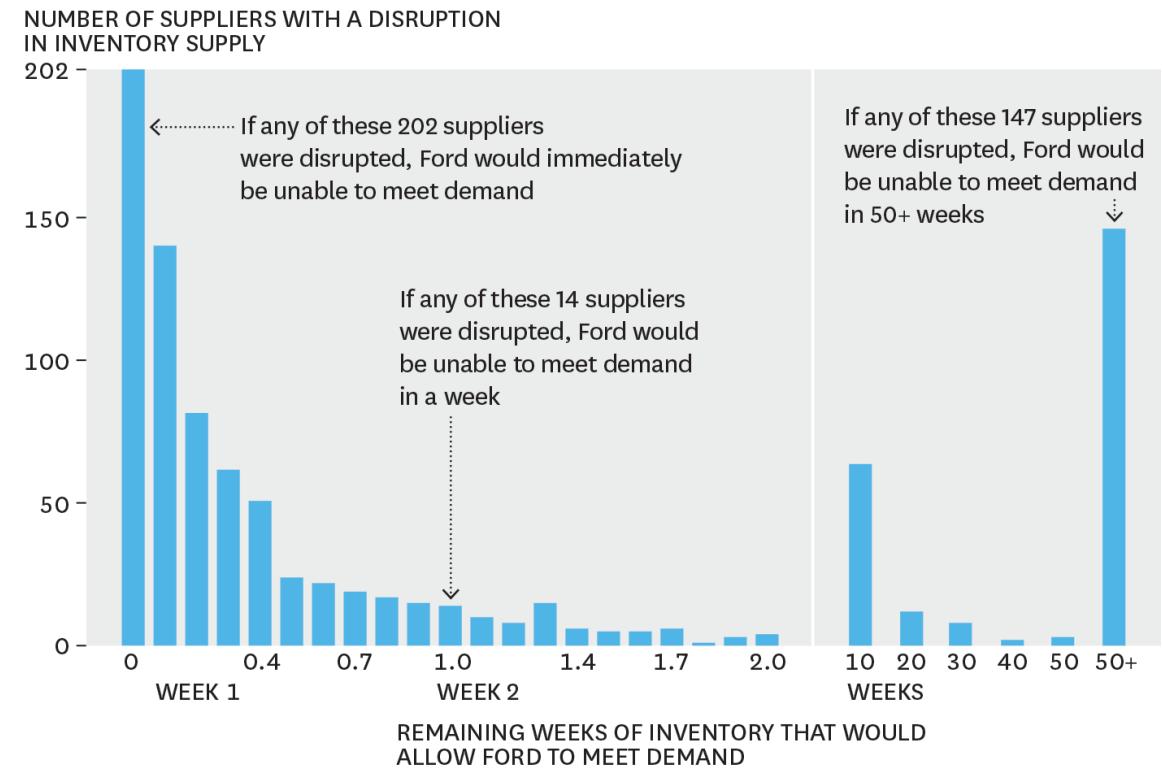
Source: Business Continuity Institute (2021)

The supply chain is only as strong as its weakest link



Stress test example – Ford supply chain

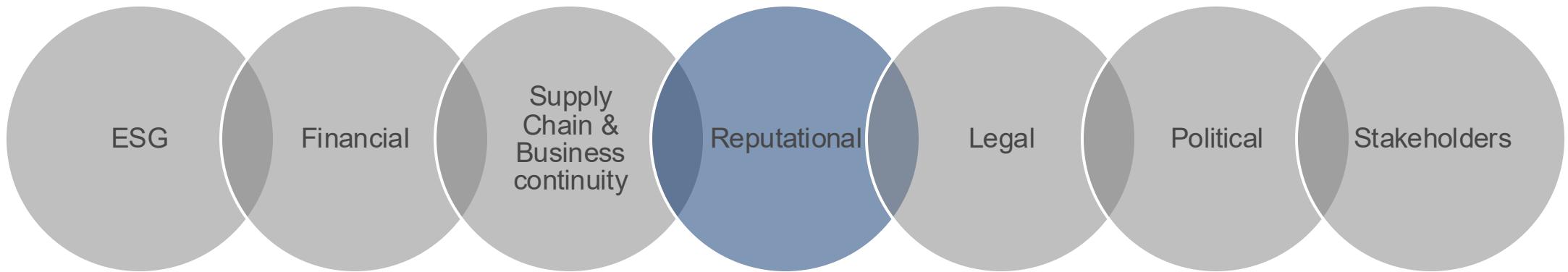
- “**Time to recovery**” (TTR): the time it would take for a particular node to be restored to full functionality after a disruption
- “**Time to survive**” (TTS). It is the maximum duration that the supply chain can match supply with demand after a node disruption
- If TTS of a specific site > TTR → no risk



