

Business Process Improvement

Part III b - Six Sigma

with BPMN,, DMAIC, Six Sigma

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Six Sigma

6σ

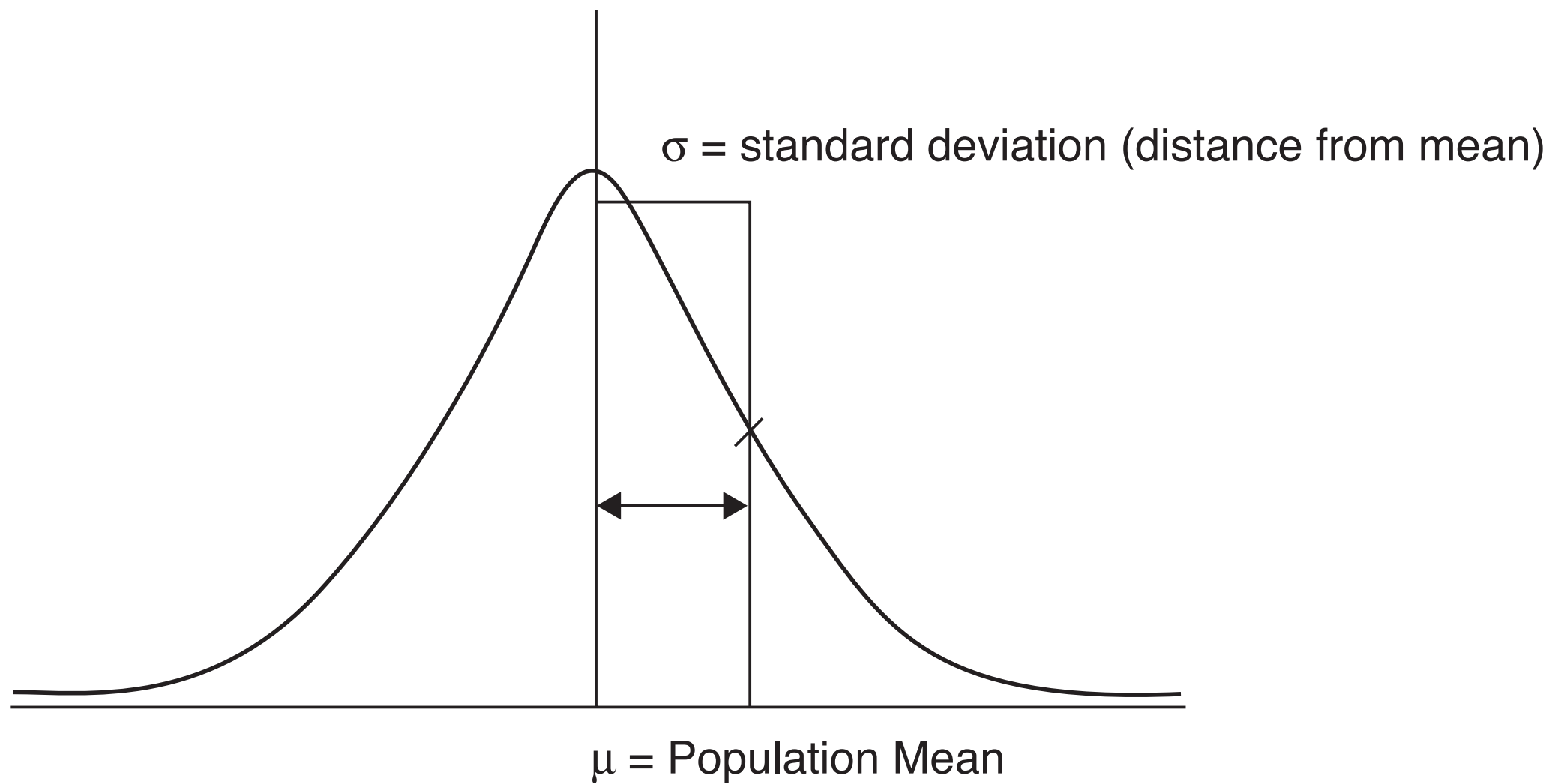
History of Six Sigma

- **Started in 1986 at Motorola,**
- **Became central in the Business Strategy of General Electric in 1995,**
- **Nowadays wild adoption in the industry,**

Why Six Sigma

- Most processes are Ad Hoc,
- They have a high variability in their results which is seen as difficult to improve,
- A company who is not able to improve her quality level in the same time as keeping competitive price will head out of business
- Focus on variability and how to minimise it
- Sigma is the standard deviation from the mean of a distribution
 - 6sigma —> 99,999996% succeed (3,4 DPMO)
 - 4sigma —> 99,4(it is the point where customer start to feel unsatisfied)

