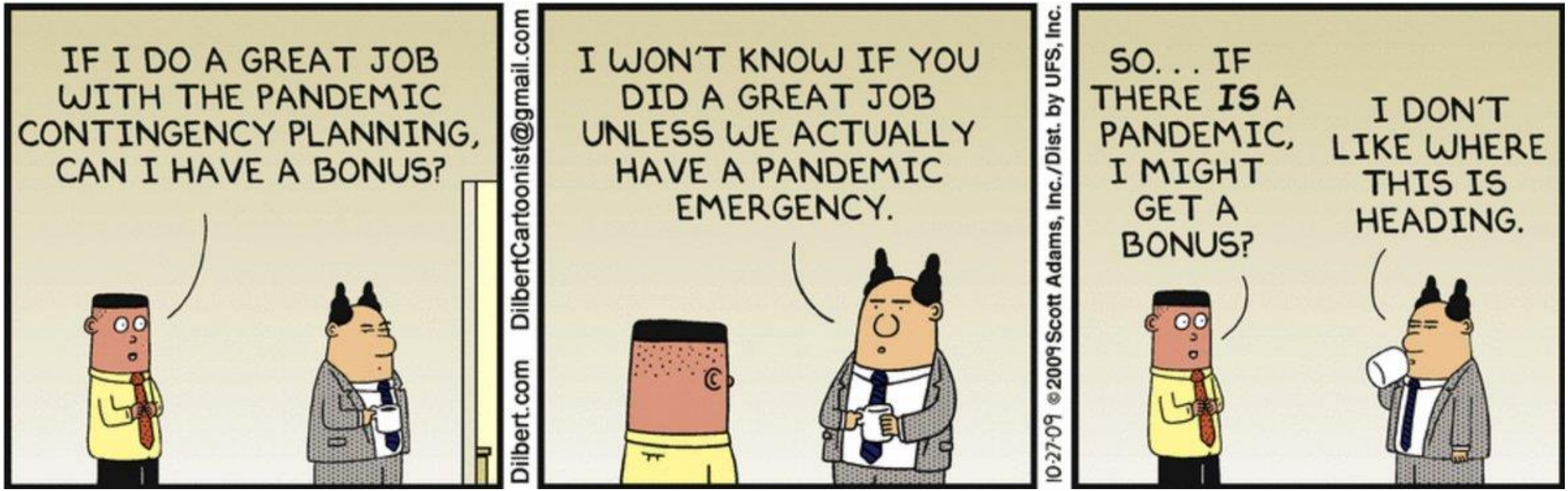
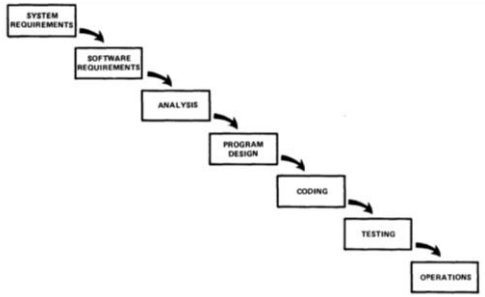
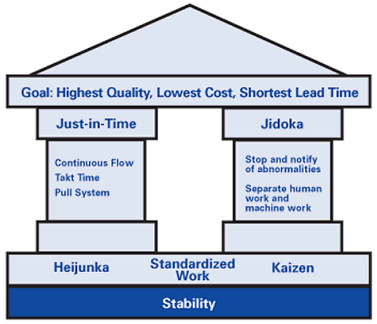
Risk Management

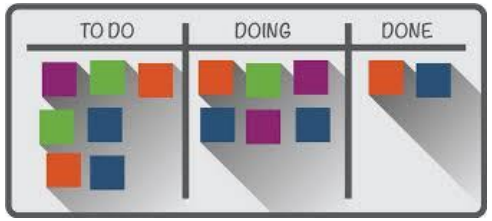


RECAP

- Initiation
  - PMBOK
  - PRINCE2
- Planning
  - Scope (WBS)
  - Time (Gantt, CPM, PERT)
  - Budget (EVA)
  - Performance (KPIs)
- Execution
  - Traditional: Planning essential (Waterfall)
  - Lean: eliminate waste, max flow of value to customer (MVP, Kanban)
  - Agile: embrace change, cont. delivery of working software, trust, collaboration (Scrum, Kanban)








● REC
This session is being recorded.

WARWICK

CS352 Project Management for Computer Scientists

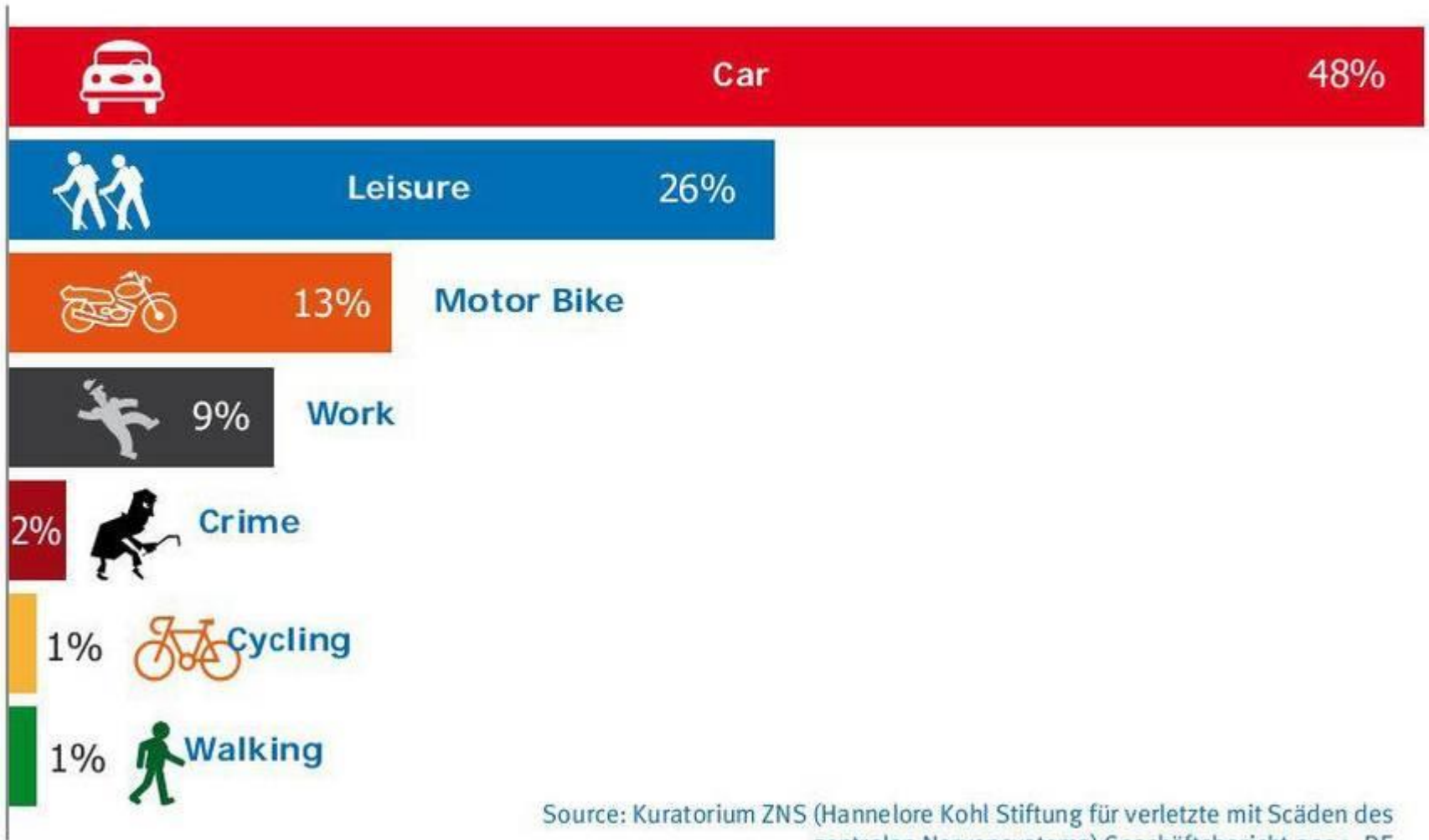
8. Managing Risk

interact at:

warwick.ac.uk/pm4cs/8

Dr Ian Saunders

Causes of head injuries



Source: Kuratorium ZNS (Hannelore Kohl Stiftung für verletzte mit Scäden des zentralen Nervensystems) Geschäftsbericht 2004, DE

Some Cycle Helmet “Facts”

- *Bike helmets may reduce the risk of head and brain injury by 85-88%, but only for those who get into accidents* -- Thompson et al 1989
- *Motor vehicle occupants are actually slightly more likely to suffer head injury than cyclists* -- Robinson 1996
- *The health benefits of cycling outweigh the life-years lost by a factor of twenty to one* -- Hillman 2007
- *Wearing a helmet changes how drivers perceive the cyclist. Drivers pass closer to a cyclist wearing a helmet* -- Walker 2007
- *In Australia, when a helmet law was introduced at a time when the popularity of cycling was on the rise, a 44% decrease in children cycling was observed, which was five times the size of the increase in children wearing helmets.* -- Hillman 2007

https://bigthink.com/neurobonkers/the-bike-helmet-paradox

Today

- **Risk in Projects**
- Risk in Software Development
- Taking Responsibility
  - RACI Matrix
- Identifying Risks
  - SWOT / RBS
  - Decision Tree / EMV Analysis
- Identifying Causes
  - Ishikawa (Fishbone)
  - Sensitivity Analysis
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  - Risk Matrix
  - FMEA

Standardizing the management of risk

ISO 31000

- ~~"chance or probability of loss"~~
- **"effect of uncertainty on objectives"**

How to deal with risk?

- Avoid - discontinue activity that gives rise to the risk
- Remove the risk source
- Change the likelihood
- Change the consequences
- Share the risk with another party or parties
- Retain the risk by informed decision
- Accept
- Increase the risk in order to pursue an opportunity

https://www.iso.org/obp/ui/#iso:std:iso:31000:ed-2:v1:en

Risks vs Opportunities

Terminology

Risk: effect of *uncertainty* on objectives

Uncertainty: something that is not definite, i.e. has a probability of occurrence
Types of uncertainty: events that may or may not happen, lack of information.
Areas of uncertainty: Time, Cost, Quality, Health and Safety, Legality …

Tolerance to risk: person/organisation can be risk-averse, risk-neutral, or risk-seeking.
Threats *vs* Opportunities: risk not necessarily negative – may be unexpected benefits.
Known risks: identified ones. Under control of PM (paid for from contingency reserve)
Unknown risks: not anticipated. Under control of senior management (paid out of management reserve)

Issue: If the event that caused risk occurs, it becomes an *issue*.

Risk Appetite

I'm going to toss a coin. Which gamble will you choose?

Choose One:	Payout if Heads	Payout if
Gamble 5	£0	£2000
Gamble 4	£100	£1900
Gamble 3	£300	£1500
Gamble 2	£400	£1200
Gamble 1	£450	£950
Gamble 0	£500	£500

Adapted from Binswanger (1981)

warwick.ac.uk/pm4cs/8

POLL OPEN

Risk Appetite

I'm going to toss a coin. Which gamble will you choose?

Choose One:	Payout if Heads	Payout if Tails	
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Adapted from Binswanger (1981)

Risk Appetite

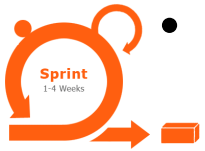
Choose One:	Payout if Heads	Payout if Tails	Gamble Structure	Expected Payout	Category Description	Choice Percentage (0.5× scale)
Gamble 5	£0	£2000	0.5 * £2000	£1000	Neutral to Preferred	19%
Gamble 4	£100	£1900	£100 + 0.5 * £1800	£950	Slight to Neutral	15%
Gamble 3	£300	£1500	£300 + 0.5 * £1200	£900	Moderate	20%
Gamble 2	£400	£1200	£400 + 0.5 * £800	£800	Intermediate	29%
Gamble 1	£450	£950	£450 + 0.5 * £500	£700	Severe Aversion	6%
Gamble 0	£500	£500	£500	£500	Extreme Aversion	2%

Adapted from Binswanger (1981)

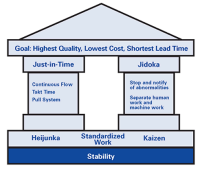
Different Approaches to Risk Management

- **PMBOK:**
  - **Systematic breakdown into KAs and PGs**: Avoid the *risk* of missing something
  - **Risk KA**: Explicitly plan to avoid *risk*

- **PRINCE2®:**
  - **Board of Directors**: to avoid the *risk* of losing control of the project
  - **Board Roles**: avoid *risk* of failure to meet stakeholder expectations
  - **Business Case**: To avoid the *risk* of failing to meet business needs



- **Agile:**
  - **Iterative**: to avoid the *risk* of delivering the wrong thing
  - **Customer collaboration**: to benefit from the *opportunities* of regular customer engagement



- **Lean:**
  - **Mudas:** Avoid the *risk* of overproduction, overburden etc…
  - **Value:** to benefit the customer by taking all *opportunities* to maximise value

PMBOK Processes

	Initiating	Planning	Executing	Controlling	Closing
Integration	Develop Project Charter	Develop Project Management Plan	Direct and Manage Project Work Manage Project Knowledge	Monitor and Control Project Work Perform Integrated Change Control	Close Project or Phase
Scope		Plan Scope Management Collect Requirements Define Scope Create WBS		Validate Scope Control Scope	
Time		Plan Schedule Management Define Activities Sequence Activities Estimate Activity Durations Develop Schedule		Control Schedule	
Cost		Plan Cost Management Estimate Costs Determine Budget		Control Costs	
Quality		Plan Quality Management	Manage Quality	Control Quality	
HR/Resources		Plan Resource Management Estimate Activity Resources	Acquired Resources Develop Team Manage Team	Control Resources	
Communication		Plan Communications Management	Manage Communications	Monitor Communications	
Risk		Plan Risk Management Identify Risks Perform Qualitative Risk Analysis Perform Quantitative Risk Analysis Plan Risk Responses	Implement Risk Responses	Monitor Risks	
Procurement		Plan Procurement Management	Conduct Procurements	Control Procurements	Close Procurements
Stakeholder	Identify Stakeholders	Plan Stakeholder Engagement	Manage Stakeholder Engagement	Monitor Stakeholder Engagement	

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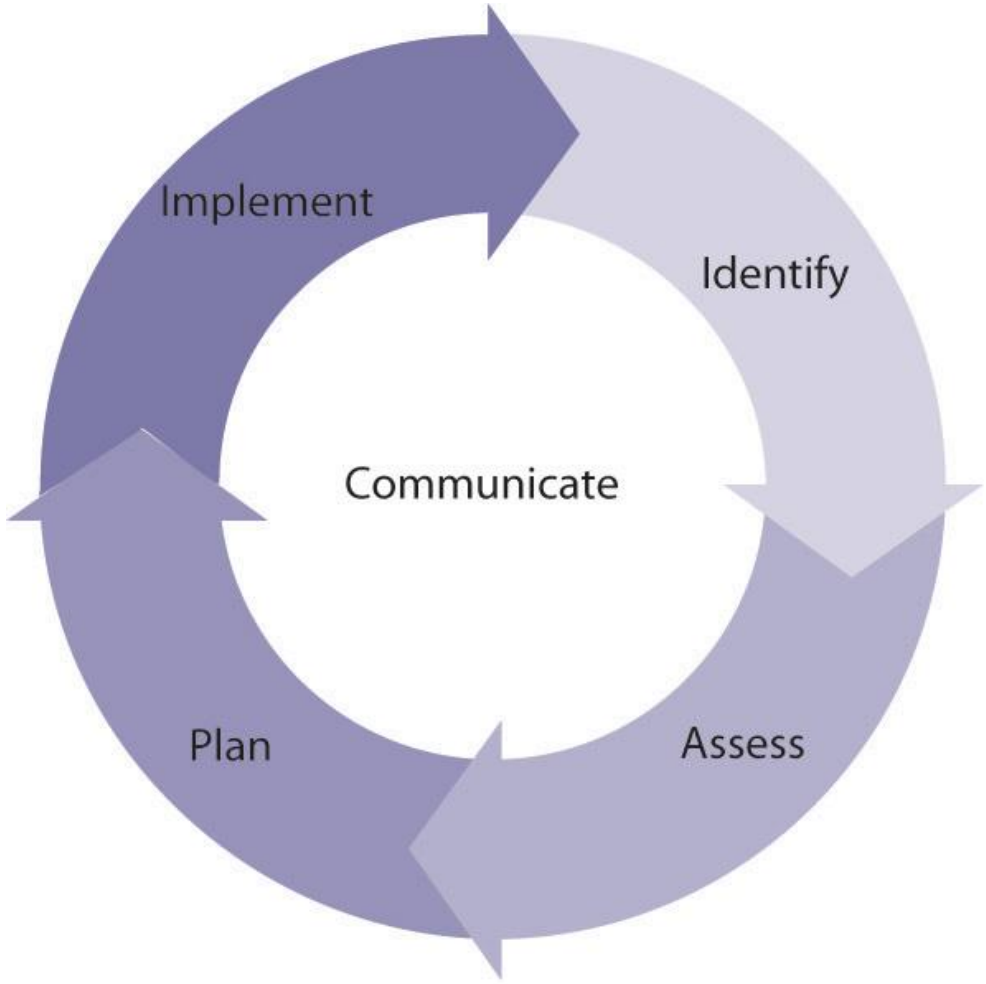
Managing Project Risks

PRINCE2® Risk Planning Cycle

1. **Identify** risks
2. **Assess** probability and consequence
   - What is the likelihood of the risk occurring?
   - How severe will the risk impact be?
3. **Plan** strategies and responses
   - How can we detect risks?
   - What can we do to reduce impact?
   - What actions should we take if risk occurs?
4. **Monitor / Implement** responses
   - When identified risk occurs, execute plan
   - When unidentified risk occurs,
5. **Communicate**
   - inform interested parties



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Risks to Technology Development

From Wallace and Keil (2004). via Arnuphaptrairong survey (2011)

User

- resistance to change;
- conflicts between users;
- negative attitudes towards the project;
- lack of commitment;
- lack of cooperation.

Team

- Inexperience;
- lack of training;
- lack of specialized skills.

Organizational Environment

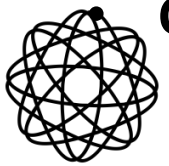
- Change in organizational management;
- negative corporate politics;
- unstable environment;
- organization restructuring.

Planning and Control

- Lack of effective PM technology;
- lack of close monitoring;
- bad estimation of required resources;
- poor planning;
- milestones not clearly defined;
- inexperienced PM;
- ineffective communication.

System Requirements

- Continually changing;
- not adequately identified;
- unclear;
- incorrect.



Complexity

- due to new technology;
- high level of technical complexity;
- immature technology;
- technology not used previously in organization.

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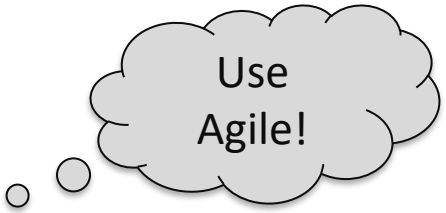

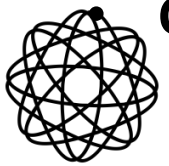

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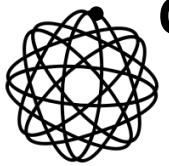

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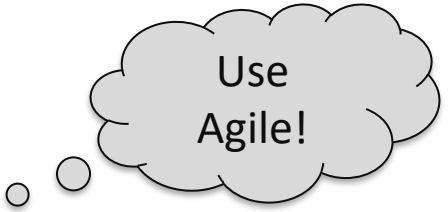

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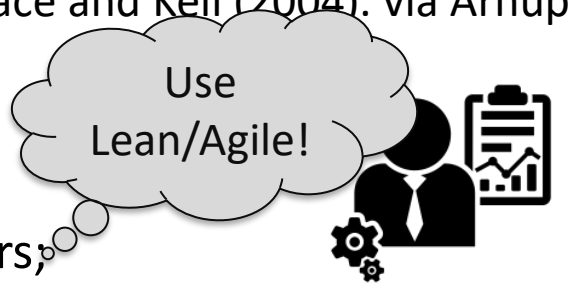

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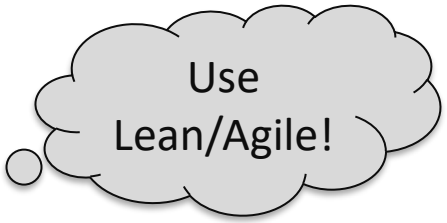

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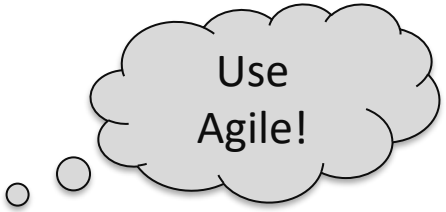

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Use Lean/Agile!

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e.g. Last weeks' seminar

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Iterative solution!

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Document everything with PRINCE2!

Planning and Control

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Take Control!