*DATA IS SLIGHTLY MODIFIED TO PROTECT PROPRIETARY INFORMATION
SOURCE DAVID SIMCHI-LEVI

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Risk dimensions



Reputational risk

Might impair prospective earnings arising from the non-delivery of the ‘promise’.

Examples: data breaches, offensive language in customer communication, fraud investigations, money laundering charges etc

It is multi-dimensional

- It affects individuals, organizations, business areas, cities and countries
- Relates to emotions (feelings), thoughts (attitudes) and actions (behaviours)
- History matters

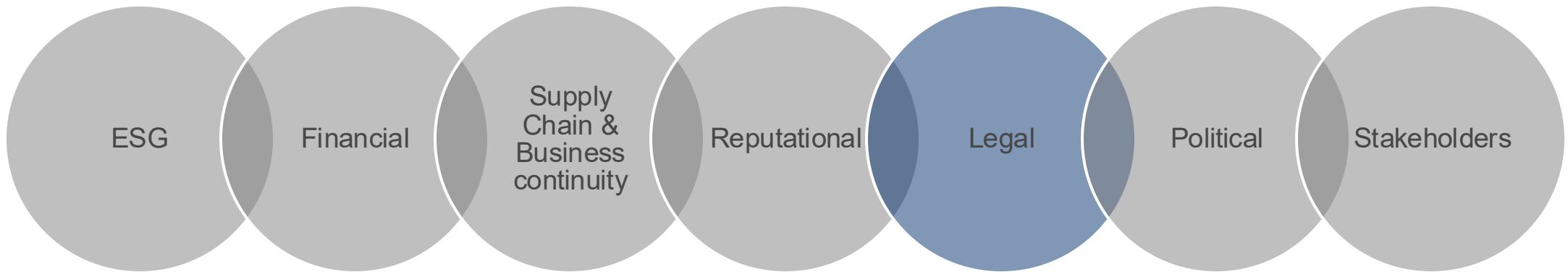
Strategies

Proactive Monitoring and Early Detection (social media, media and public relations, stakeholder feedback)

Establish a Strong Corporate Culture (ethical leadership, code of conduct and ethics training, corporate social responsibility)

Effective crisis management (crisis management plan, crisis communication strategy)

Risk dimensions



Legal risk management

Legal risk: risk related to legal, regulatory and contractual matters, and from non-contractual rights and obligations

Examples:

- Failing to meet its contractual obligation or enforce its contractual rights
- Entering contracts with onerous (or not enforceable) terms and conditions
- Failing to enforce its intellectual property (IP) rights

Strategies

Regular compliance audits

Develop and Enforce Robust Policies and Procedures

Contractual Risk Management

Legal Training and Awareness Programs

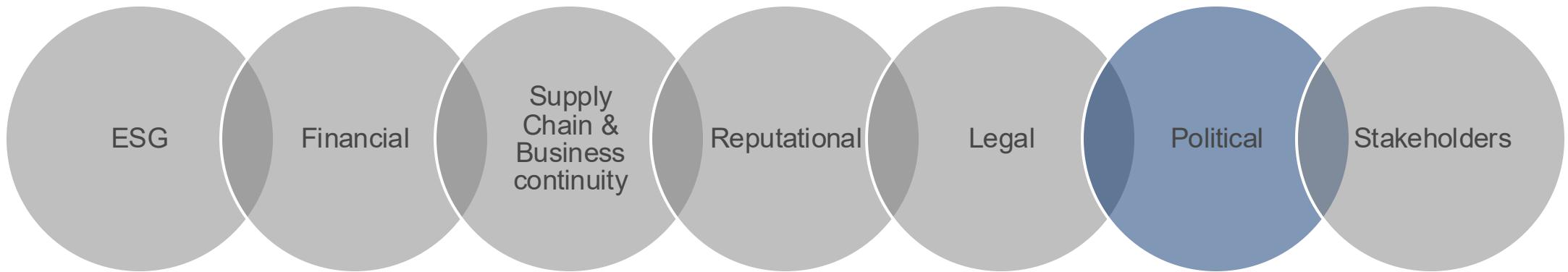
Engage Legal Counsel (Internal and External)