Standard Deviation and Population Mean



Sigma Scale

Sigma	DPMO	Efficiency (%)
1	691,462	30.9
2	308,538	69.1
3	66,807	93.3
4	6,210	99.4
5	233	99.98
6	3.4	99.9999966

What is Six Sigma

- **How to measure quality of a Process?**
 - Conformity with requirement, delivery time, documentation,
 - Availability, user experience,
- **6S is a philosophy**
 - Limit the number of defect,
- **A measure**
 - give a statistic scale to measure improvement and
 - to benchmark competitors,

What is Six Sigma

- **Defect**
 - All that can cause unsatisfaction from the Customer point of view,
 - late delivery,
 - component that doesn't work,
 - slow software,
- **Opportunity**
 - An operation that may introduce error,

Process Capability

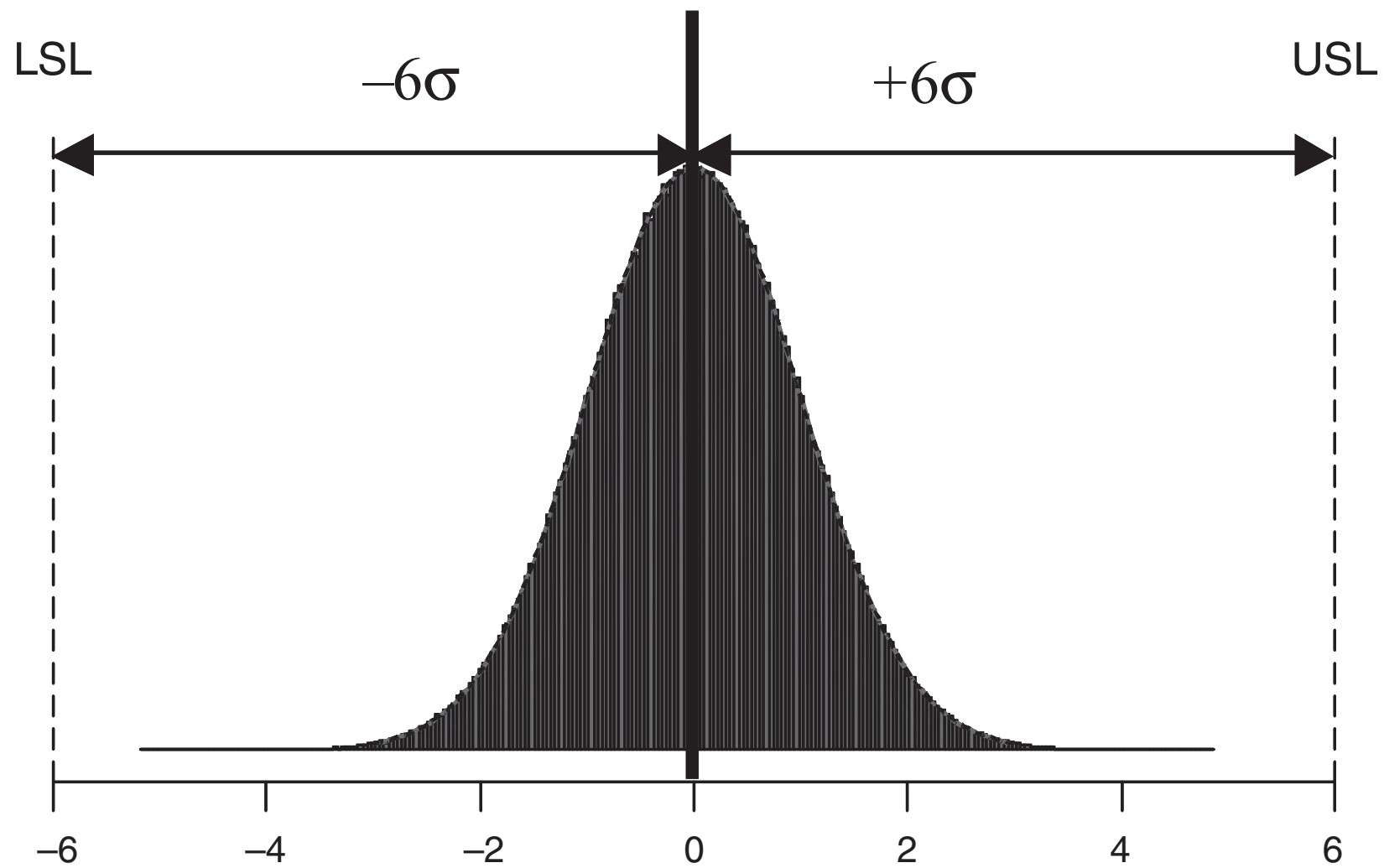


FIGURE 7.9 Highly capable pocess.