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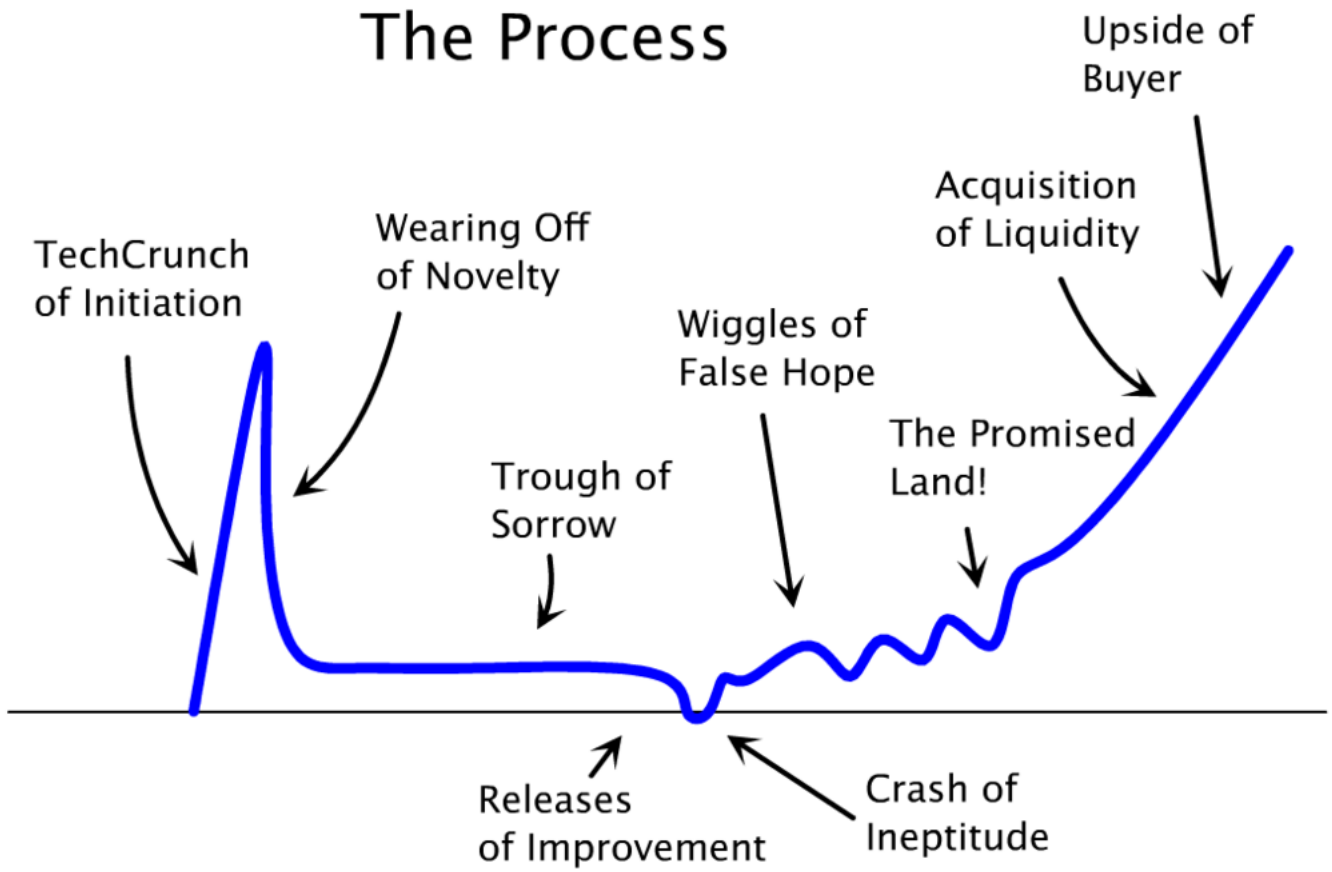
Risks to Technology Innovation

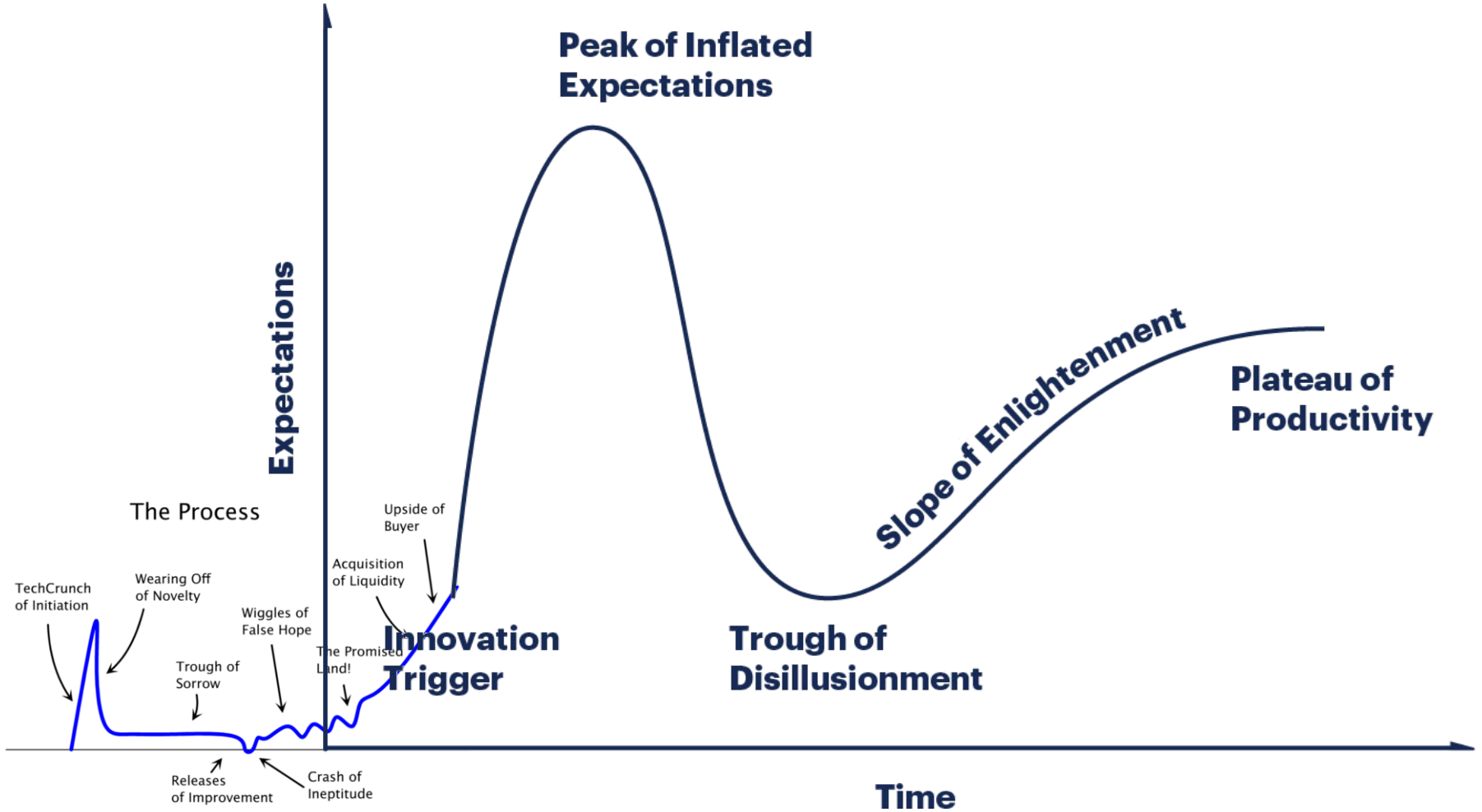
Gaining traction: From innovative ideas to disruptive technologies…



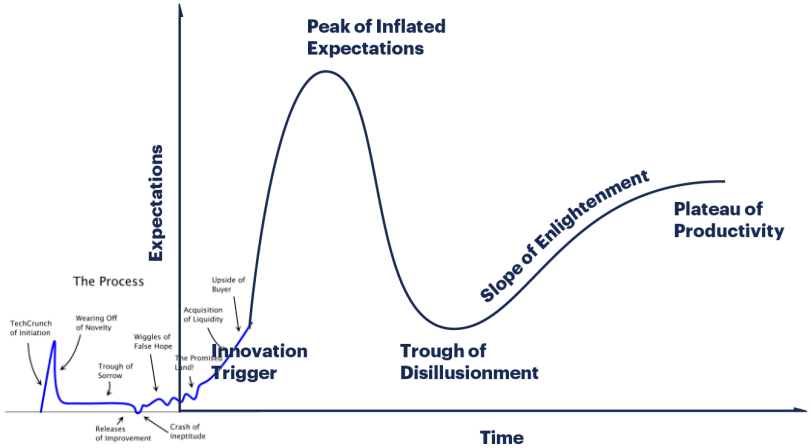
("Trough of Sorrow" Paul Graham, avc.com)

Risks to Technology Adoption

Success: Riding the Gartner **"Hype Cycle"** and Crossing the Chasm



Risk is Everywhere



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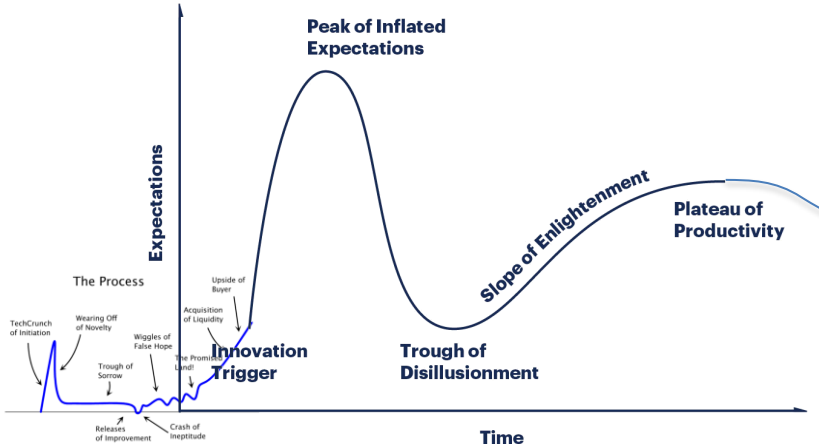

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Assigned Responsibilities

What to do when an issue arises?

- Need to have clear and unique accountability decided beforehand.

Responsibility Assignment Matrix (RACI Matrix)

- Clarifies roles and responsibilities for each item in the WBS
- Records who is **R**esponsible, **A**ccountable, **C**onsulted and **I**nformed.
- All tasks should have **at least** one person **responsible** (the people who actually complete the task)
- Every task should have one and **only one accountable** (the individual who is ultimately answerable for the task)

ROLE / Project Deliverable (or Activity)	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
	Project Leadership					Project Team Members					Project Sub-Teams					External Resources			
Initiate Phase Activities																			
Request Review by PMO	A/C	R/A				R/A	A/C		C										
Submit Project Request						R											A		
Research Solution	I					R/A	A/C	A/C	C				C			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			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		A	A	A	A							C	I		
Close Phase Activities																			
Create Lessions 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		

ROLE / Project Deliverable (or Activity)	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
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Initiate Phase Activities																			
Request Review by PMO	A/C	R/A				R/A	A/C		C										
Submit Project Request						R											A		
Research Solution	I					R/A	A/C	A/C	C				C			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			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		A	A	A	A							C	I		
Close Phase Activities																			
Create Lessions 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		

No R → Who is doing the work?

ROLE / Project Deliverable (or Activity)	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
	Project Leadership					Project Team Members								Project Sub-Teams			External Resources		
Initiate Phase Activities																			
Request Review by PMO	A/C	R/A				R/A	A/C		C										
Submit Project Request						R											A		
Research Solution	I					R/A	A/C	A/C	C				C			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			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		A	A	A	A							C	I		
Close Phase Activities																			
Create Lessions 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		

More than 1 A → Who is in charge?

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Submit Project Request						R											A		
Research Solution	I					R/A	A/C	A/C	C				C			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			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		A	A	A	A							C	I		
Close Phase Activities																			
Create Lessions 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		

Too many Cs → Slow!

ROLE / Project Deliverable (or Activity)	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
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Request Review by PMO	A/C	R/A				R/A	A/C		C										
Submit Project Request						R											A		
Research Solution	I					R/A	A/C	A/C	C				C			C			
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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			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																			
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Create Project Closure Report	I	I	I	I		R/A	I	I	I	I	I	I	I				I		

No Is? → Out of the loop!

ROLE / Project Deliverable (or Activity)	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
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Submit Project Request						R											A		
Research Solution	I					R/A	A/C	A/C	C				C			C			
Develop Business Case	I	A/C	I	I		R/A	C	C	C				C			C	C		
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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			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		A	A	A	A							C	I		
Close Phase Activities																			
Create Lessions 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		

Too many Rs → Turf war!

ROLE / Project Deliverable (or Activity)	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
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Submit Project Request						R											A		
Research Solution	I					R/A	A/C	A/C	C				C			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			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		A	A	A	A							C	I		
Close Phase Activities																			
Create Lessions 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		

Overloaded → Board should take on more accountability

Today

- Risk in Projects
- Risk in Software Development
- Taking Responsibility
  - RACI Matrix
- **Identifying Risks**
  - **SWOT / RBS**
  - **Decision Tree / EMV Analysis**
- Identifying Causes
  - Ishikawa (Fishbone)
  - Sensitivity Analysis
- Planning Risk Responses
  - Risk Matrix
  - FMEA

Identifying Risks

- **SWOT** (Strengths, Weaknesses, Opportunities, Threats) Analysis.
- **Risk Breakdown Structure** (RBS): breaking down into small units.
- **Delphi Technique**: experts who participate anonymously and iterate until a consensus is reached.
- **Decision Tree Analysis**: model of decisions, chance, and possible outcomes, costs and utility.

SWOT Analysis

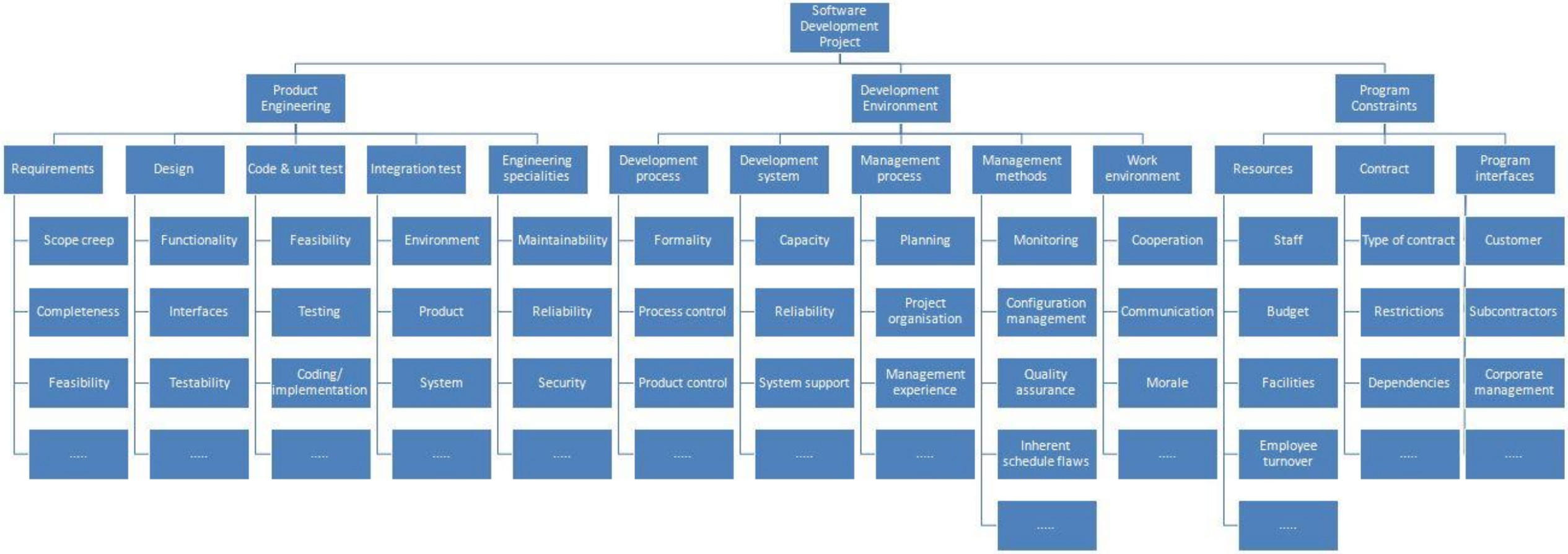
- What are you good at?
- What do you do better than your competitors?

- What do you need to improve?
- What can your competitors do better than you?

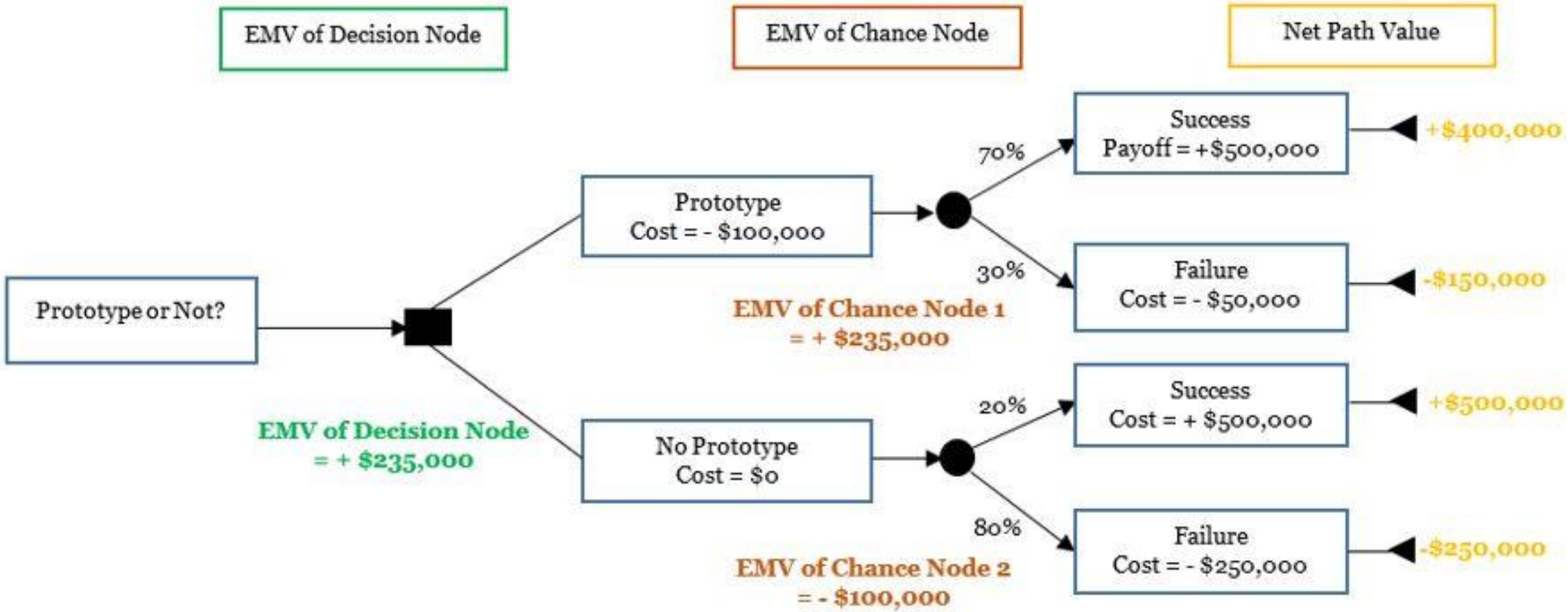
- What are your objectives?
- What do you hope to achieve?

- Who are your competitors?
- What challenges do you face?

Risk Breakdown Structure (RBS)



Decision Tree Analysis



Decision Tree Analysis

Problem:

- Buggy system.
- Customers unhappy.
- What to do?

KEY

Decision node

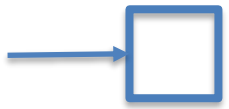
Chance node

Outcome node

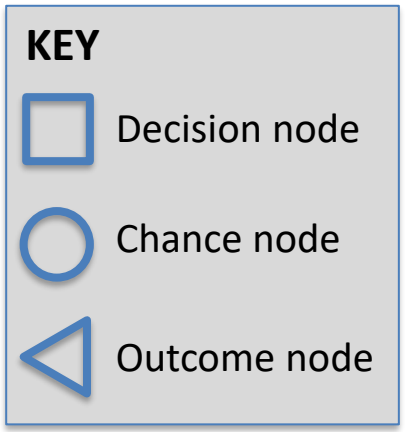
Decision Tree Analysis

Problem:

- Buggy system.
- Customers unhappy.
- What to do?