Monitor Regulatory and Legal Developments

Implement Risk Transfer Mechanisms (e.g. insurance)

Create a Strong Documentation and Record-Keeping System

Risk dimensions



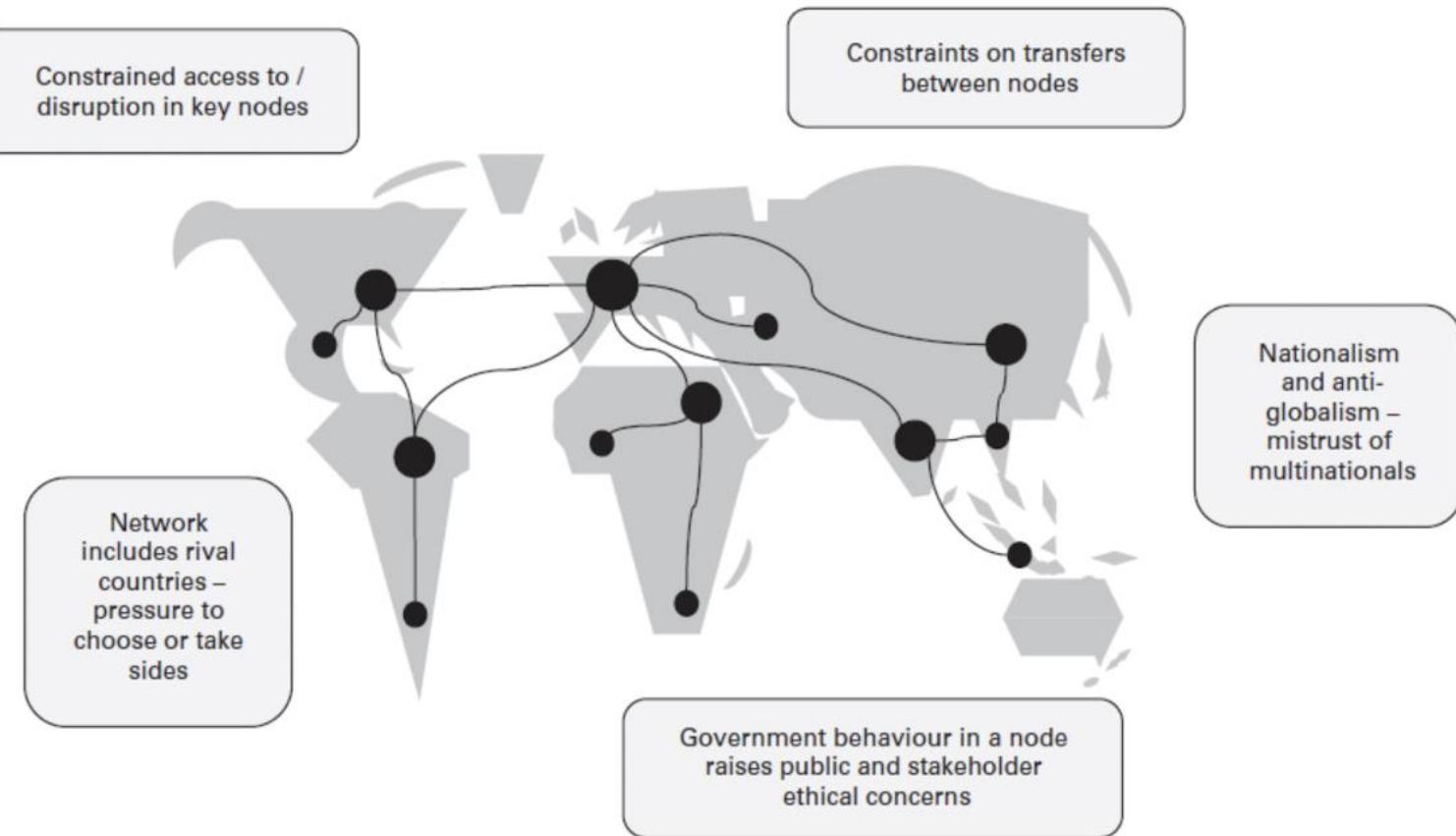
Political risk management

Political risk: how a company avoids, prevents, reduces and mitigates political risk at both the global and country operational levels

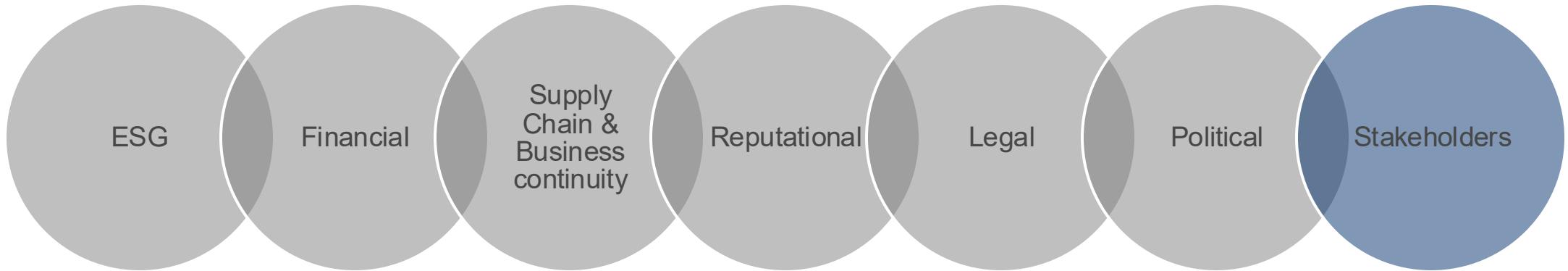
Strategies

- Adjust international exposures, international growth plans
- Long-range strategic options
- Socio-political relationships and communications
- Policies and standard operating procedures
- Crisis and contingency plans

Global corporate political risk



Risk dimensions



Stakeholders risk

Who are the stakeholders ?

Individuals

Groups (or organizations);

individuals holding multiple stakeholder roles – such as decision maker, employee, employer, shareholder, supplier, lobbyist or neighbour

Key challenge: understanding who is important at any particular time and then allocating scarce resources to work with the people who matter

Stakeholder management

5 step process

1. Identify
2. Prioritize who is important
3. Visualize to understand the overall stakeholder community
4. Engage through effective communication
5. Monitor the effect of the engagement

Stakeholder Circle software (free)

<https://mosaicprojects.com.au/PMKI-SHM-030.php>

Risk is not rational

The way people feel about risk is an amalgam of emotional reaction, learned experience and rational consideration

The very concept of risk is tied to perceptions and emotions; attempts to manage risk as a pragmatic, rational process will lead to suboptimal outcomes

Sensemaking: a filter through which everything experienced, consciously or unconsciously, is passed.

Exercises



Exercise 1

You are in the process of risk identification which is going to involve many cross functional managers and experts. Some of the managers are very aggressive and their subordinates are scared to express their opinions freely in front of them. This is the pet project of your sponsor and you have to complete the project with minimum obstruction. So it is imperative for you to complete the risk identification as soon as possible. In this case, what technique will you use to complete the task?

- (a) Brainstorming
- (b) Expert interview
- (c) Delphi technique
- (d) Nominal group technique

Exercise 2

You are managing a project to construct a strategically important bridge. During the risk identification process a team member identified a risk with a very high impact and low probability of happening. Although the chance of the risk occurring is low, you don't want to take any chances, so you ask to make an amendment to the project plan so the risk does not impact your project in any way. This amendment requires a change in your cost baseline but you still decide to go with it. What kind of risk response strategy have you used here?