Process Capability

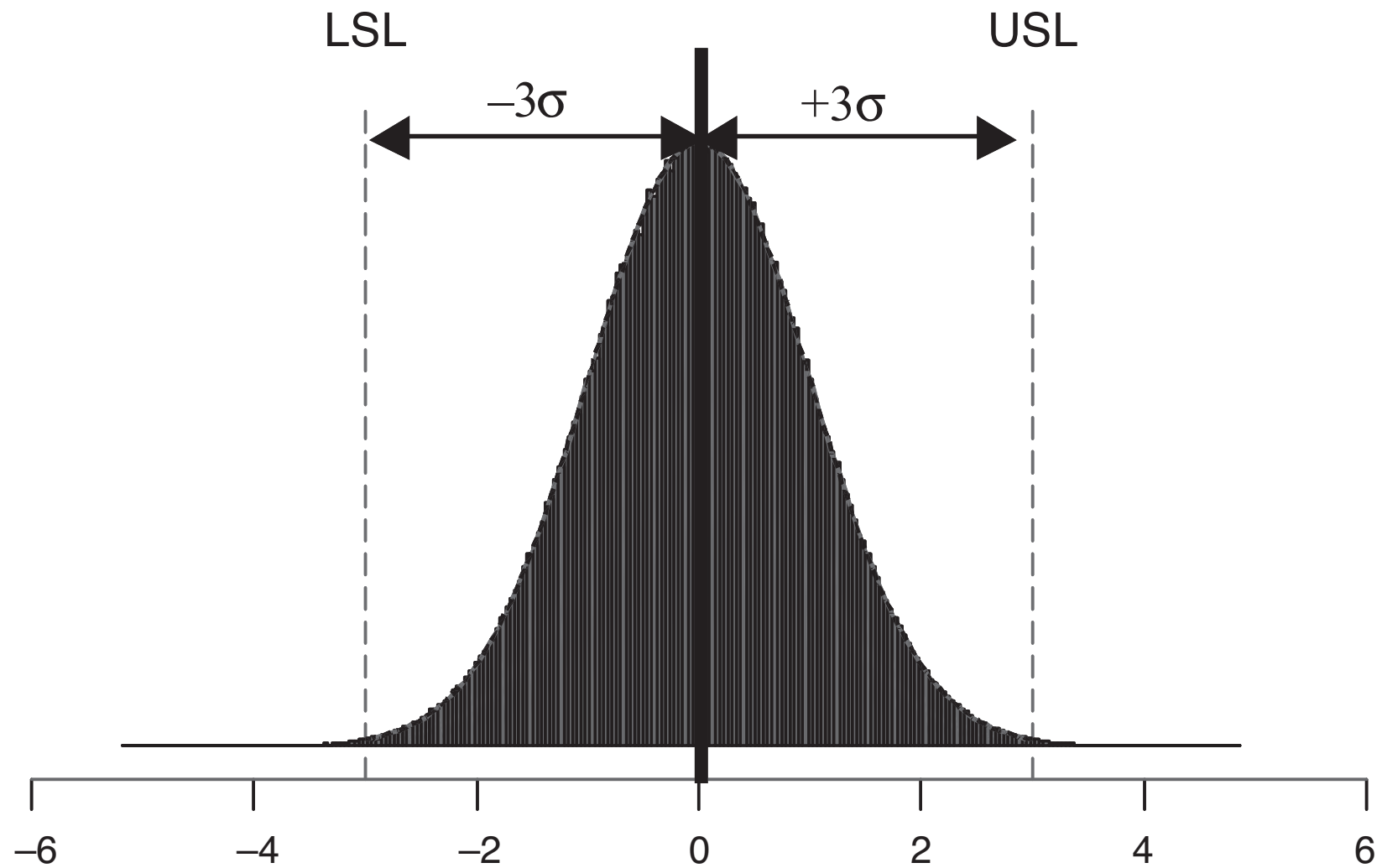


FIGURE 7.10 Marginally capable pocess.