Decision Tree Analysis



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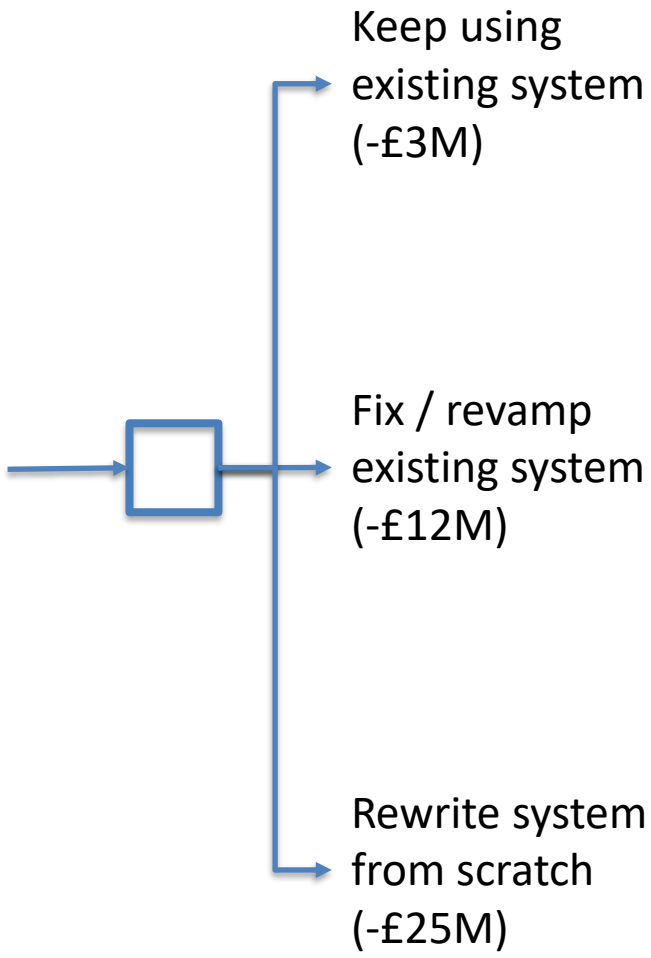

Decision Tree Analysis

KEY

- Decision node
- Chance node
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Problem:

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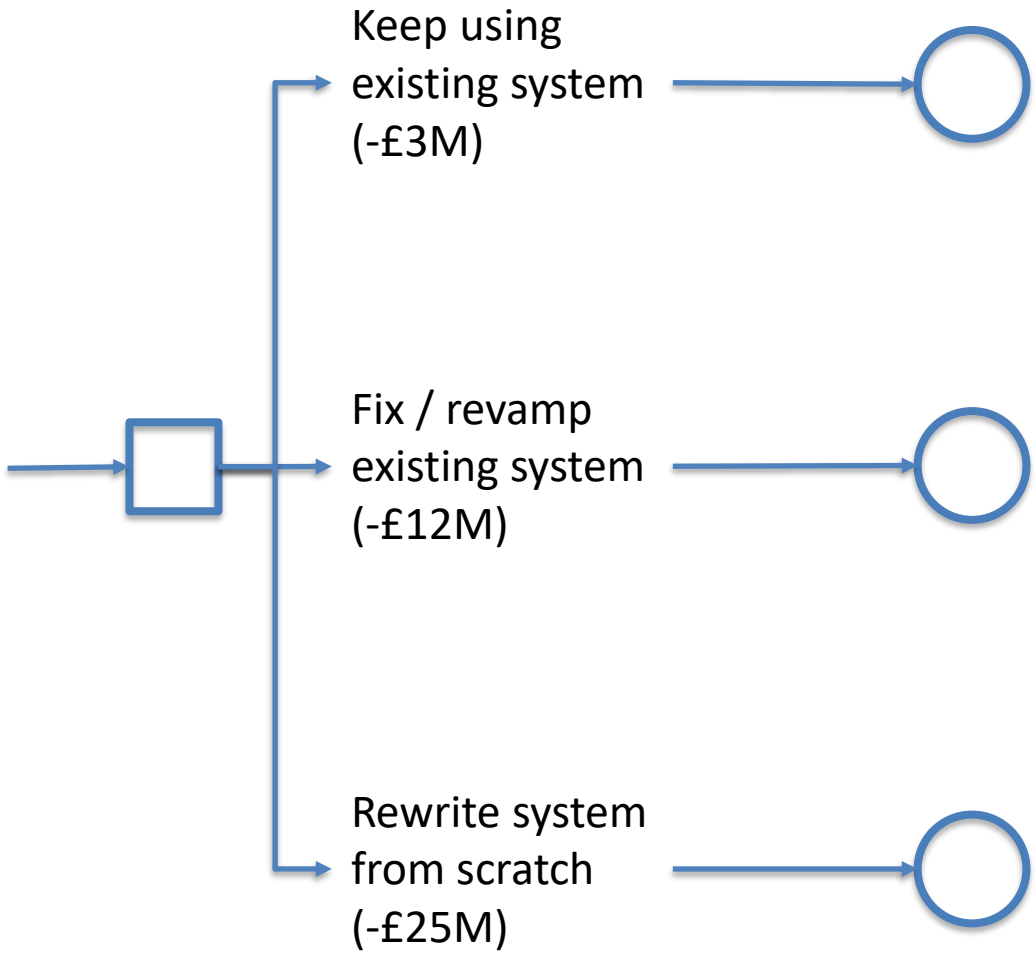

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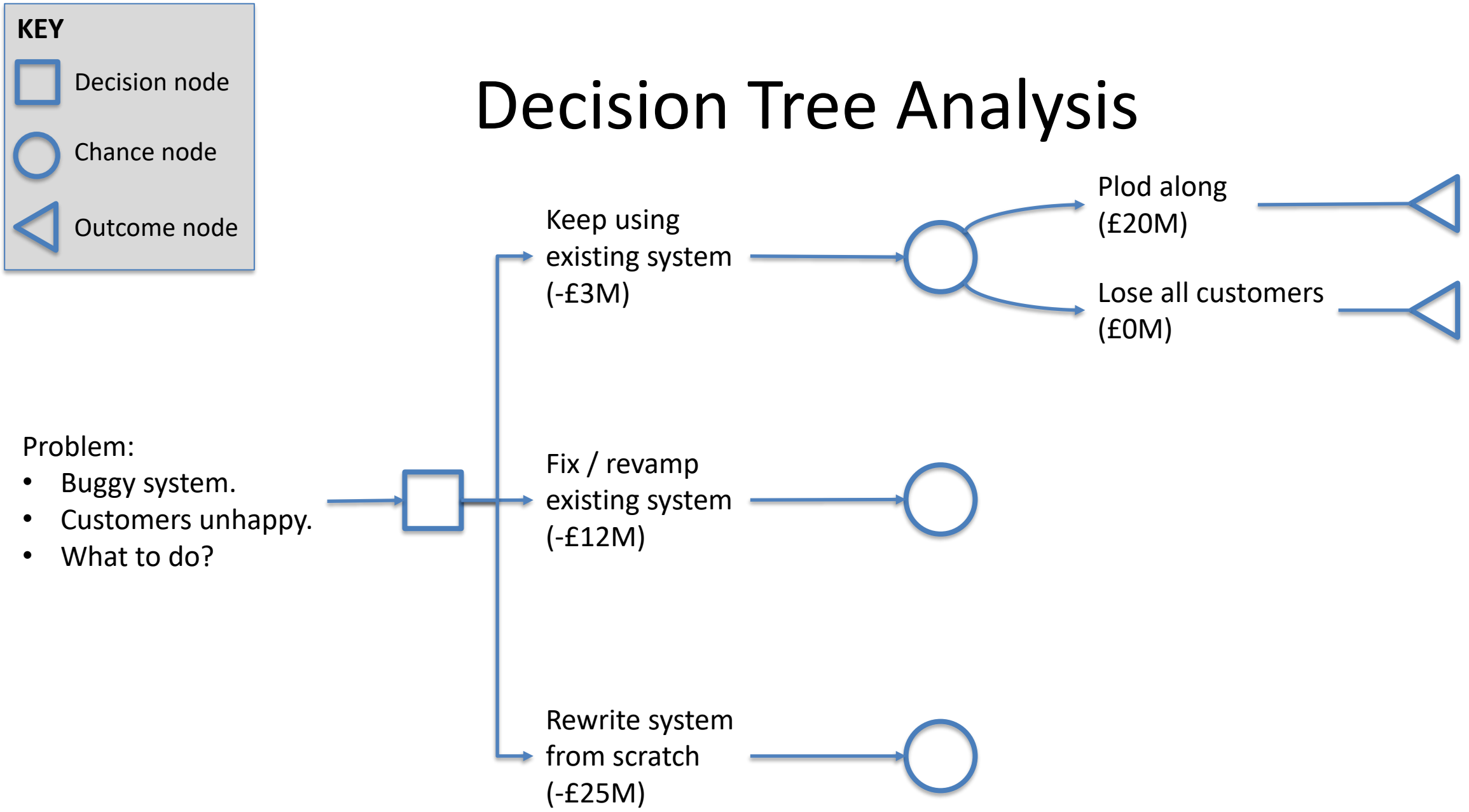

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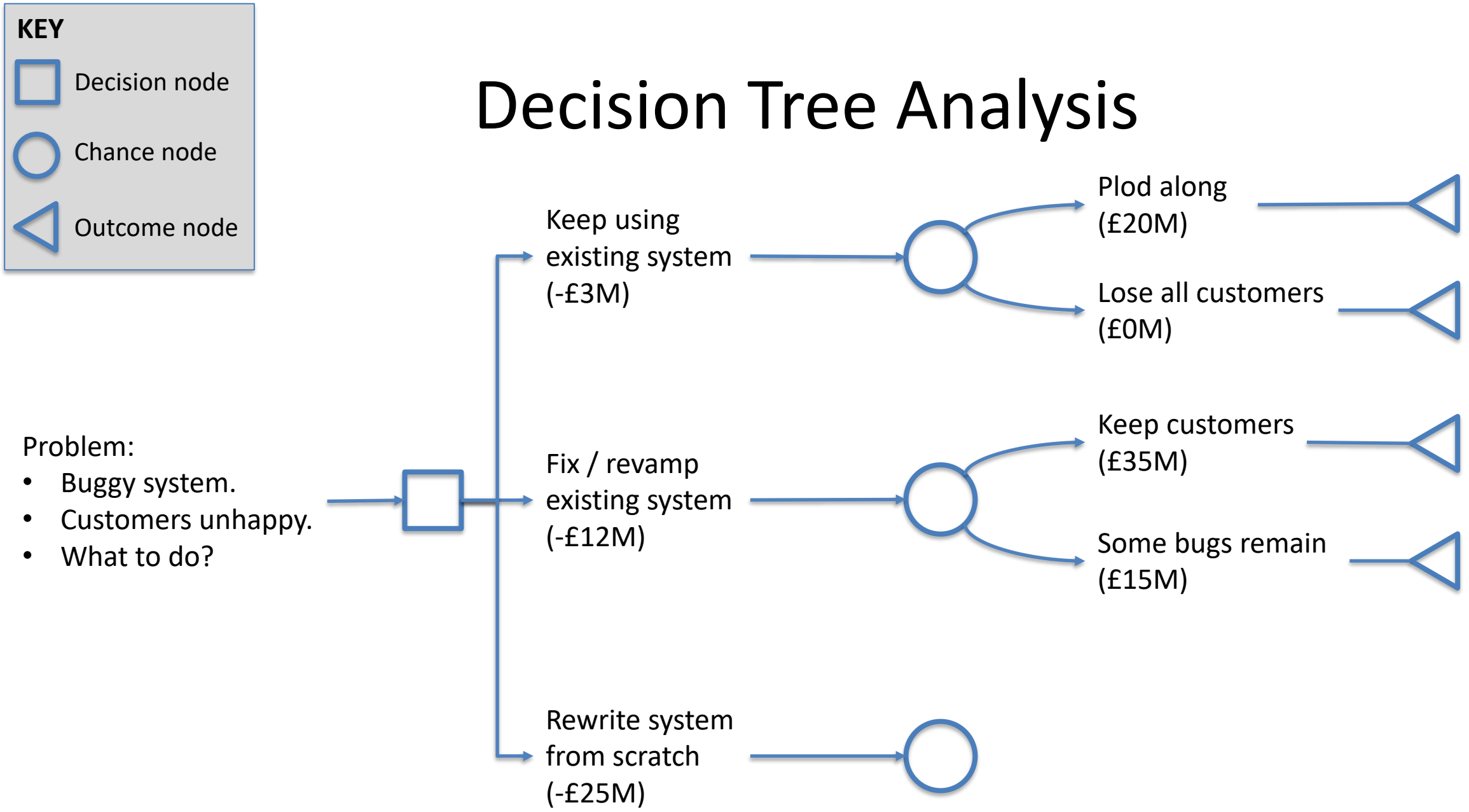

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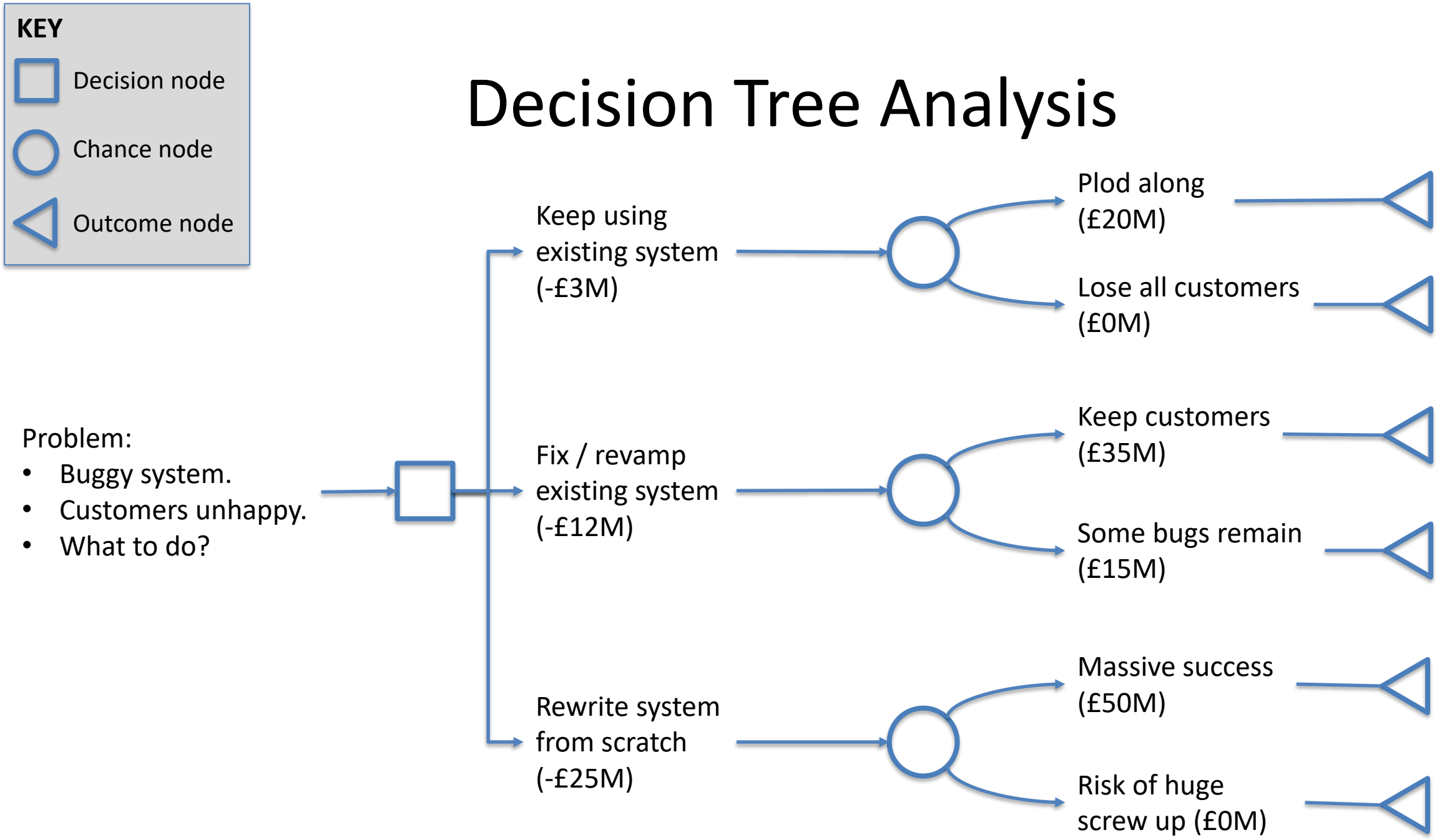

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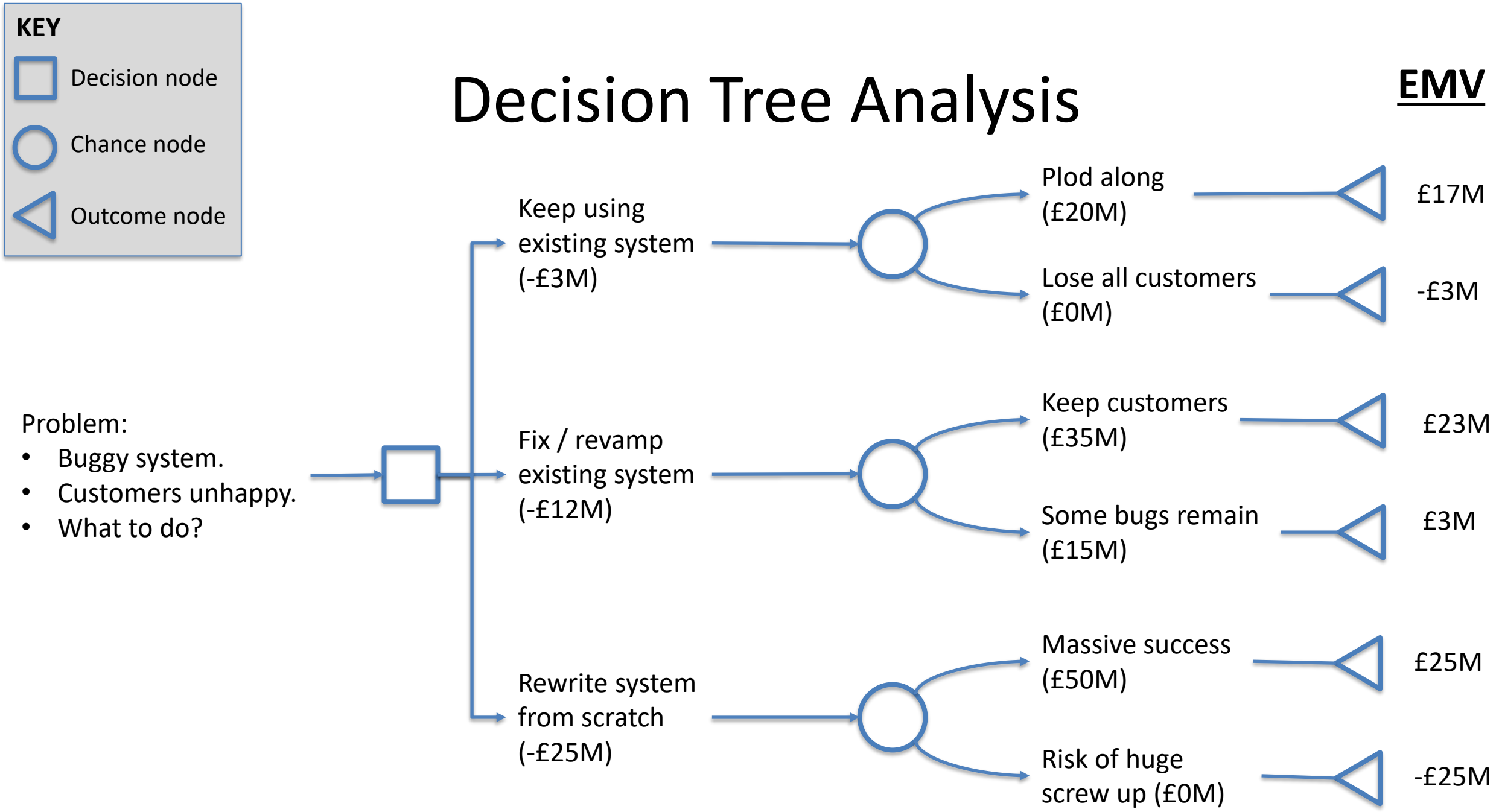

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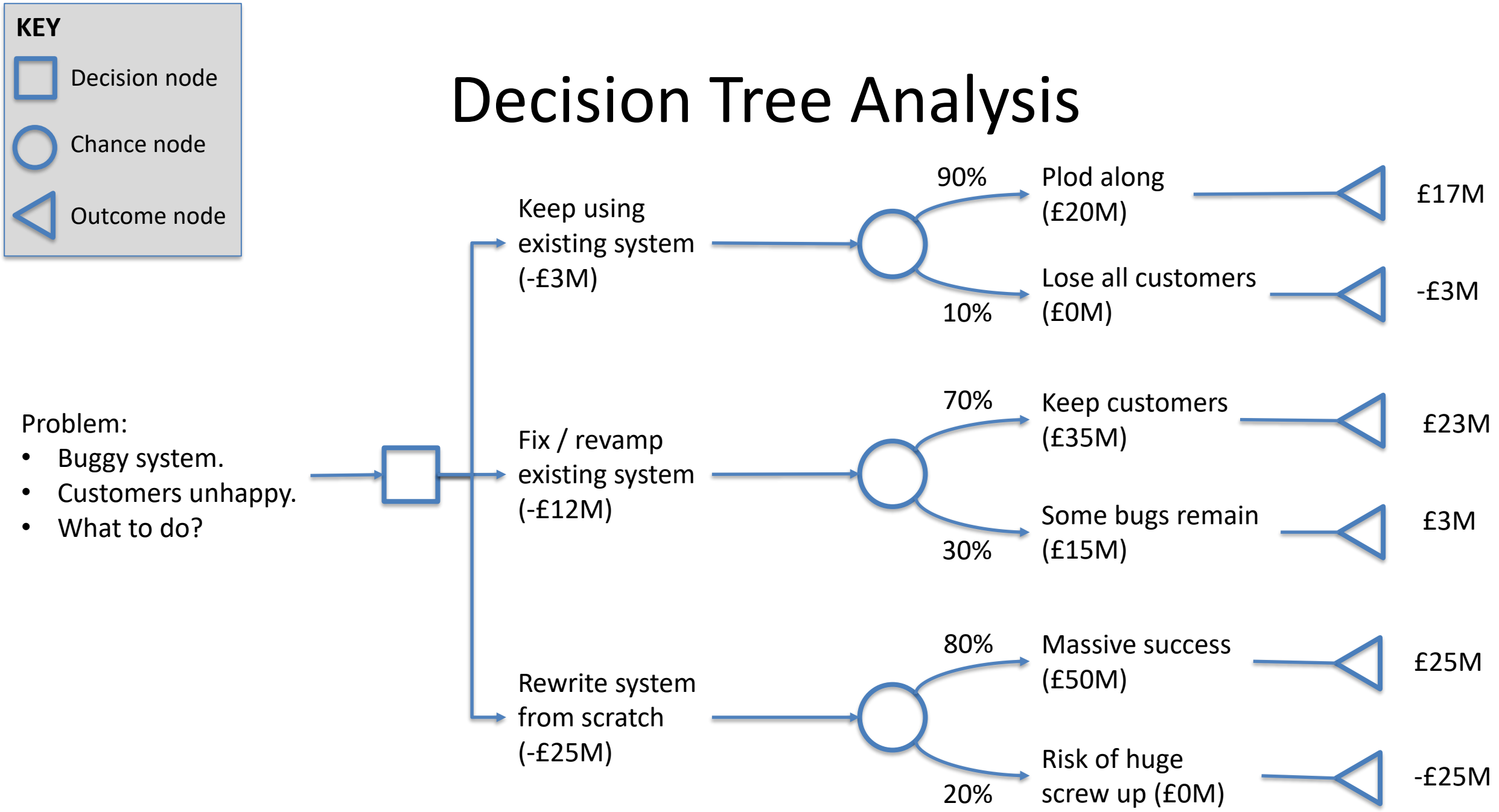