- (a) Transfer
- (b) Accept
- (c) Avoid
- (d) Mitigate

Exercise 3

You join an ongoing project whose project manager has left the job due to personal reasons. While reviewing some project documents you see that while recording probability distribution data, he took a wide range between the pessimistic and optimistic values. What was the risk attitude of the previous project manager?

- (a) Risk seeker
- (b) Risk neutral
- (c) Risk averse
- (d) Risk rational

Exercise 4

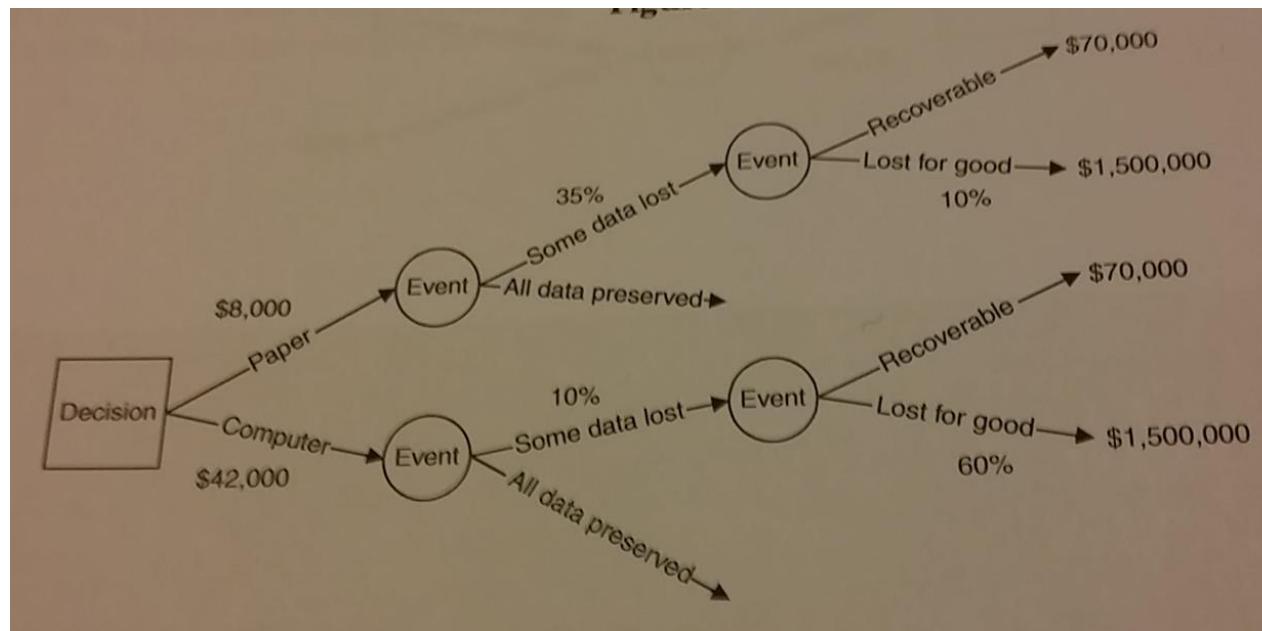
What is an opportunity ?

- A. A positive risk
- B. An issue
- C. A problem
- D. A threat

Exercise 5

Applying EVM approach, which of the following is correct ? Figures in the diagram represent costs

- A. The computer solution will save us \$52,250
- B. **The paper solution will save us \$52,250**
- C. The paper solution will save us \$749,000
- D. The computer solution will save us \$749,000



Exercise 6

During the risk response process you have identified a negative risk for which your team members are suggesting several responses, which are given below. Which of the following responses is the best?

- (a) Investment amount is 10,000 and probability of success is 80%
- (b) Investment amount is 6,000 and probability of success is 40%**
- (c) Investment amount is 15,000 and probability of success is 60%
- (d) Investment amount is 12,000 and probability of success is 25%