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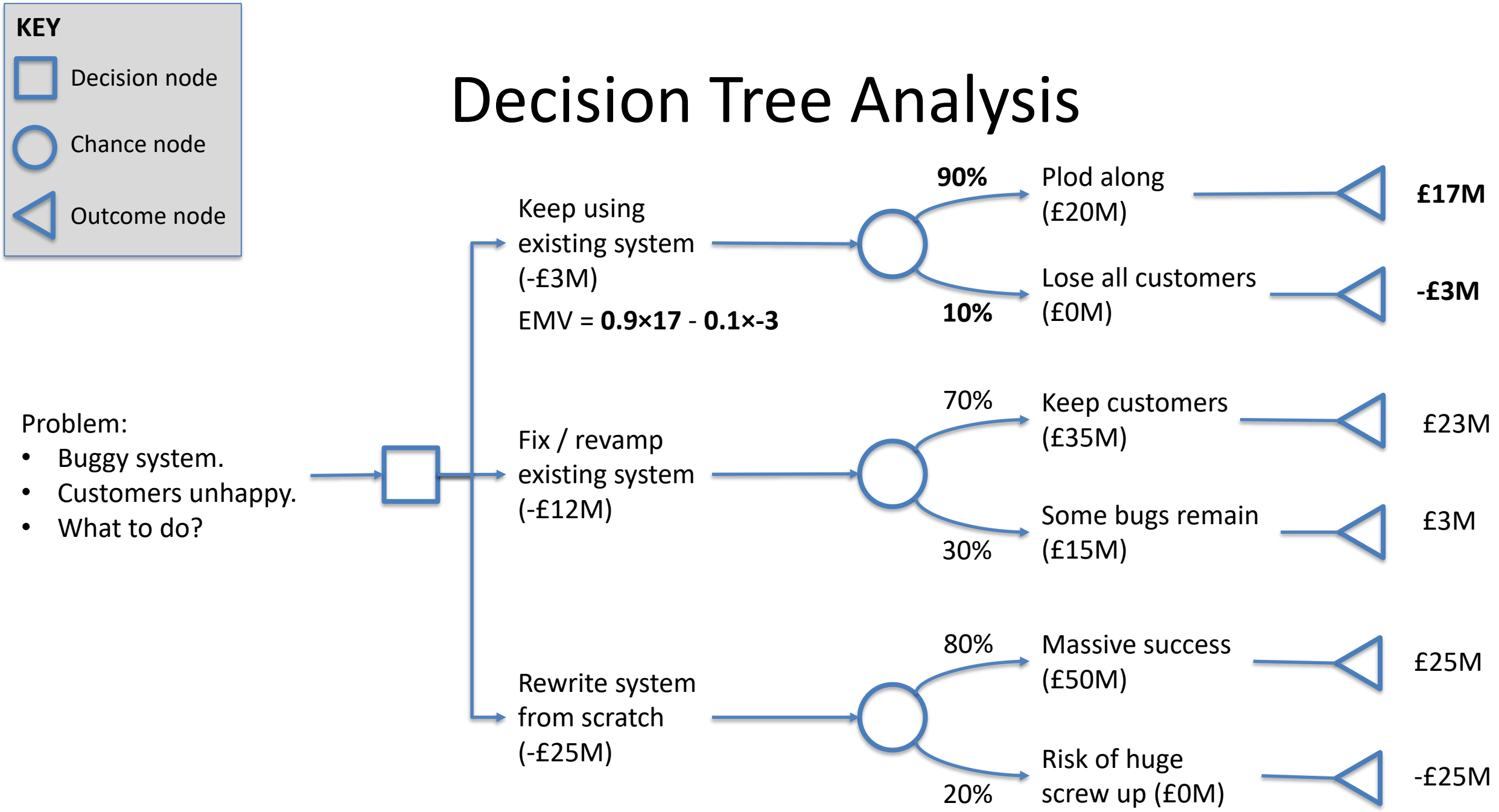

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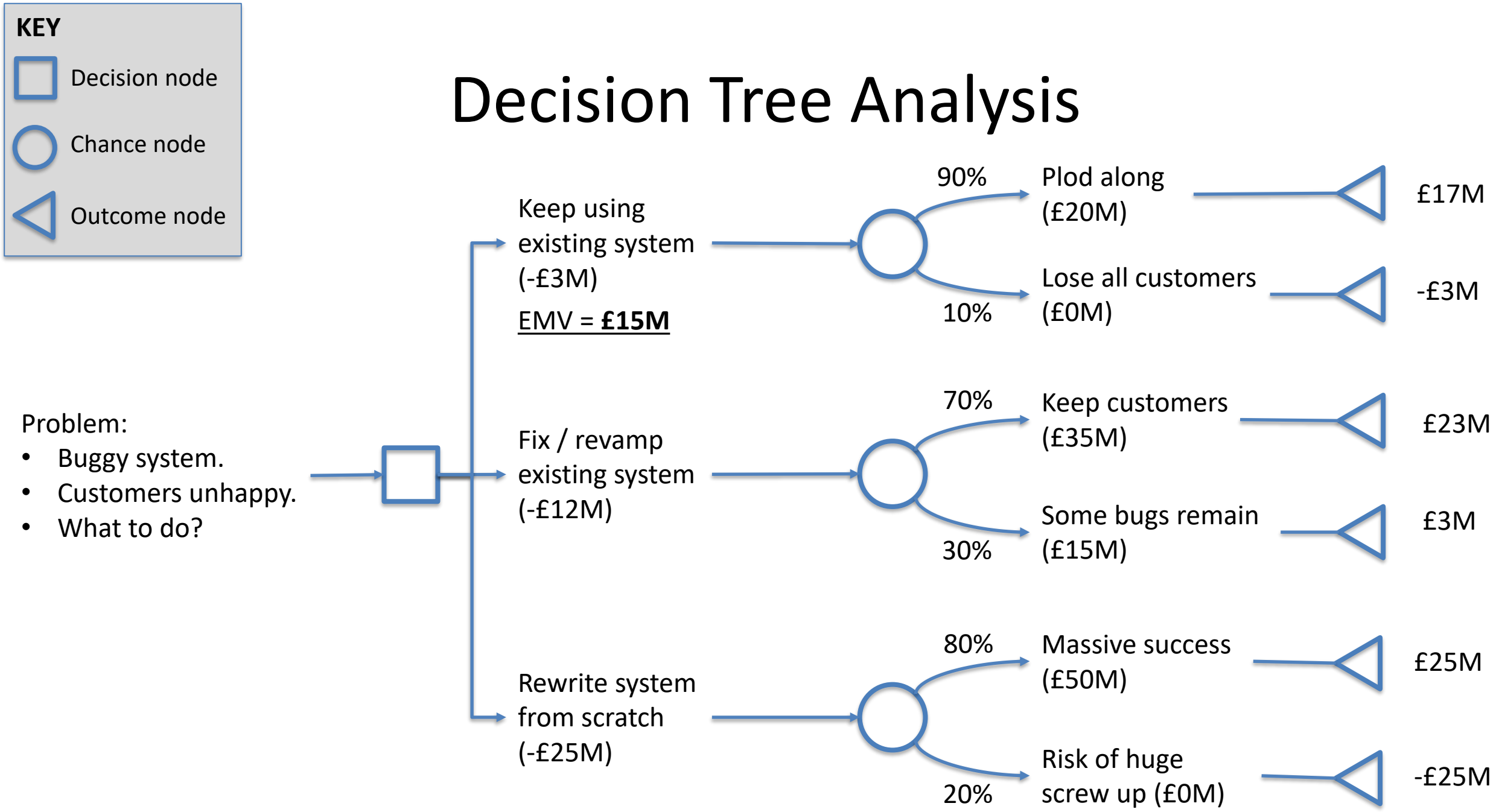

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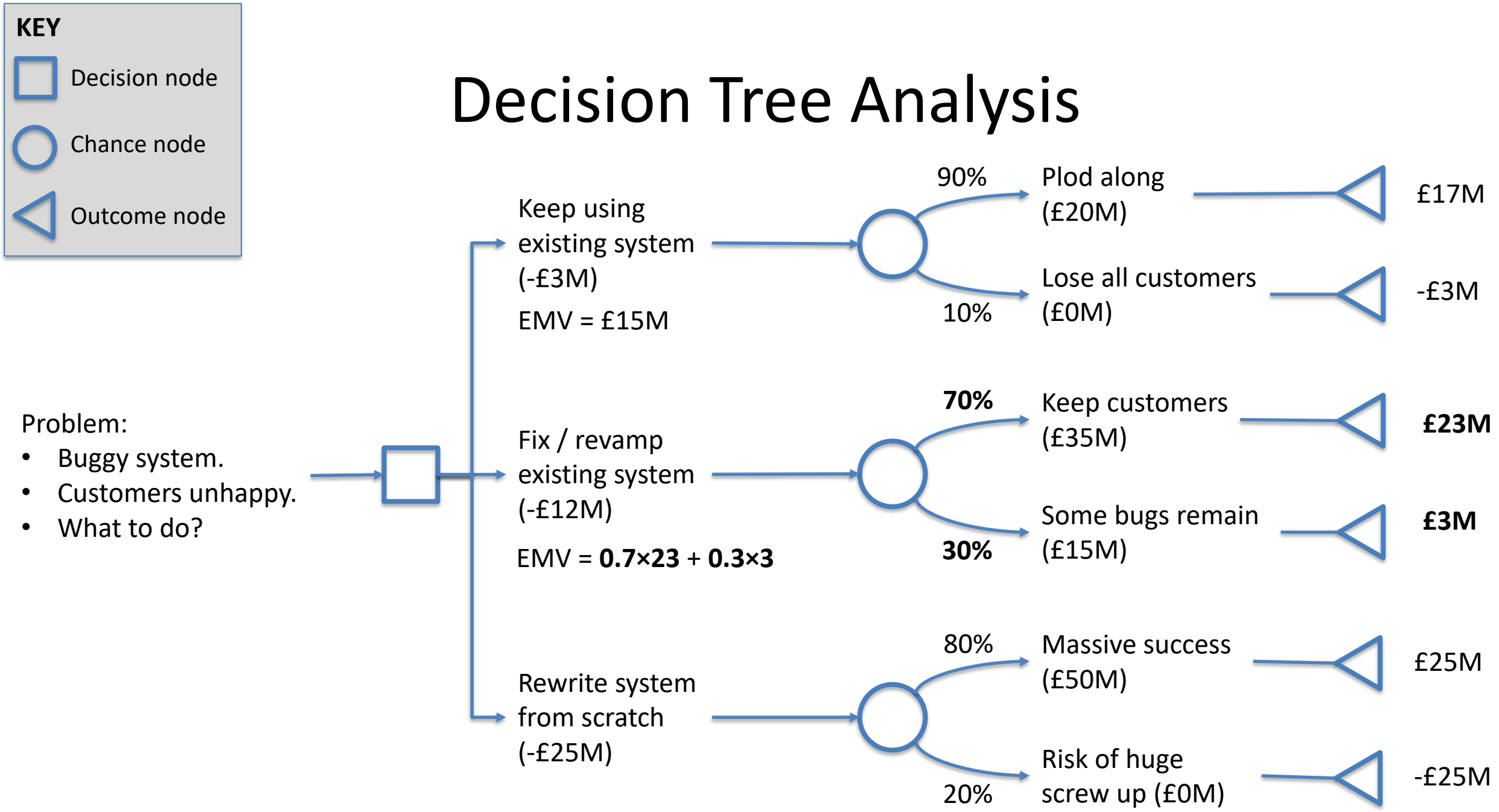

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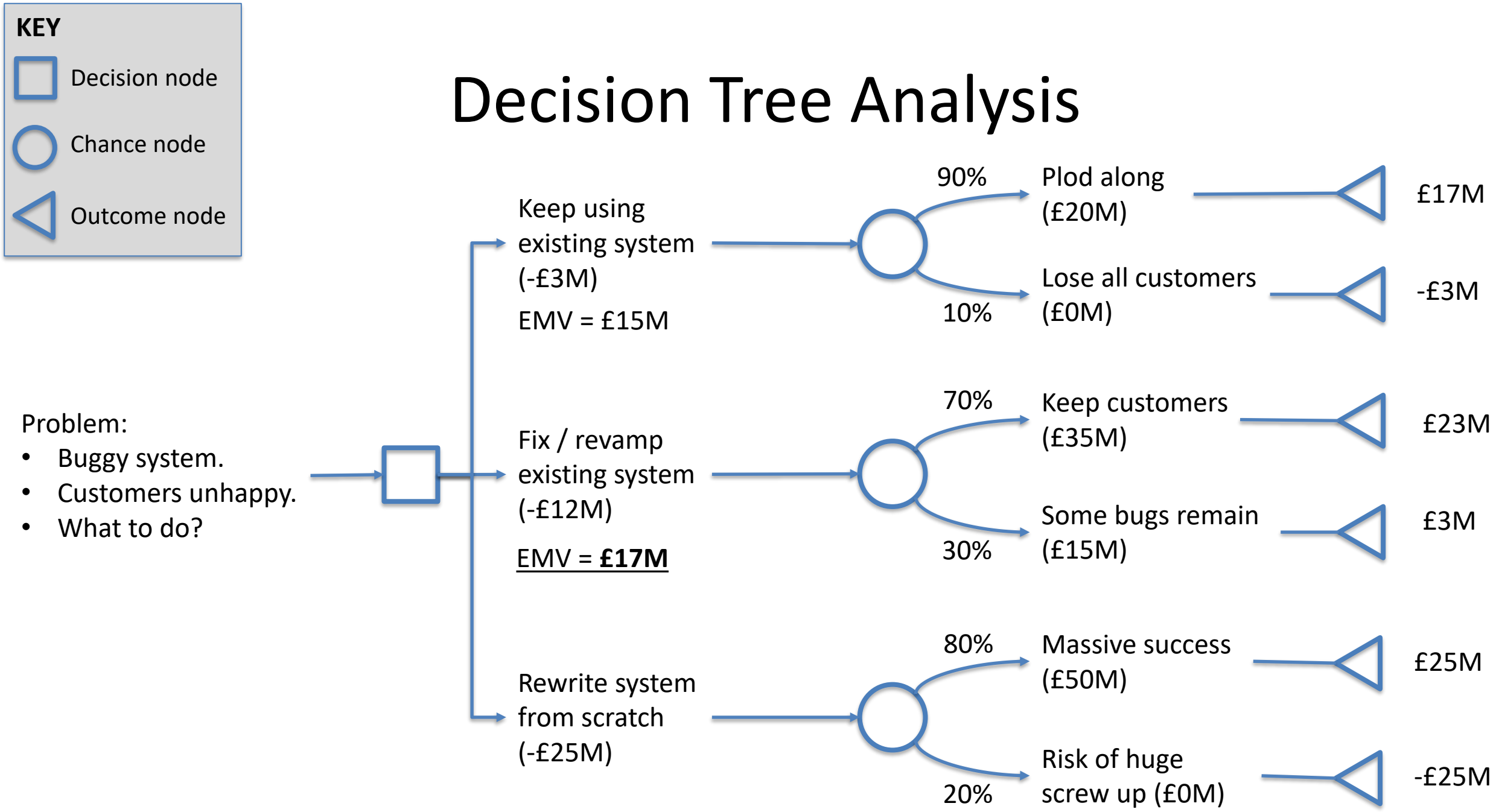

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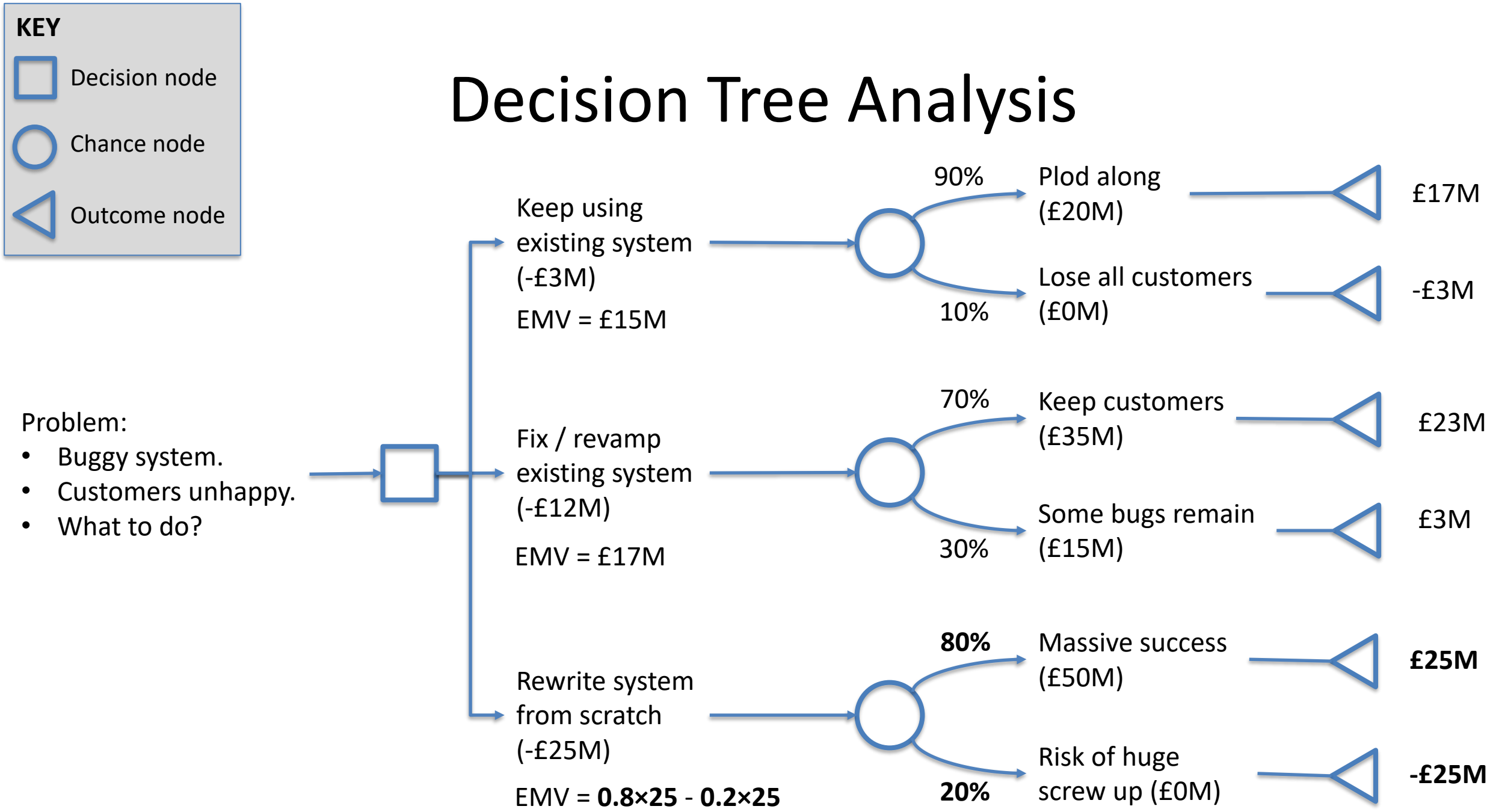

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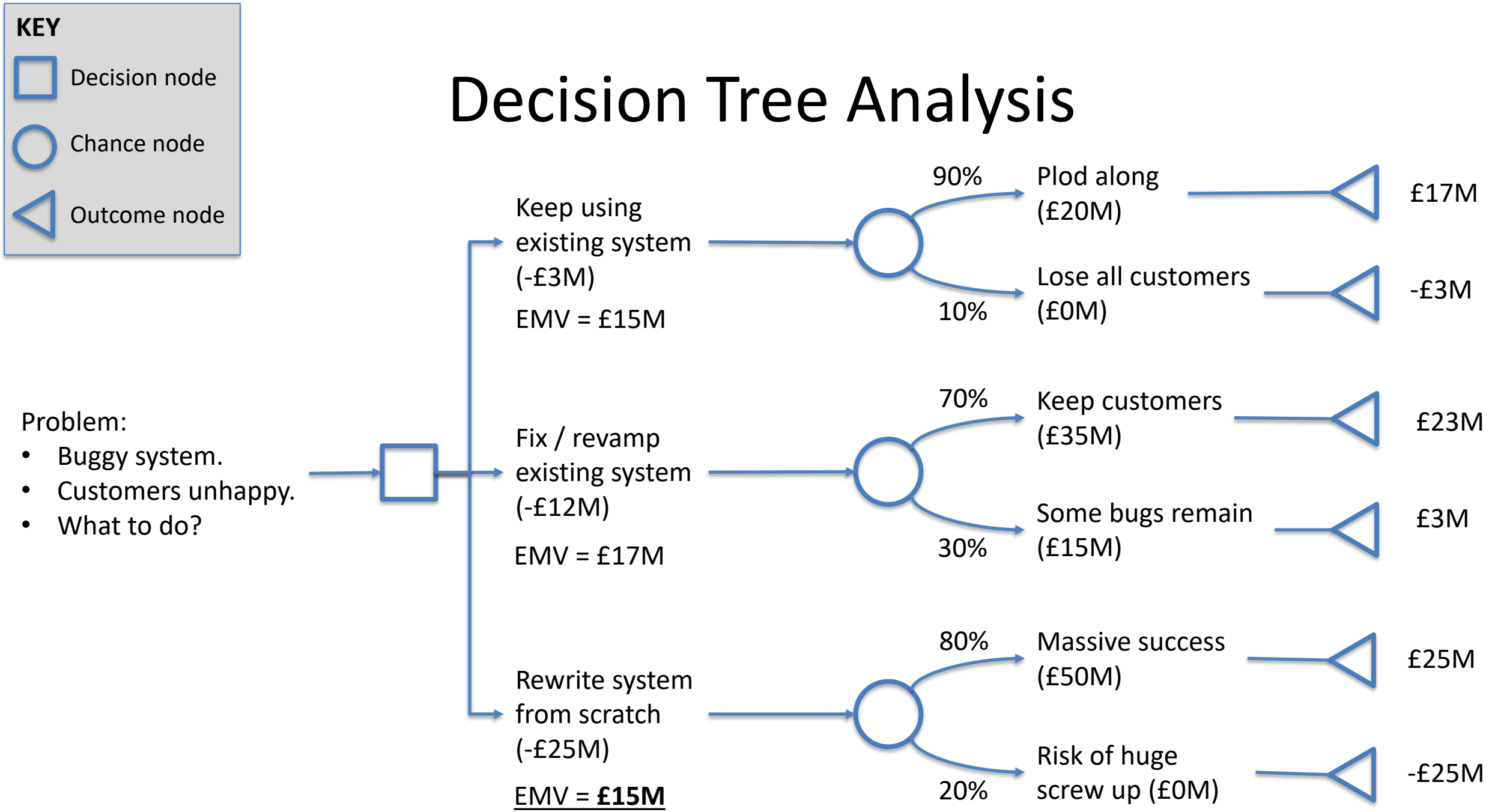

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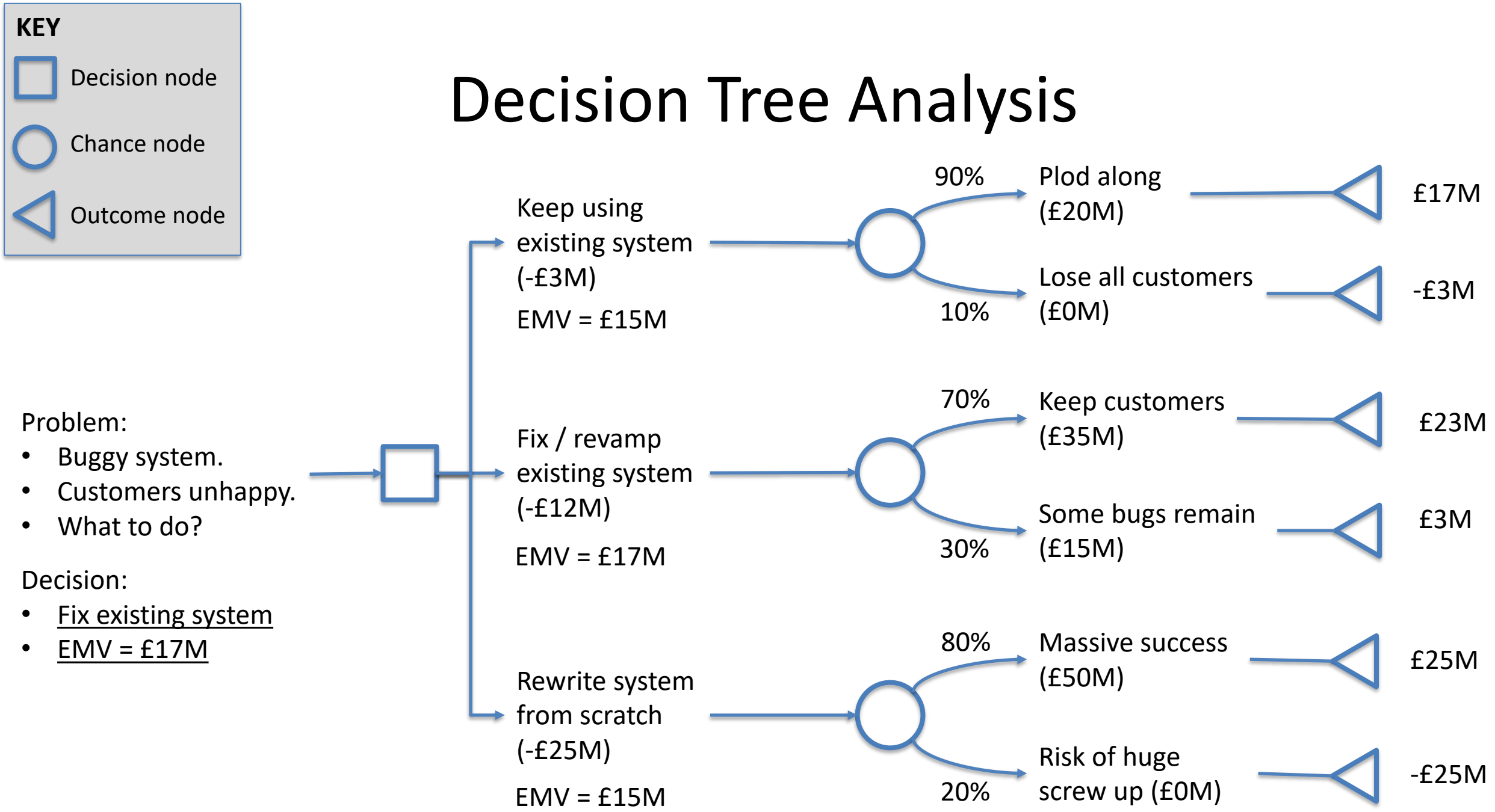

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Ishikawa Diagram

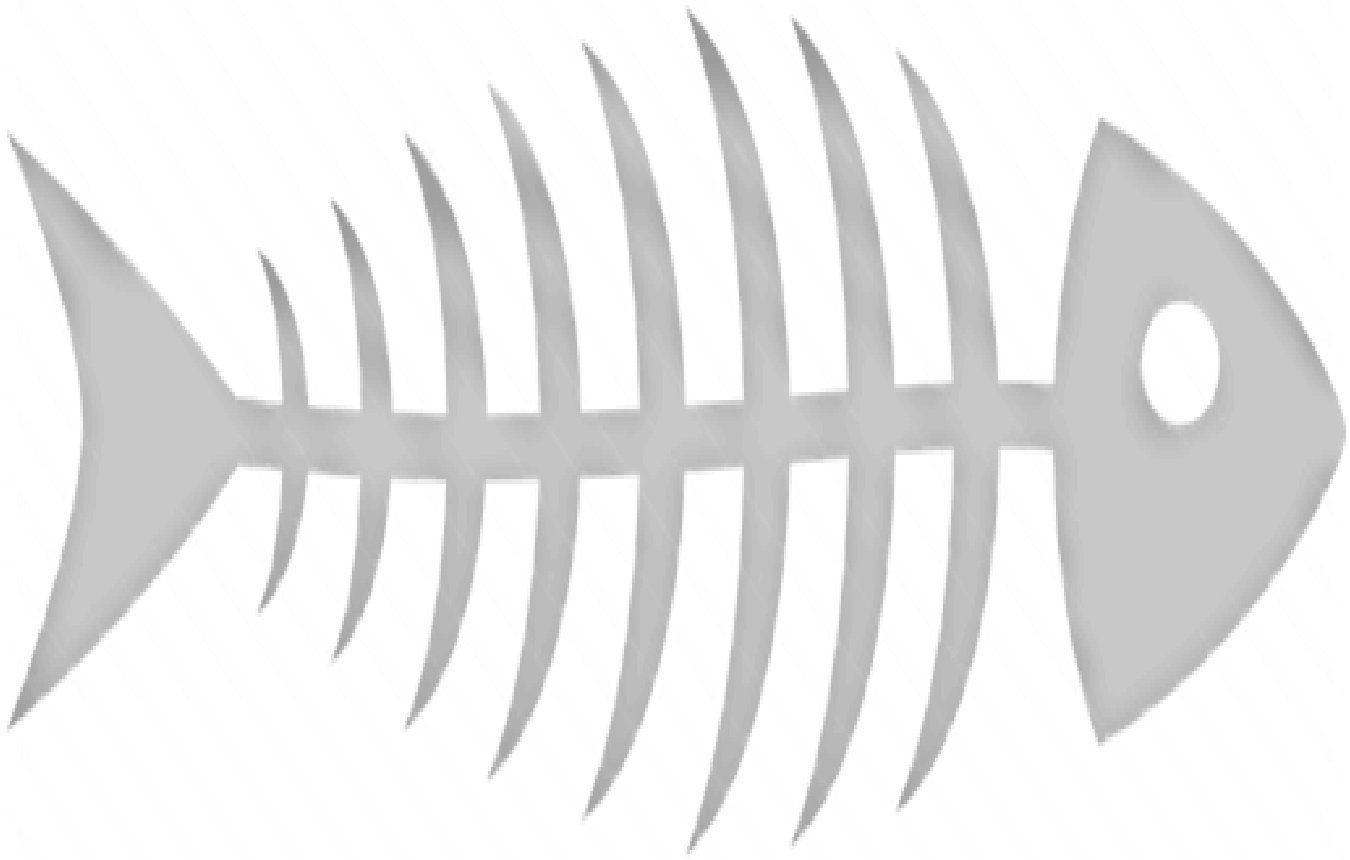
Cause and Effect often represented by a ***Fishbone*** or ***Ishikawa*** diagram. Work *backwards* from a risk to think about how it can be mitigated.

Originally developed for Manufacturing (6 Ms):

- Machines
- Methods
- Materials
- Measurements
- Mother Nature (Environment)
- Manpower (People)

Can be used more generally with the 4 Ps:

- Policies
- Procedures
- People
- Plant (Technology)



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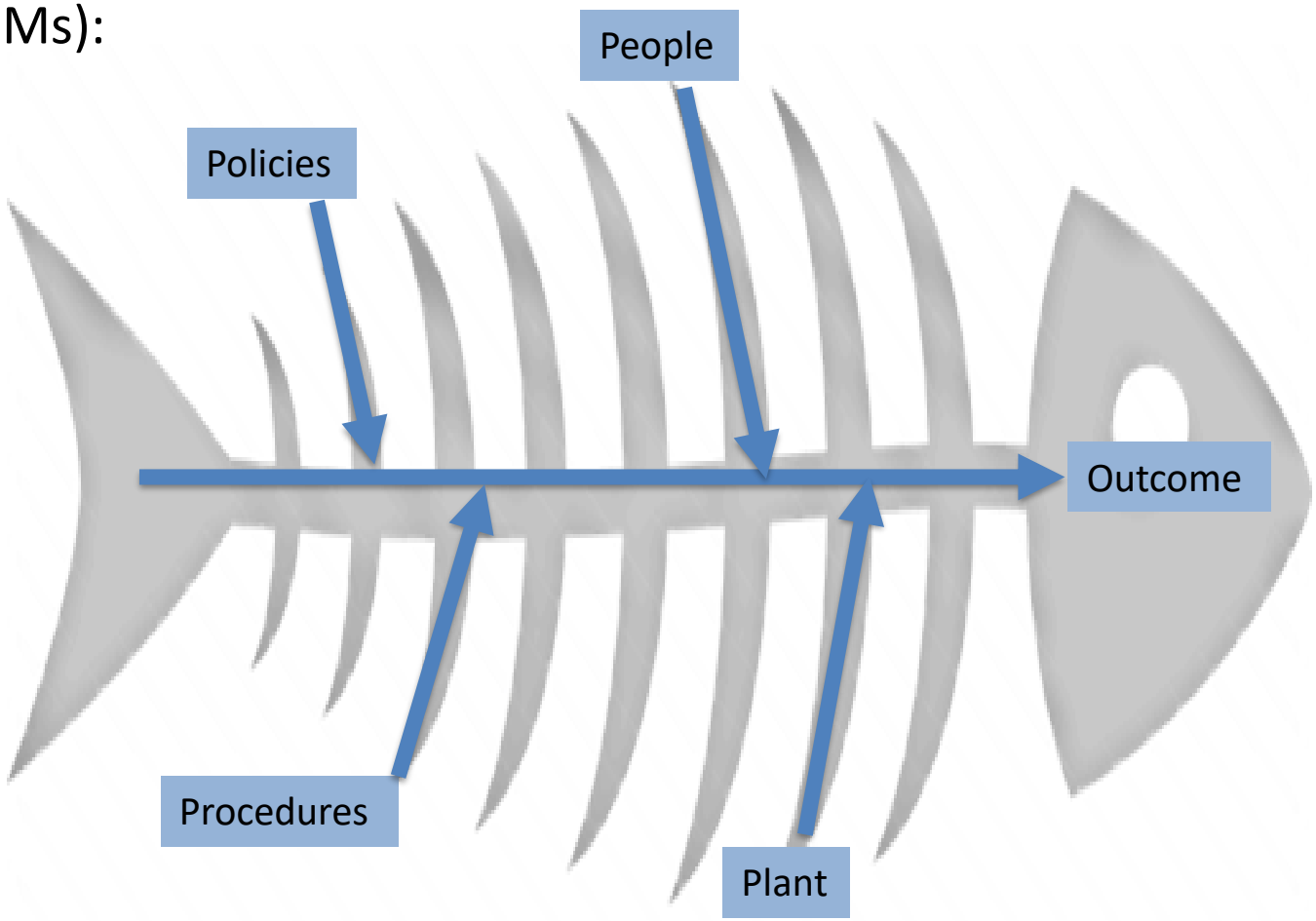

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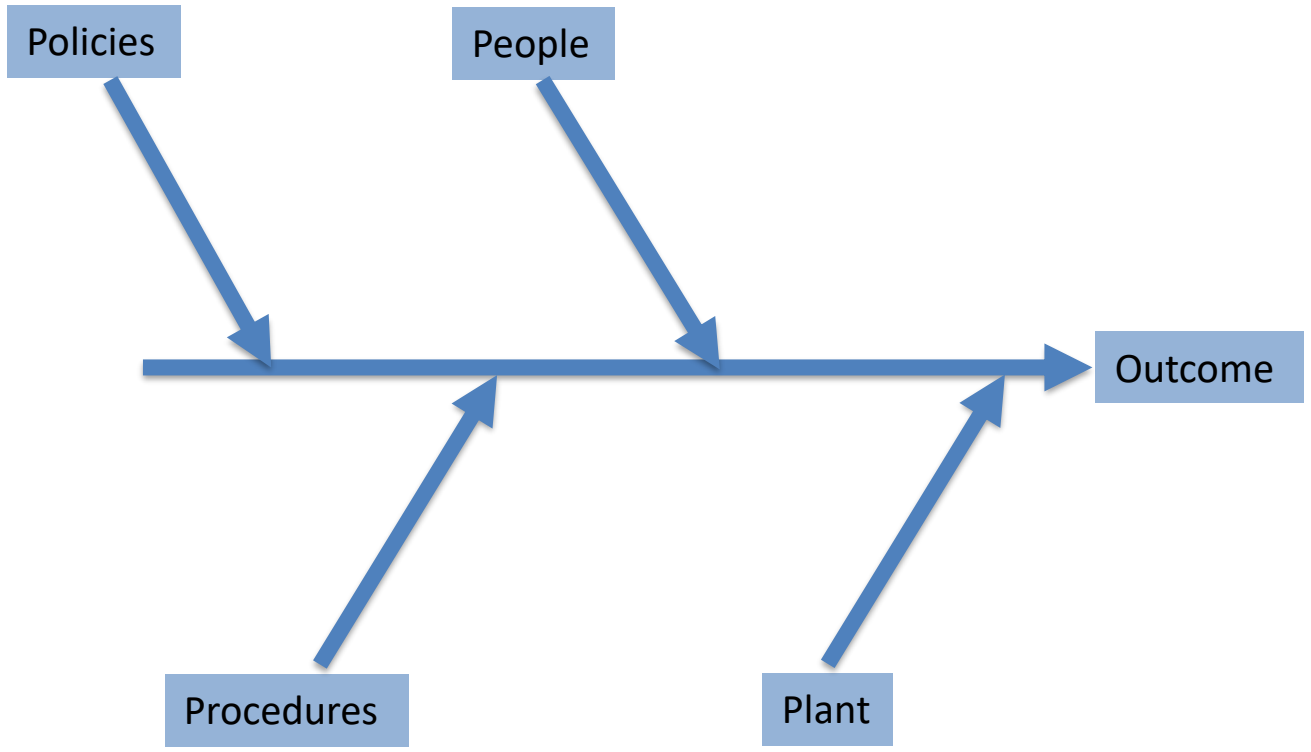

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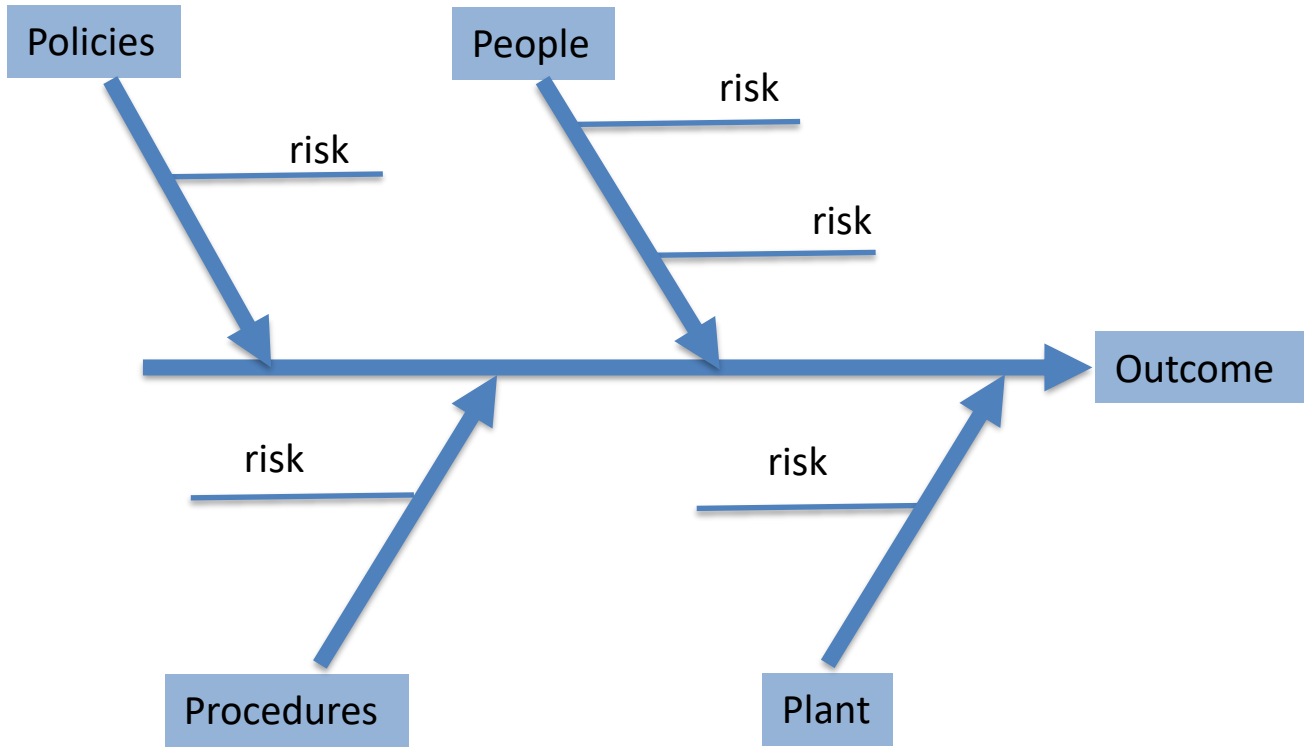