Exercise 7

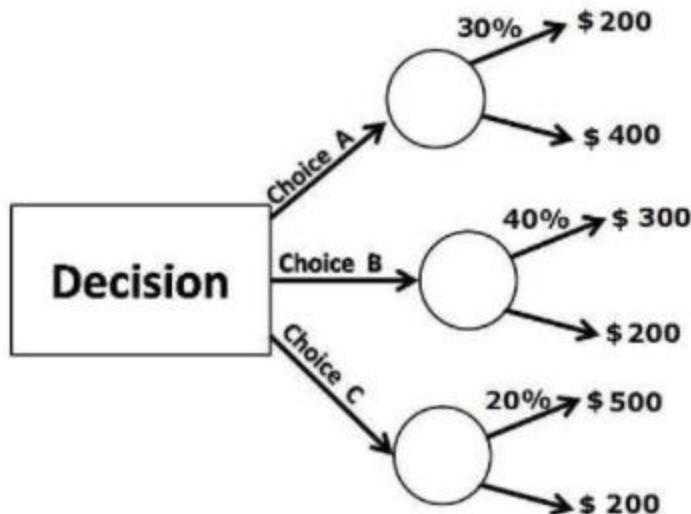
Due to the rainy season, there is a chance that a certain consumable to be used in your project may become cheaper by 25%, saving you 10,000 USD. Moreover, there is also a 40% chance that rain may slow down your progress and you may need to keep the equipment for a few more days, causing you an additional 25,000 USD. Calculate the expected monetary value of these two events.

- (a) -7,500
- (b) 7,500**
- (c) 12,500
- (d) -12,500

Exercise 8

Based on the decision tree diagram below, identify which option is the best choice (figures refers to pay-offs)

- A. Choice A
- B. Choice B
- C. Choice C
- D. Insufficient data



Exercise 9

You are performing the “qualitative risk assessment” phase for your project and you have identified the following risks and opportunities through a combination of Brainstorming and Delphi Technique.

Item	Item Type	Probability (from 1 to 10)	Impact (from 1 to 10)
A	risk	6	5
B	risk	4	7
C	risk	3	2
D	risk	2	5
E	risk	4	6
F	opportunity	3	4

During the “Plan Risk Management” phase you have established that all only the items with a risk score greater than 11, will move forward to the following steps (e.g. quantitative analysis & plan risk response).

1. Determine the “non-top” risks/opportunities (e.g. items which will not be considered for the following steps) C,D
2. Determine the risk score for each risk and opportunity to be considered in the mitigation steps A=30, B=28, E=24, F=-12
3. Calculate the overall project risk score **17.5**

Exercise 10

You are the project manager for a farm. The farm is looking for additional sources of income and one of your projects is to set up a cheese-making class for other local farmers and interested hobbyists. This activity is expected to generate \$10,000 profit.

There are four risks identified:

Risk	Type	Probability	Impact (\$)
There is a risk that the cheese-making class will be cancelled due to staff shortage	Threat	25%	5000 (cost)
There is a risk that the cheese-making class will be over-subscribed	Opportunity	10%	5000 (profit!)
There is a risk that the marketing materials will be late	Threat	50%	600 (cost)
There is a risk that the barn will not be fit for purpose and we have to relocate the class to a more expensive marquee	Threat	25%	10000 (cost)

1. With no risk analysis, how much profit would the management expect to generate **\$10,000**
2. What is the best case profit taking into account the risk analysis but assuming only good things happen? **\$15,000**
3. What is the expected monetary value (EVM) of the project ? **\$6450**
4. What is the worst case profit (e.g. only bad thing happen) **-\$5600**

Exercise 11

You are the project manager for a farm. The farm is looking for additional sources of income and it has two options to consider. The team could offer weddings, or they could convert a barn into a children's play area. They want to use EMV to work out which would be the best option

The table below shows the investment required under each option and the revenue forecast for each level of demand (high, medium, low)

Option	Investment (\$)	Revenue forecast- High Demand (\$)	Revenue forecast - Medium Demand (\$)	Revenue forecast - Low Demand (\$)
Wedding	50,000	100,000	75,000	40,000
Children's play barn	80,000	140,000	125,000	95,000

Probability of high demand is 25% and probability of medium demand is 50%.

- Under the Wedding option, what are the expected revenues for each level of demand ? **High=25000, Medium=37500, Low=10000**
- Under the Children's play barn option, what are the expected revenues for each level of demand ? **High=35000, Medium=62500, Low=23750**
- Determine which option is the best. **Children's barn**