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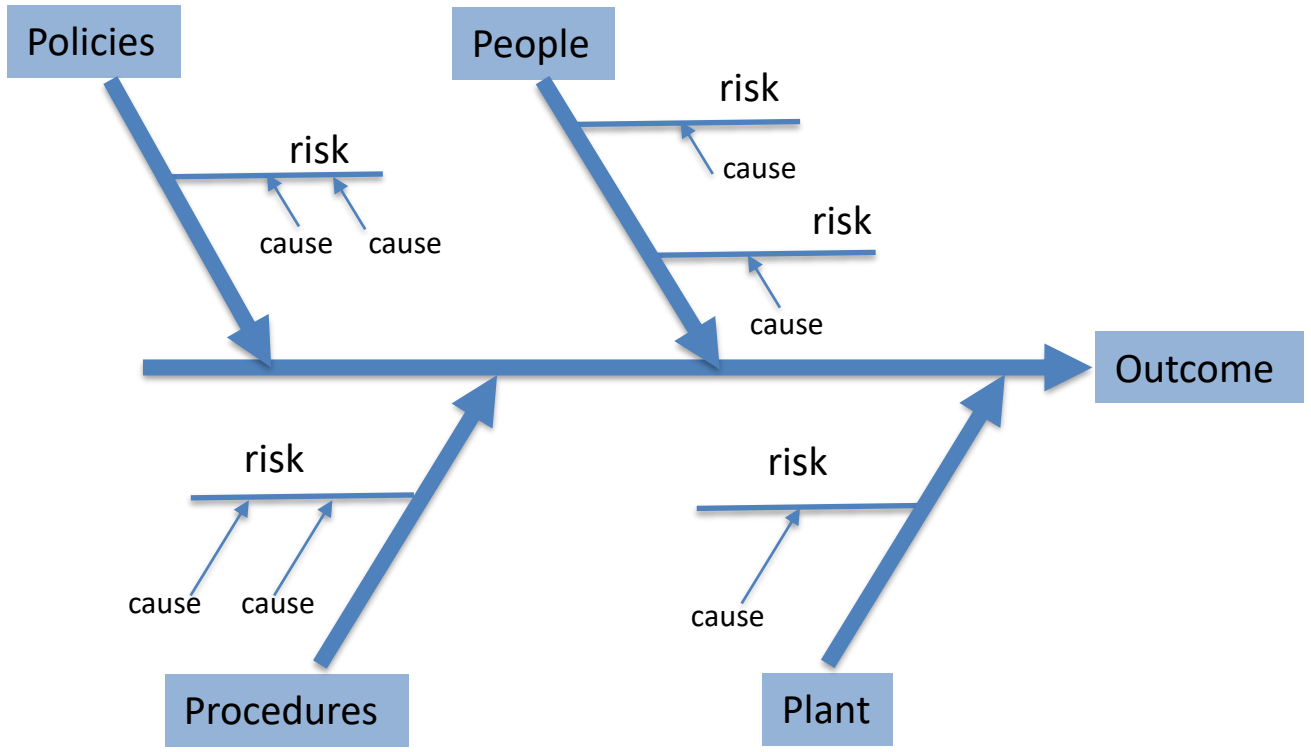
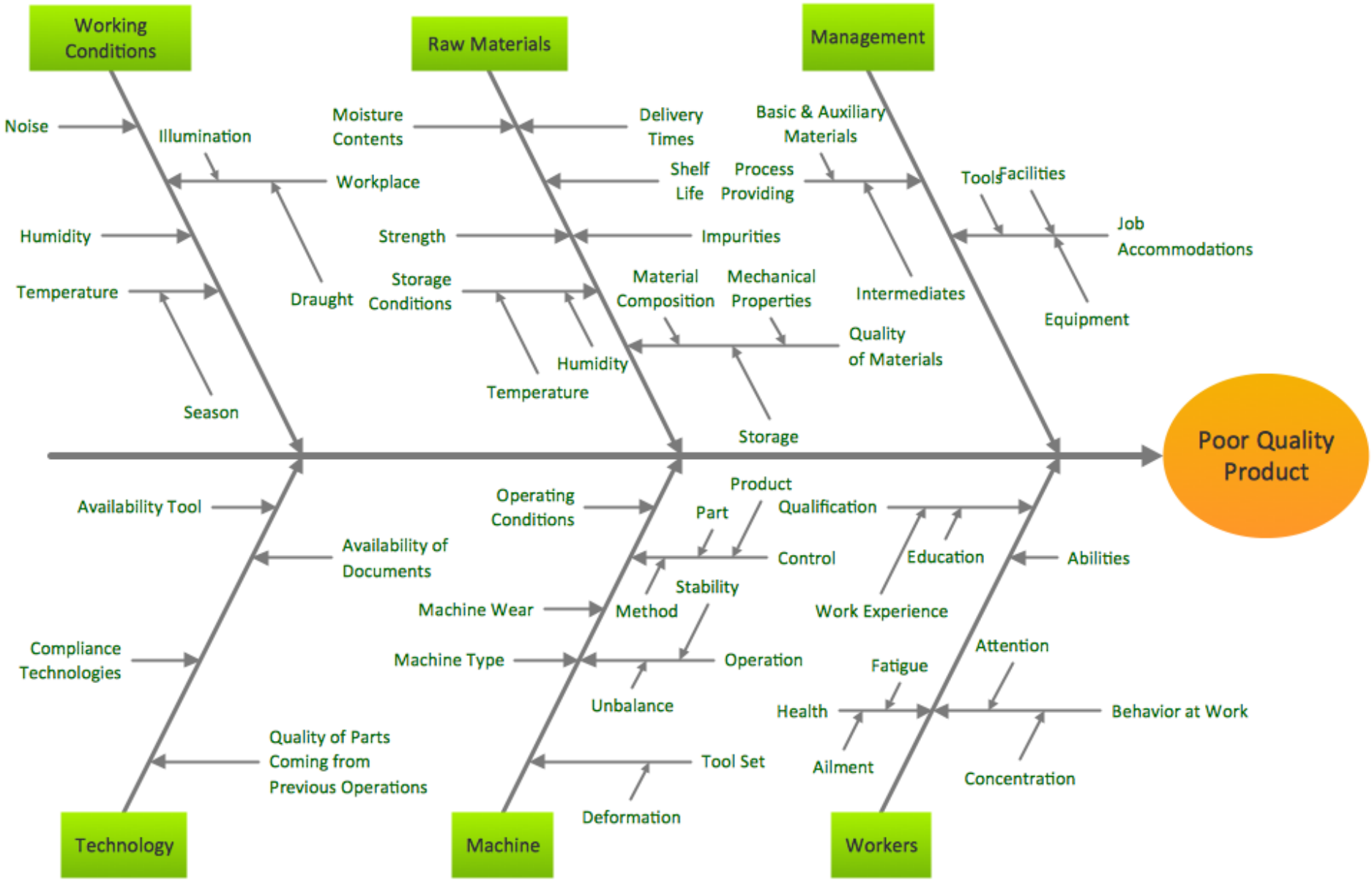


Ishikawa Example

Fishbone Diagram - Causes of Low-Quality Output

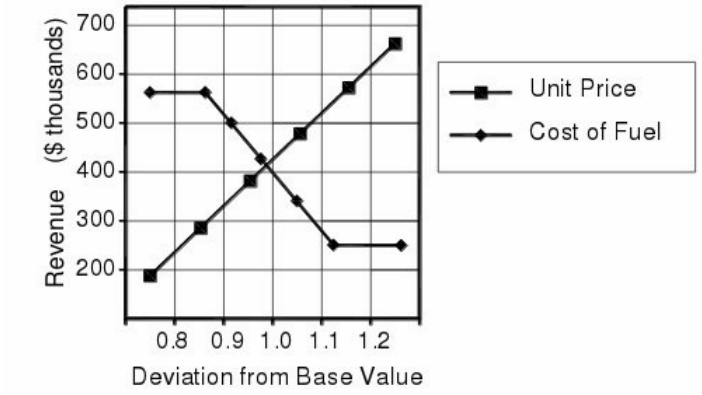


Sensitivity Analysis

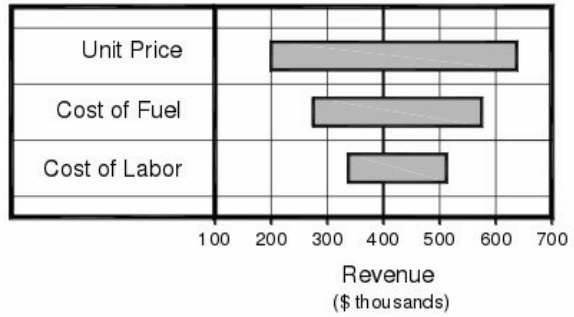
To determine how different values of an independent variable impact a particular dependent variable under a given set of assumptions.

- **Simple Estimate** – Estimate a range of values, e.g. low/med/high
- **Simulation** – model the system to measure the effects of a variable.
- **Empirical data** – correlate risk factors with outcome.

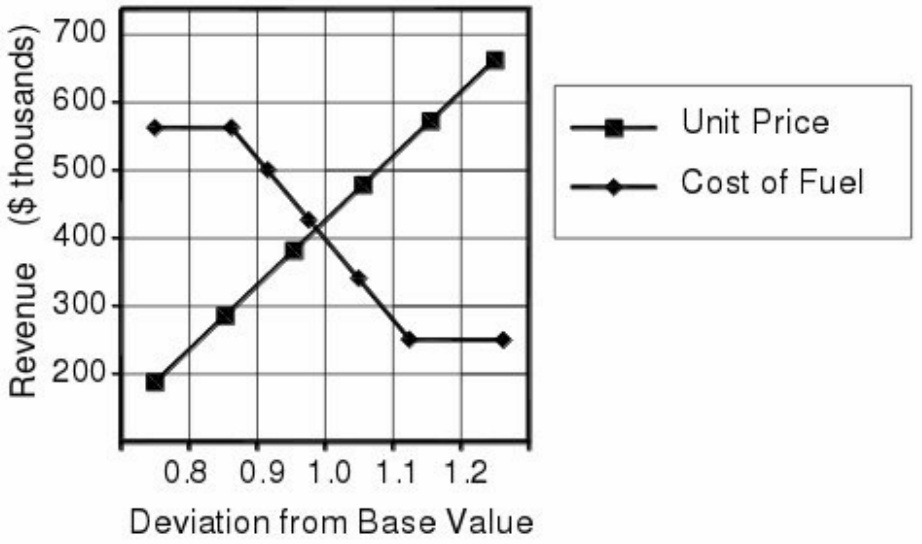
Spider Graph: plots the dependent variable against deviations of the independent variable from a baseline.



Tornado Diagram: summarises the relative importance of different variables.

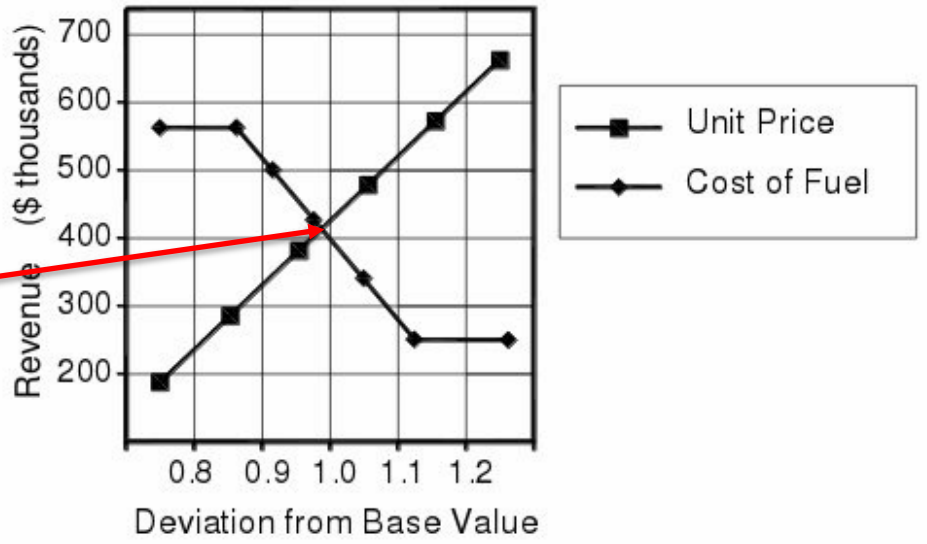


Sensitivity Analysis

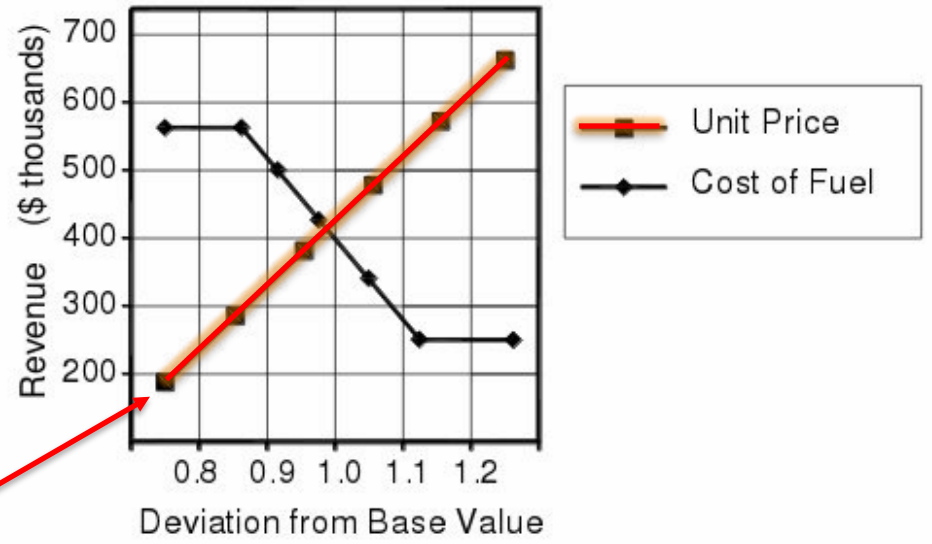


Sensitivity Analysis

Base Value
(What happens if we do nothing)



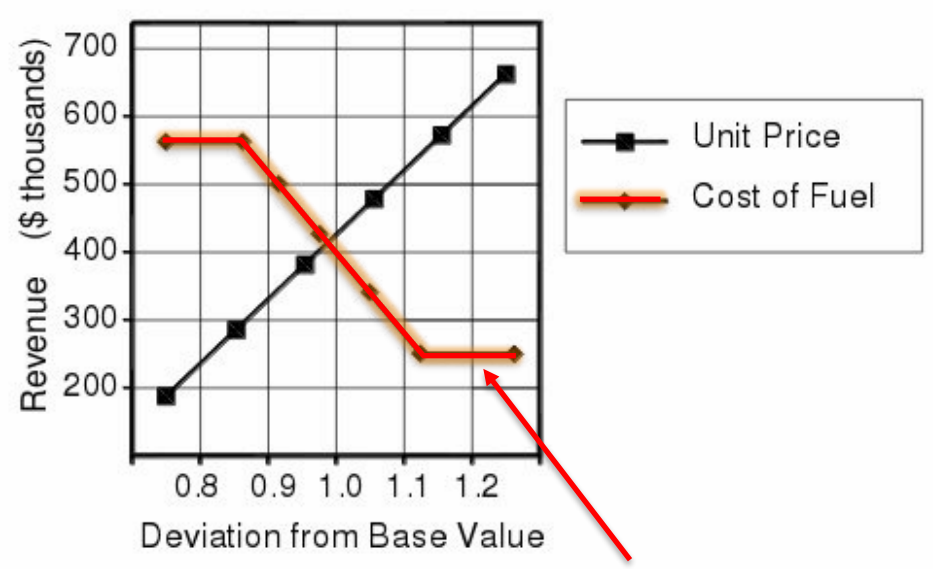
Sensitivity Analysis



How is sensitivity curve determined?

- Naïve calculation?
- Consumer model?
- Empirical data?

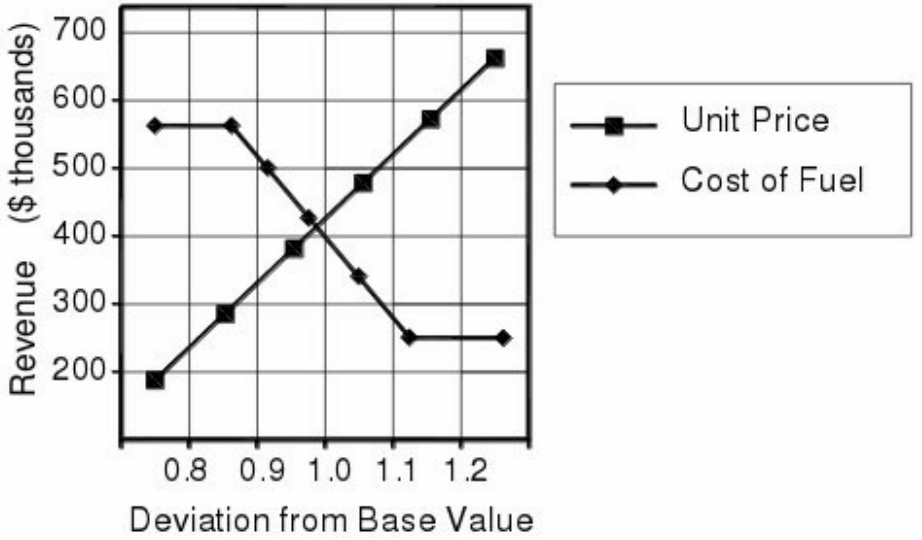
Sensitivity Analysis

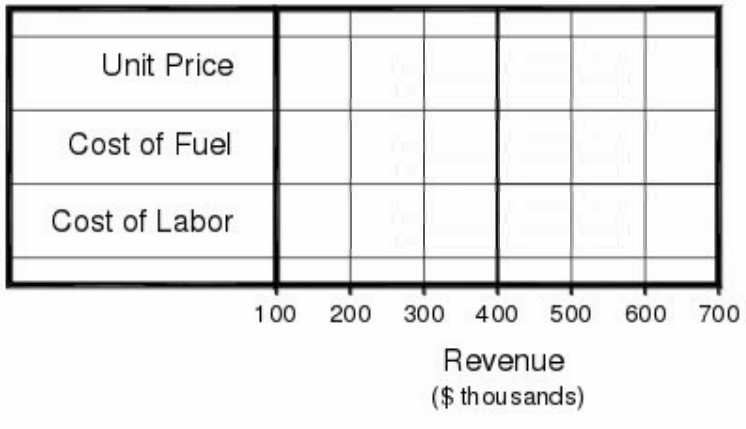


Non-linear output

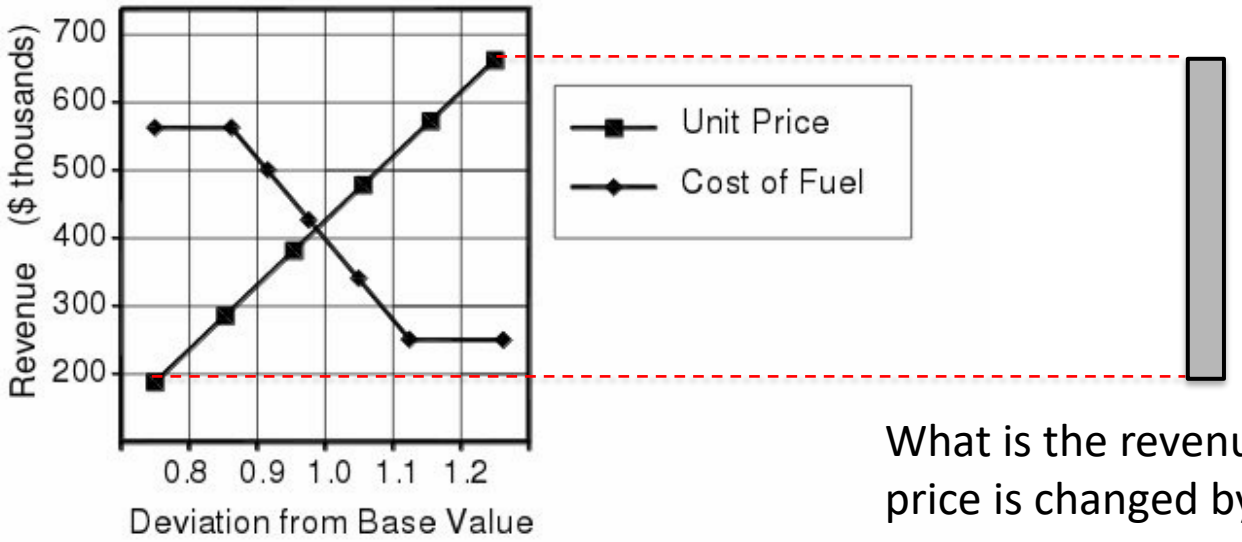
(e.g. If fuel price gets too high, switch to electric vehicles)

Sensitivity Analysis

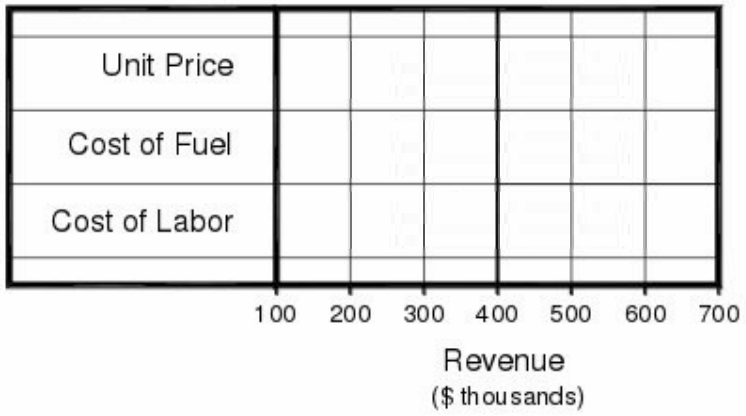




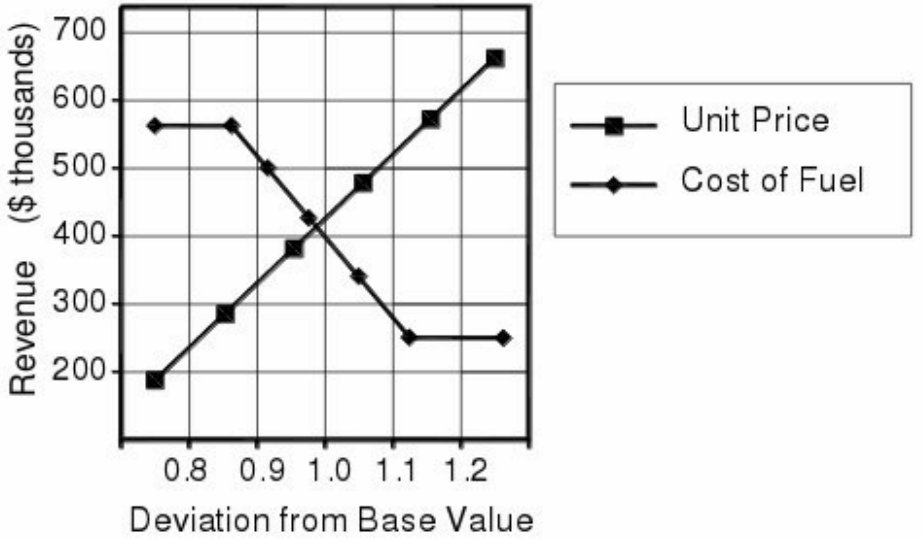
Sensitivity Analysis

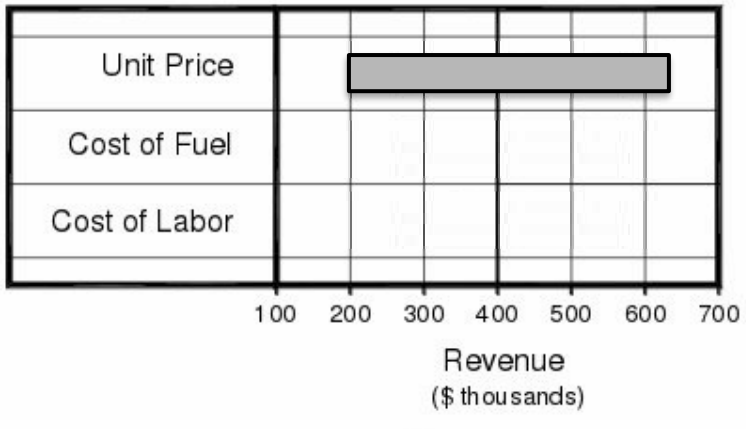


What is the revenue if unit price is changed by ±25% ?

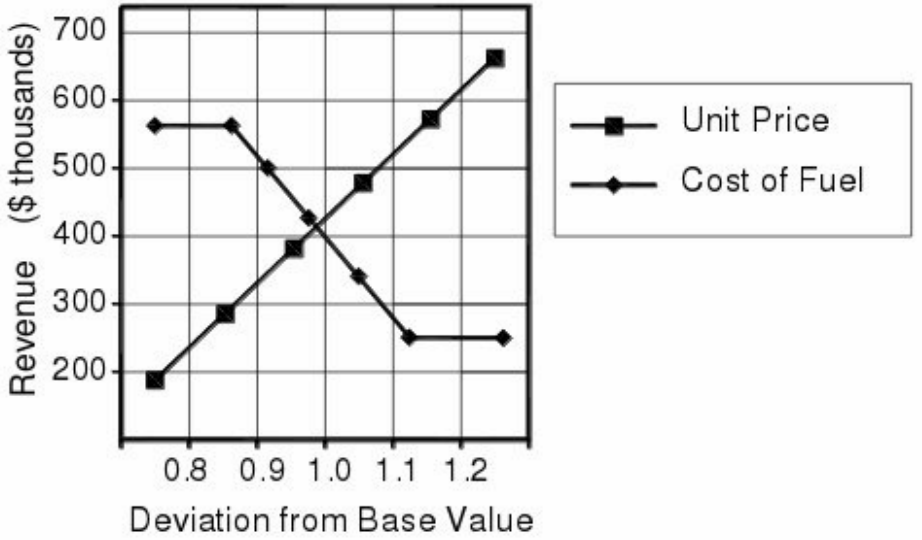


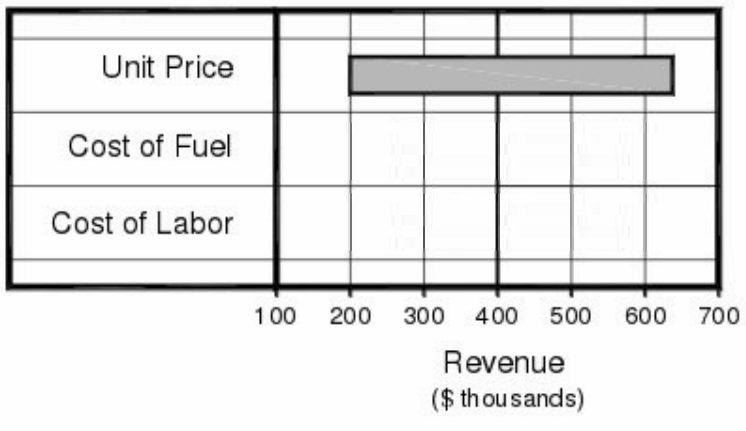
Sensitivity Analysis



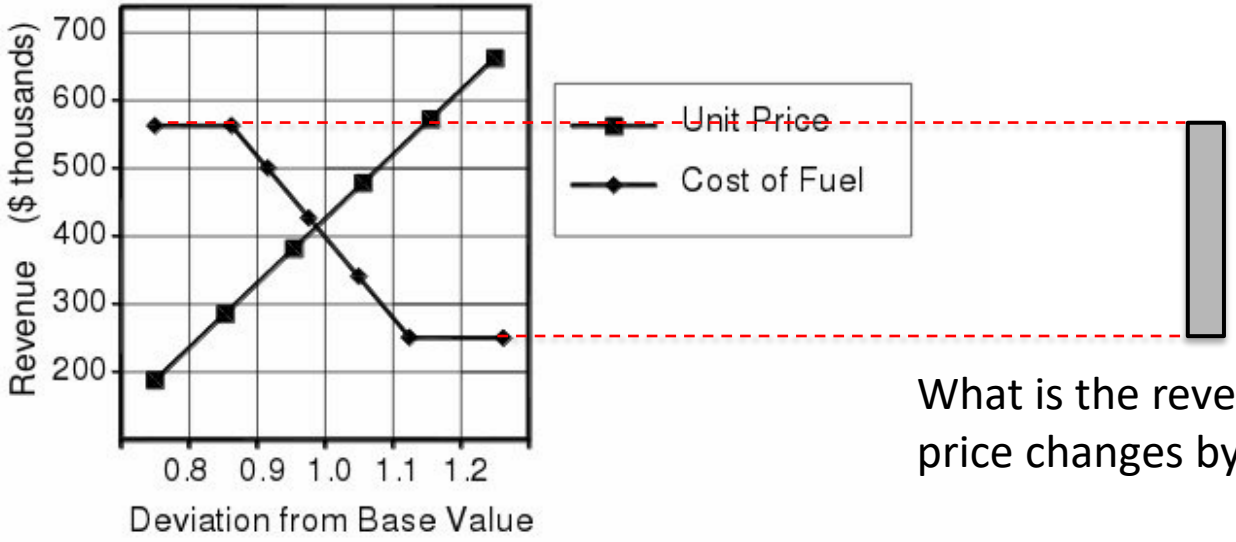


Sensitivity Analysis

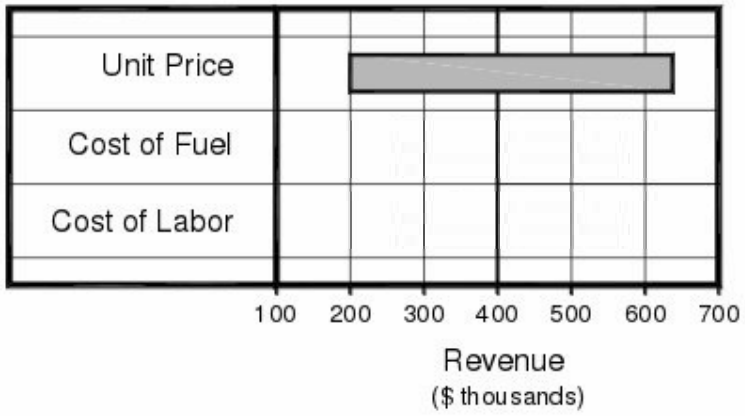




Sensitivity Analysis



What is the revenue if fuel price changes by ±25% ?



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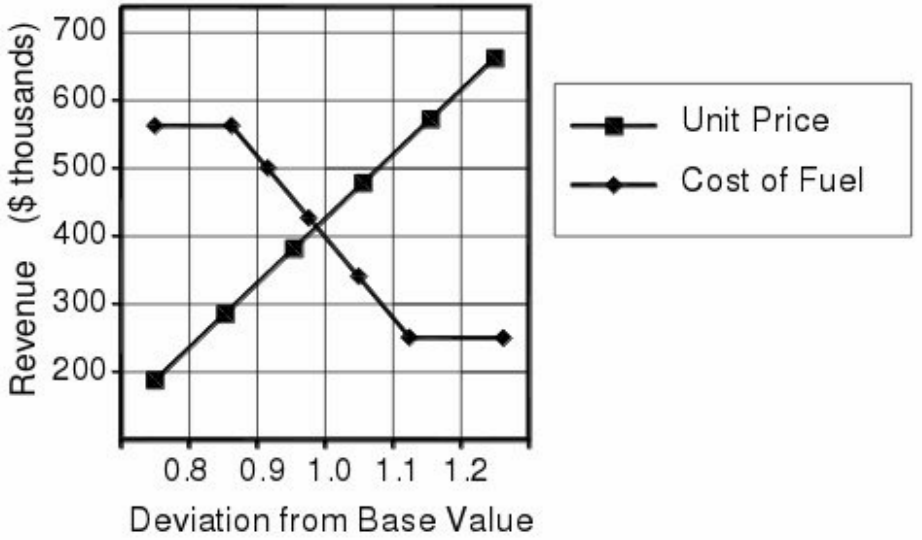

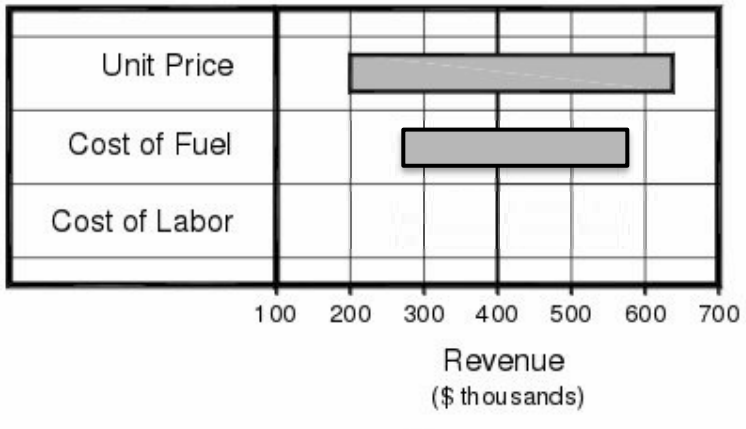

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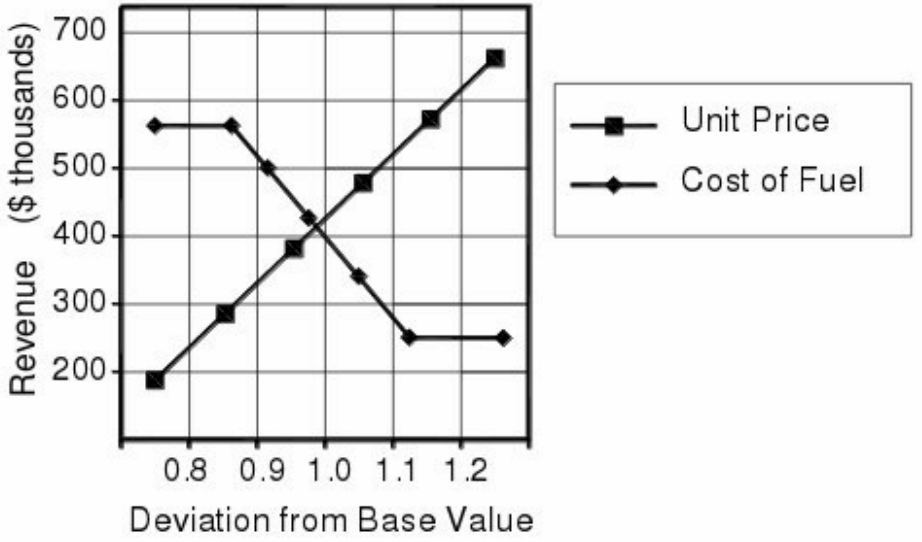
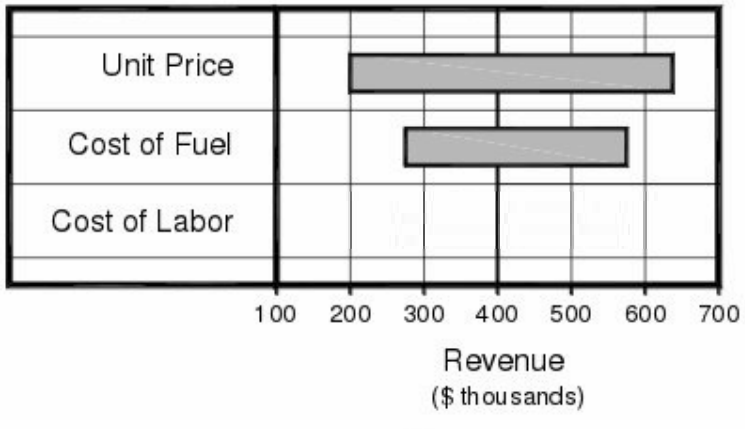
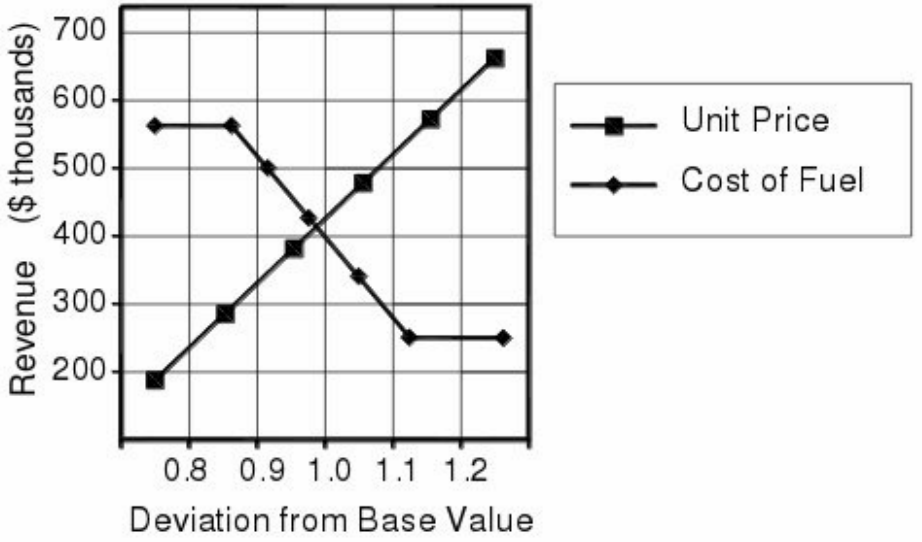
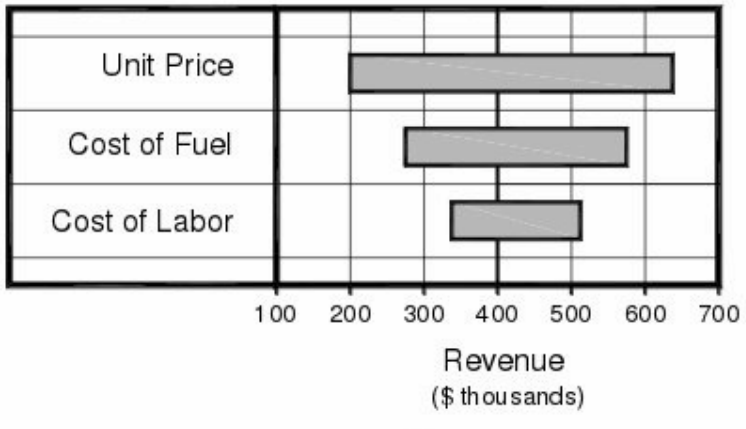




Sensitivity Analysis

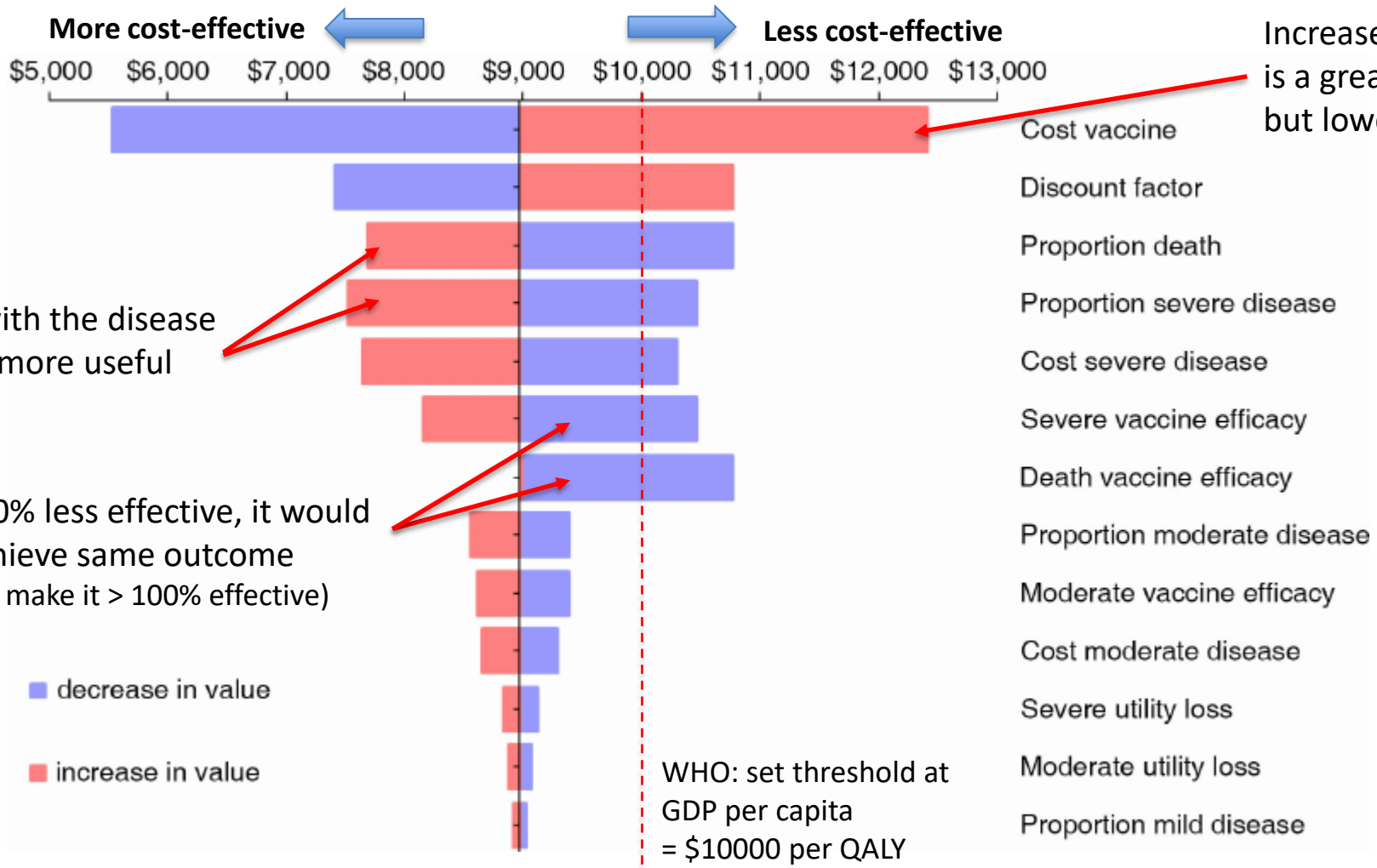




Tornado Diagram

Libya Rotovirus vaccine - Cost per QALY

Quality-adjusted life-year



Increase in vaccine price by 20% is a great way to make a profit, but lowers the cost-effectiveness

More people with the disease makes vaccine more useful

If vaccine was 20% less effective, it would cost more to achieve same outcome
(Asymmetry: can't make it > 100% effective)

WHO: set threshold at GDP per capita = $10000 per QALY

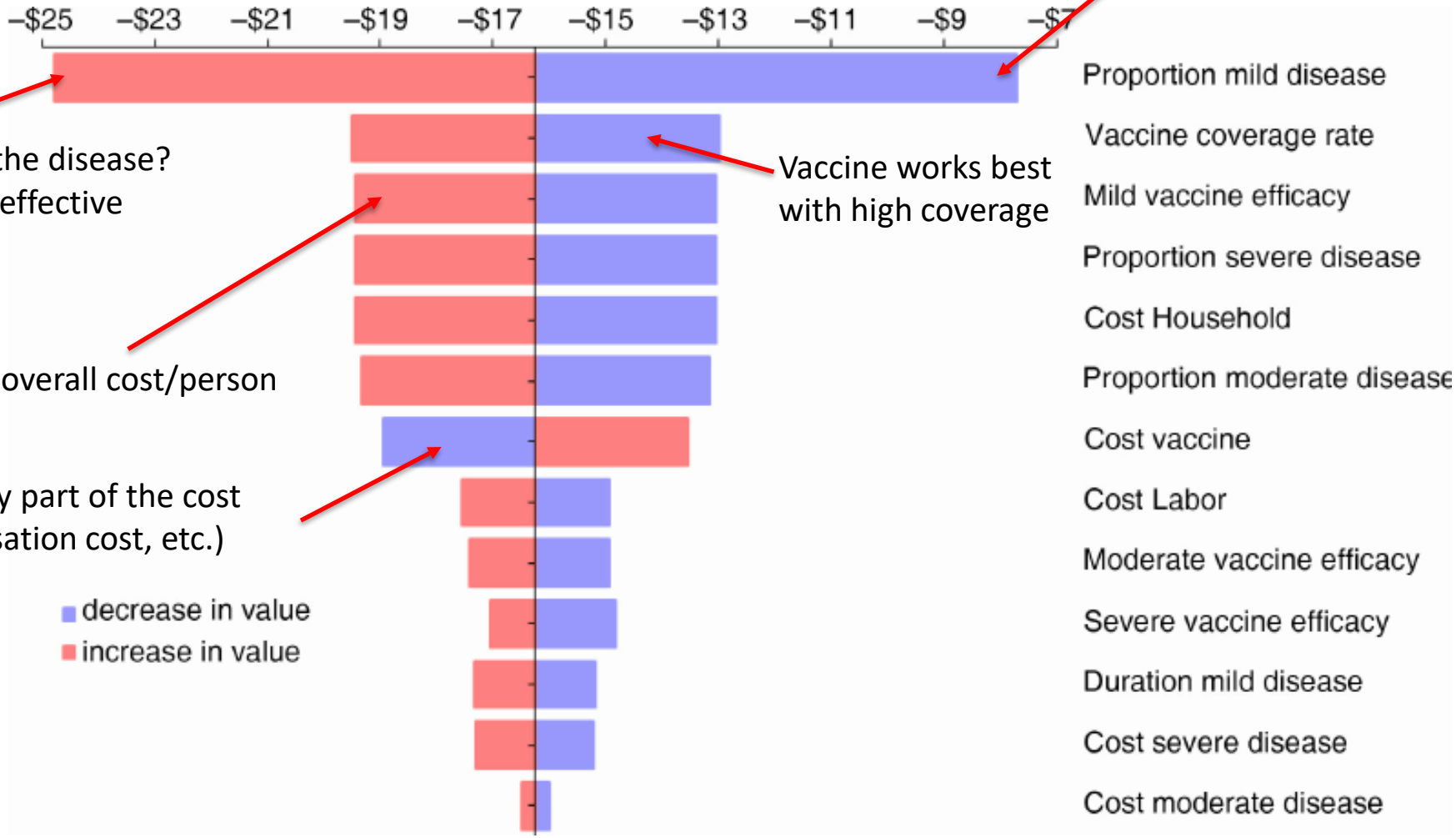
https://www.researchgate.net/figure/Sensitivity-analysis-tornado-diagram-of-the-incremental-cost-per-QALY-gained-analyzed_fig1_269462611

Costs are negative
Vaccine offers **good value** for society

Tornado Diagram

Full economic cost of vaccine (per child)

Currently 40% catch the disease.
What if 32% catch the disease?
→ benefits diminish



What if 48% catch the disease?
→ even more cost-effective

Vaccine works best with high coverage

Better vaccine lowers overall cost/person

Price of vaccine is only part of the cost (negated by hospitalisation cost, etc.)

https://www.researchgate.net/figure/Sensitivity-analysis-tornado-diagram-of-the-incremental-cost-per-QALY-gained-analyzed_fig1_269462611

Today

- Risk in Projects
- Risk in Software Development
- Taking Responsibility
  - RACI Matrix
- Identifying Risks
  - SWOT / RBS
  - Decision Tree / EMV Analysis
- Identifying Causes
  - Ishikawa (Fishbone)
  - Sensitivity Analysis
- **Planning Risk Responses**
  - **Risk Matrix**
  - **FMEA**

Risk Management Plan

Plan for when something goes wrong.

Risk Response depends on **probability** and **impact**.

e.g.

HP, HI : **Avoid**! Plan project such that it won't ever happen.

LP, HI : **Transfer** the risk (e.g. buy insurance, or hedge investments).

HP, LI : **Mitigate** (reduce) the probability or impact

LP, LI : **Accept**: if it happens, respond quickly.

Risk Matrix

Categorise risks according to their **probability** and **impact**.

- Simple to use / understand
- Different risk response for each category
- Asymmetric matrix reflects attitude to risk.

Replaces detailed quantification ("false sense of precision").

Subjective (prone to bias; may easily overestimate / underestimate **true** risk)

Likelihood \ Impact	Negligible	Minor	Moderate	Significant	Severe
Very Likely	Low Med	Medium	Med Hi	High	High
Likely	Low	Low Med	Medium	Med Hi	High
Possible	Low	Low Med	Medium	Med Hi	Med Hi
Unlikely	Low	Low Med	Low Med	Medium	Med Hi
Very Unlikely	Low	Low	Low Med	Medium	Medium

The Pareto Principle
(The 80/20 rule)

- “20% of the people own 80% of the wealth”
  - Pareto, 1906
- "20 percent of the code has 80 percent of the errors. Find them, fix them!“
  - Lowell Arthur
- “It takes 80% of the time to write the hardest 20% of the code”
- “The top 20% of the most-reported bugs cause 80% of the related errors and crashes”
  - Microsoft, 2002
- Conclusion: **Prioritise**

Failure Mode Effects Analysis (FMEA)

"FMEA is an inductive reasoning (forward logic) single point of failure analysis"

A table of:

- Failure Modes (what might go wrong)
- Failure effects (damage caused)
- Possible causes
- Detection measures
- *Bigger numbers indicate a worse outcome*

Method:

Assign a score from 1-10 to:

- Severity **S**
- Occurrence Probability **O**
- Detection Rate **D**

Calculate:

- Criticality **C** = **S×O**
- Risk Priority Number **RPN** = **C×D**

Highest RPN: failure is not detectable by inspection, very severe, and the occurrence is almost sure.

Process Step	Potential Failure Mode	Potential Failure Effect	SEV[1]	Potential Causes	OCC[2]	Current Process Controls	DET[3]	RPN[4]	Action Recommended
What is the step?	In what ways can the step go wrong?	What is the impact on the customer if the failure mode is not prevented or corrected?	How severe is the effect on the customer?	What causes the step to go wrong (i.e., how could the failure mode occur)?	How frequently is the cause likely to occur?	What are the existing controls that either prevent the failure mode from occurring or detect it should it occur?	How probable is detection of the failure mode or its cause?	Risk priority number calculated as SEV x OCC x DET	What are the actions for reducing the occurrence of the cause or for improving its detection? Provide actions on all high RPNs and on severity ratings of 9 or 10.
ATM Pin Authentication									

Process Step	Potential Failure Mode	Potential Failure Effect	SEV[1]	Potential Causes	OCC[2]	Current Process Controls	DET[3]	RPN[4]	Action Recommended
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ATM Pin Authentication	Unauthorized access								
	Authentication failure								

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ATM Pin Authentication	Unauthorized access	• Unauthorized cash withdrawal • Very dissatisfied customer							
	Authentication failure	Annoyed customer							

Process Step	Potential Failure Mode	Potential Failure Effect	SEV[1]	Potential Causes	OCC[2]	Current Process Controls	DET[3]	RPN[4]	Action Recommended
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ATM Pin Authentication	Unauthorized access	• Unauthorized cash withdrawal • Very dissatisfied customer	8						
	Authentication failure	Annoyed customer	3						

Process Step	Potential Failure Mode	Potential Failure Effect	SEV[1]	Potential Causes	OCC[2]	Current Process Controls	DET[3]	RPN[4]	Action Recommended
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	Authentication failure	Annoyed customer	3	Network failure					

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ATM Pin Authentication	Unauthorized access	• Unauthorized cash withdrawal • Very dissatisfied customer	8	Lost or stolen ATM card	3				
	Authentication failure	Annoyed customer	3	Network failure	5				

Process Step	Potential Failure Mode	Potential Failure Effect	SEV[1]	Potential Causes	OCC[2]	Current Process Controls	DET[3]	RPN[4]	Action Recommended
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	Authentication failure	Annoyed customer	3	Network failure	5	Install load balancer to distribute work-load across network links			

Process Step	Potential Failure Mode	Potential Failure Effect	SEV[1]	Potential Causes	OCC[2]	Current Process Controls	DET[3]	RPN[4]	Action Recommended
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ATM Pin Authentication	Unauthorized access	• Unauthorized cash withdrawal • Very dissatisfied customer	8	Lost or stolen ATM card	3	Block ATM card after three failed authentication attempts	3 (easy)		
	Authentication failure	Annoyed customer	3	Network failure	5	Install load balancer to distribute work-load across network links	5		

Easy to detect

In FMEA, small numbers are always better!

Process Step	Potential Failure Mode	Potential Failure Effect	SEV[1]	Potential Causes	OCC[2]	Current Process Controls	DET[3]	RPN[4]	Action Recommended
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	Authentication failure	Annoyed customer	3	Network failure	5	Install load balancer to distribute work-load across network links	5	75	

Process Step	Potential Failure Mode	Potential Failure Effect	SEV[1]	Potential Causes	OCC[2]	Current Process Controls	DET[3]	RPN[4]	Action Recommended
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	Authentication failure	Annoyed customer	3	Network failure	5	Install load balancer to distribute work-load across network links	5	75	Redundant network connection (reduce OCC) Handshaking protocol (reduce DET)

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	Authentication failure	Annoyed customer	3	Network failure	5	Install load balancer to distribute work-load across network links	5	75	Redundant network connection (reduce OCC) Handshaking protocol (reduce DET)
Dispense Cash	Cash not disbursed	Dissatisfied customer	7	ATM out of cash	7	Internal alert of low cash in ATM	4	196	Use historical data to predict demand (reduce OCC)
	Account debited but no cash disbursed	Very dissatisfied customer	8	• Transaction failure • Network issue	3	Install load balancer to distribute work-load across network links	4	96	Use transactional database (reduce OCC)
	Extra cash dispensed	Bank loses money	8	• Bills stuck to each other • Bills stacked incorrectly	2	Verification while loading cash in ATM	8	128	Weigh cash on dispense (reduce DET)

Extended Failure Mode Effects Analysis (E-FMEA)

E-FMEA extends FMEA by:

- Adding **corrective actions**
- Deciding the **feasibility** of the action (how easy it would be to achieve)
- Choose the corrective action which gives the *most feasible reduction in risk*.

Method

For each *corrective action*:

- Revaluate **S**, **O**, **D** and **RPN**
- Assign a score for feasibility **F** (from 1-10, easy to hard)
- Compute: **ΔRPN/F,** the reduction in RPN scaled by the feasibility

Highest ΔRPN/F: greatest reduction in risk for the least amount of effort. This action should take the highest priority.

Process Step	Potential Failure Mode	Potential Failure Effect	SEV[1]	Potential Causes	OCC[2]	Current Process Controls	DET[3]	RPN[4]	Action Recommended
What is the step?	In what ways can the step go wrong?	What is the impact on the customer if the failure mode is not prevented or corrected?	How severe is the effect on the customer?	What causes the step to go wrong (i.e., how could the failure mode occur)?	How frequently is the cause likely to occur?	What are the existing controls that either prevent the failure mode from occurring or detect it should it occur?	How probable is detection of the failure mode or its cause?	Risk priority number calculated as SEV x OCC x DET	What are the actions for reducing the occurrence of the cause or for improving its detection? Provide actions on all high RPNs and on severity ratings of 9 or 10.
ATM Pin Authentication	Unauthorized access	• Unauthorized cash withdrawal • Very dissatisfied customer	8	Lost or stolen ATM card	3	Block ATM card after three failed authentication attempts	3 (easy)	72	Set withdrawal limit (reduce SEV) 2-factor Authentication (reduce OCC)
	Authentication failure	Annoyed customer	3	Network failure	5	Install load balancer to distribute work-load across network links	5	75	Redundant network connection (reduce OCC) Handshaking protocol (reduce DET)
Dispense Cash	Cash not disbursed	Dissatisfied customer	7	ATM out of cash	7	Internal alert of low cash in ATM	4	196	Use historical data to predict demand (reduce OCC)
	Account debited but no cash disbursed	Very dissatisfied customer	8	• Transaction failure • Network issue	3	Install load balancer to distribute work-load across network links	4	96	Use transactional database (reduce OCC)
	Extra cash dispensed	Bank loses money	8	• Bills stuck to each other • Bills stacked incorrectly	2	Verification while loading cash in ATM	8	128	Weigh cash on dispense (reduce DET)

Process Step	Potential Failure Mode	Potential Failure Effect	SEV[1]	Potential Causes	OCC[2]	Current Process Controls	DET[3]	RPN[4]	Action Recommended	SE
What is the step?	In what ways can the step go wrong?	What is the impact on the customer if the failure mode is not prevented or corrected?	How severe is the effect on the customer?	What causes the step to go wrong (i.e., how could the failure mode occur)?	How frequently is the cause likely to occur?	What are the exist-ing controls that either prevent the failure mode from occurring or detect it should it occur?	How probable is detection of the failure mode or its cause?	Risk priority number calculated as SEV x OCC x DET	What are the actions for reducing the occurrence of the cause or for improving its detection? Provide actions on all high RPNs and on severity ratings of 9 or 10.	
ATM Pin Authentication	Unauthorized access	• Unauthorized cash withdrawal • Very dissatisfied customer	8	Lost or stolen ATM card	3	Block ATM card after three failed authentication attempts	3 (easy)	72	Set withdrawal limit (reduce SEV) 2-factor Authentication (reduce OCC)	
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SEV[1]	Potential Causes	OCC[2]	Current Process Controls	DET[3]	RPN[4]	Action Recommended	SEV	OCC	DET	RPN	F	ΔRPN/F
How severe is the effect on the customer?	What causes the step to go wrong (i.e., how could the failure mode occur)?	How frequently is the cause likely to occur?	What are the existing controls that either prevent the failure mode from occurring or detect it should it occur?	How probable is detection of the failure mode or its cause?	Risk priority number calculated as SEV x OCC x DET	What are the actions for reducing the occurrence of the cause or for improving its detection? Provide actions on all high RPNs and on severity ratings of 9 or 10.	Severity after action taken	How likely to occur after action taken	How hard to detect after action taken	New RPN	How feasible is this action (or how hard will it be to implement?)	*Reduction* in RPN divided by feasibility
8	Lost or stolen ATM card	3	Block ATM card after three failed authentication attempts	3 (easy)	72	Set withdrawal limit (reduce SEV) 2-factor Authentication (reduce OCC)						
3	Network failure	5	Install load balancer to distribute work-load across network links	5	75	Redundant network connection (reduce OCC) Handshaking protocol (reduce DET)						
7	ATM out of cash	7	Internal alert of low cash in ATM	4	196	Use historical data to predict demand (reduce OCC)						
8	• Transaction failure • Network issue	3	Install load balancer to distribute work-load across network links	4	96	Use transactional database (reduce OCC)						
8	• Bills stuck to each other • Bills stacked incorrectly	2	Verification while loading cash in ATM	8	12 8	Weigh cash on dispense (reduce DET)						

SEV[1]	Potential Causes	OCC[2]	Current Process Controls	DET[3]	RPN[4]	Action Recommended	SEV	OCC	DET	RPN	F	ΔRPN/F
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8	Lost or stolen ATM card	3	Block ATM card after three failed authentication attempts	3 (easy)	72	Set withdrawal limit (reduce SEV)	**7**	3	3			
						2-factor Authentication (reduce OCC)	8	**1**	3			
3	Network failure	5	Install load balancer to distribute work-load across network links	5	75	Redundant network connection (reduce OCC)	3	**4**	5			
						Handshaking protocol (reduce DET)	3	5	**3**			
7	ATM out of cash	7	Internal alert of low cash in ATM	4	196	Use historical data to predict demand (reduce OCC)	7	**4**	4			
8	• Transaction failure • Network issue	3	Install load balancer to distribute work-load across network links	4	96	Use transactional database (reduce OCC)	8	**1**	4			
8	• Bills stuck to each other • Bills stacked incorrectly	2	Verification while loading cash in ATM	8	12 8	Weigh cash on dispense (reduce DET)	8	2	**5**			

SEV[1]	Potential Causes	OCC[2]	Current Process Controls	DET[3]	RPN[4]	Action Recommended	SEV	OCC	DET	RPN	F	ΔRPN/F
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8	Lost or stolen ATM card	3	Block ATM card after three failed authentication attempts	3 (easy)	72	Set withdrawal limit (reduce SEV)	**7**	3	3	63		
						2-factor Authentication (reduce OCC)	8	**1**	3	24		
3	Network failure	5	Install load balancer to distribute work-load across network links	5	75	Redundant network connection (reduce OCC)	3	**4**	5	60		
						Handshaking protocol (reduce DET)	3	5	**3**	45		
7	ATM out of cash	7	Internal alert of low cash in ATM	4	196	Use historical data to predict demand (reduce OCC)	7	**4**	4	112		
8	• Transaction failure • Network issue	3	Install load balancer to distribute work-load across network links	4	96	Use transactional database (reduce OCC)	8	**1**	4	32		
8	• Bills stuck to each other • Bills stacked incorrectly	2	Verification while loading cash in ATM	8	12 8	Weigh cash on dispense (reduce DET)	8	2	**5**	80		

SEV[1]	Potential Causes	OCC[2]	Current Process Controls	DET[3]	RPN[4]	Action Recommended	SEV	OCC	DET	RPN	F	ΔRPN/F
How severe is the effect on the customer?	What causes the step to go wrong (i.e., how could the failure mode occur)?	How frequently is the cause likely to occur?	What are the existing controls that either prevent the failure mode from occurring or detect it should it occur?	How probable is detection of the failure mode or its cause?	Risk priority number calculated as SEV x OCC x DET	What are the actions for reducing the occurrence of the cause or for improving its detection? Provide actions on all high RPNs and on severity ratings of 9 or 10.	Severity after action taken	How likely to occur after action taken	How hard to detect after action taken	New RPN	How feasible is this action (or how hard will it be to implement?)	*Reduction* in RPN divided by feasibility
8	Lost or stolen ATM card	3	Block ATM card after three failed authentication attempts	3 (easy)	72	Set withdrawal limit (reduce SEV)	**7**	3	3	63	1 (easy)	
						2-factor Authentication (reduce OCC)	8	**1**	3	24	6	
3	Network failure	5	Install load balancer to distribute workload across network links	5	75	Redundant network connection (reduce OCC)	3	**4**	5	60	3	
						Handshaking protocol (reduce DET)	3	5	**3**	45	2	
7	ATM out of cash	7	Internal alert of low cash in ATM	4	196	Use historical data to predict demand (reduce OCC)	7	**4**	4	112	7 (hard)	
8	• Transaction failure • Network issue	3	Install load balancer to distribute workload across network links	4	96	Use transactional database (reduce OCC)	8	**1**	4	32	1	
8	• Bills stuck to each other • Bills stacked incorrectly	2	Verification while loading cash in ATM	8	12 8	Weigh cash on dispense (reduce DET)	8	2	**5**	80	6	

SEV[1]	Potential Causes	OCC[2]	Current Process Controls	DET[3]	RPN[4]	Action Recommended	SEV	OCC	DET	RPN	F	ΔRPN/F
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						Handshaking protocol (reduce DET)	3	5	**3**	45	2	15
7	ATM out of cash	7	Internal alert of low cash in ATM	4	196	Use historical data to predict demand (reduce OCC)	7	**4**	4	112	7 (hard)	12
8	• Transaction failure • Network issue	3	Install load balancer to distribute work-load across network links	4	96	Use transactional database (reduce OCC)	8	**1**	4	32	1	64
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Recap

- Risk in Projects
- Risk in Software Development
- Taking Responsibility
  - RACI Matrix
- Identifying Risks
  - SWOT / RBS
  - Decision Tree / EMV Analysis
- Identifying Causes
  - Ishikawa (Fishbone)
  - Sensitivity Analysis
- Planning Risk Responses
  - Risk Matrix
  - FMEA

Next: Guest Lecture

Craig Adamson

- **Programme Director, Credit Risk Change at** Deutsche Bank
- Expert in *Risk Management*

Deutsche Bank

Project Management & Financial Services

Craig Adamson

Programme Director, Credit Risk Change at **Deutsche Bank**

Introduction

- My role
- Why is project management required in the Financial Services industry?
- What are the key items to consider when managing a project?
- Managing risks, issues, dependencies and assumptions
- Q&A

Drivers for change within the Financial Services industry

- Improving profit margins
- Tap into new technology
- Changes to business strategy and outside influences
- Scale of business and systems
- Compliance with regulations

Key items to consider when planning and delivering a project

Objectives	• What does the project aim to achieve?
Scope	• What is included within the delivery of the project?
Approach & Governance	• How will the project be managed and governed?
Benefit Milestones	• What are the key project outputs that create a benefit?
Task Schedule	• A schedule of the key tasks required to deliver the project
Risks, Issues, Dependencies & Assumptions	• What other items can influence the success of the project?

Risks, Issues, Dependencies & Assumptions

Item	Description	Why is it important?
Risks	An event that could materialise into an issue (positive or negative)	Allows planning and pre-emptive action to increase the chance of delivery success
Issues	An event that is affecting the project	The negative or positive impact must be understood to allow for management action
Dependencies	A linkage between different activities	Ensures that tasks are scheduled appropriately alongside known constraints
Assumptions	A statement that is taken as true for planning purposes	Provides transparency on the key assumptions that are used in the project plans and deliveries

Which of the following are risks, issues, dependencies & assumptions?

1. Joe Bloggs time is required for the data sourcing work required to roll out the system
2. New regulations are emerging which may require reprioritisation of project resources
3. The lead developer for the project has resigned from the Bank
4. The requirements deliver compliance with the industry regulation
5. The project may receive additional funding and resourcing next year
6. The regulator may delay the finalisation of the industry rules
7. This lecture will be useful for students

POLL OPEN

Joe Bloggs time is required for the data sourcing work required to roll out the system

1. Risk
2. Issue
3. Dependency
4. Assumption

POLL OPEN

New regulations are emerging which may require reprioritisation of project resources

1. Risk
2. Issue
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4. Assumption

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POLL OPEN

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POLL OPEN

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The regulator may delay the finalisation of the industry rules

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4. Assumption

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POLL OPEN

This lecture will be useful for students

1. Risk
2. Issue
3. Dependency
4. Assumption

Key things to consider

- RAIDs are not always mutually exclusive – often they will overlap
- RAIDs should be defined at the beginning of a project – but don't forget to manage and review throughout the project
- RAIDs can be measured against each other – e.g. probability of occurrence and scale of impact
- RAIDs should always have an owner – this doesn't have to be the PM
- RAIDs can be both positive as well as negative – look out for opportunities

Questions & Answers

Week	Lectures		Seminars			Individual Report		
	Topic	Guest	Case Study	Exercises	Submission	Chapter	Submission	Marking
1	Specification			Specification				
2	Initiation		Selection		Pitch			
3	Scope / Time			Scope/Time				
4	PRINCE2	PRINCE2	Initiation			Ch.1 Initiation		
5	Budgeting			Budgeting				Self-assess
6	Lean/Agile 1	Waterfall / Agile	Planning			Ch.2 Planning		
7	Lean/Agile 2	Lean		Scrum/Kanban			Ch.1-2	
8	Risk	Risk / Finance	Monitoring					Review Ch.1-2
9	Teamwork	Large Projects	Prepare Presentation	Risk		Ch.3 Execution		
10	Revision				Presentation	Ch.4 Monitoring		
11							Ch.1-4	
Term 2								Review Ch. 1-4

Ch 1-2 Peer Assessment

- 5 essays to mark via Moodle
- **Due on Thursday @ noon!**

Individual Report - Submission and Peer Assessment

In addition to the team-based activities in this module, you will need to produce an **Individual Report.** You will work on this in your own time (independently of your team).

You will submit this report (including an interim submission) to Moodle. You are also required to mark the work of your peers and provide constructive feedback. See the assignments page for more details. You should also be aware of the deadlines and penalties.

- Self-Assessment (Ch. 1)
- How to mark the essay
- Interim Essay Submission and Peer Marking (Ch.1-2) ← This one!
- Interim Essay Results (Ch. 1-2)
- Final Essay Submission and Peer Marking (Ch.1-4)
- Final Essay Results (Ch. 1-4)

- If you are driving home…