Process Capability

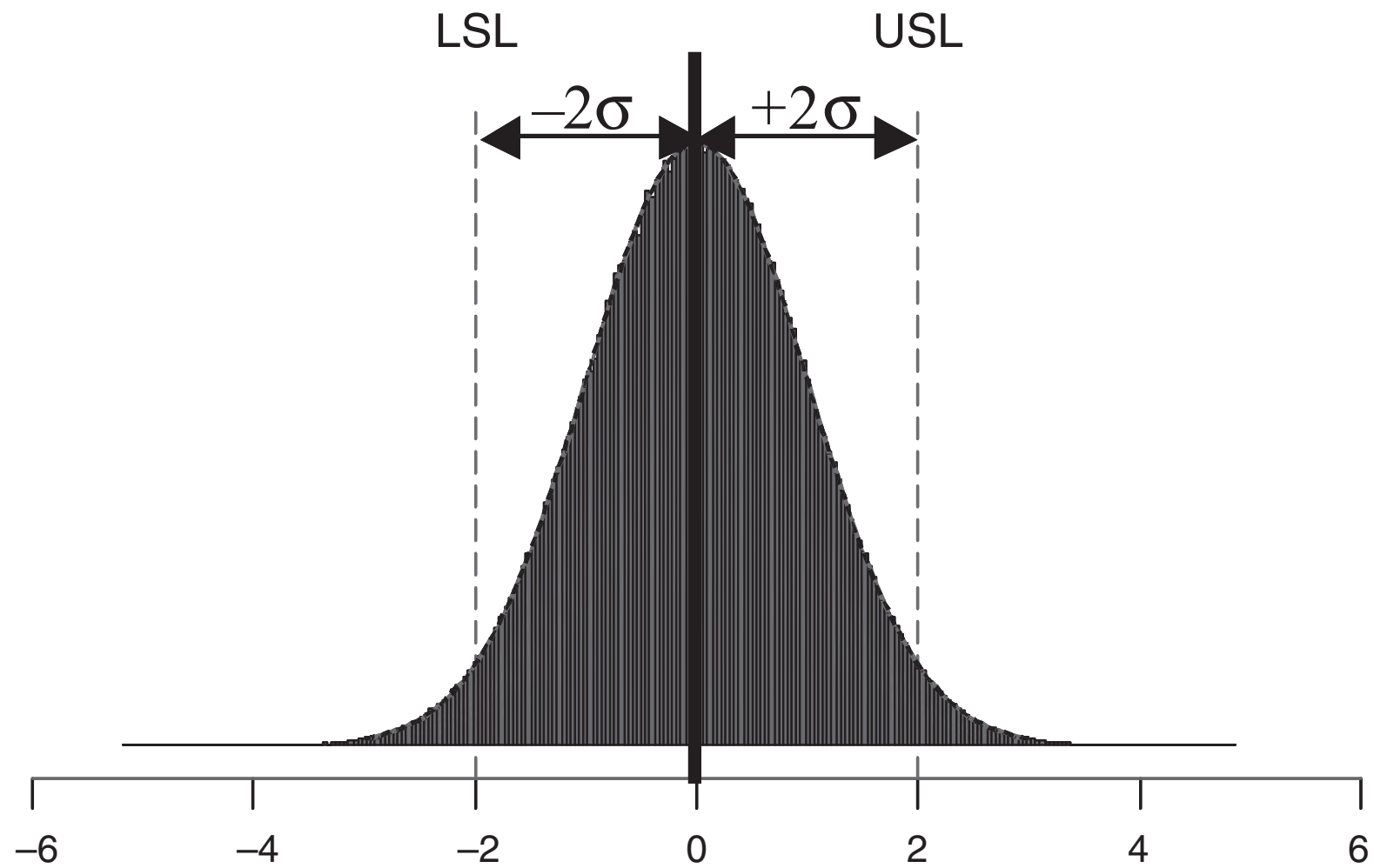


FIGURE 7.11 Incapable process.

DMAIC



Define



Measure



Analyze



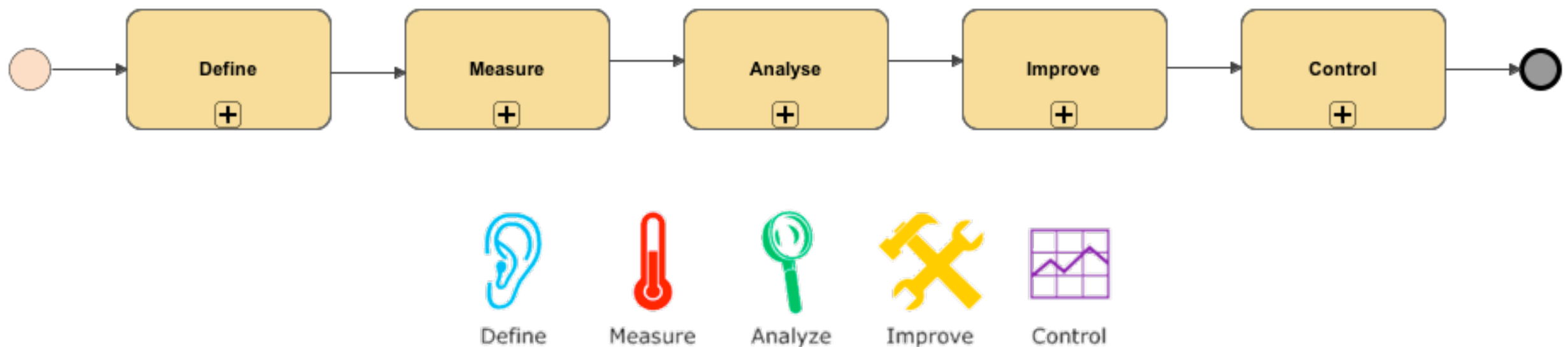
Improve

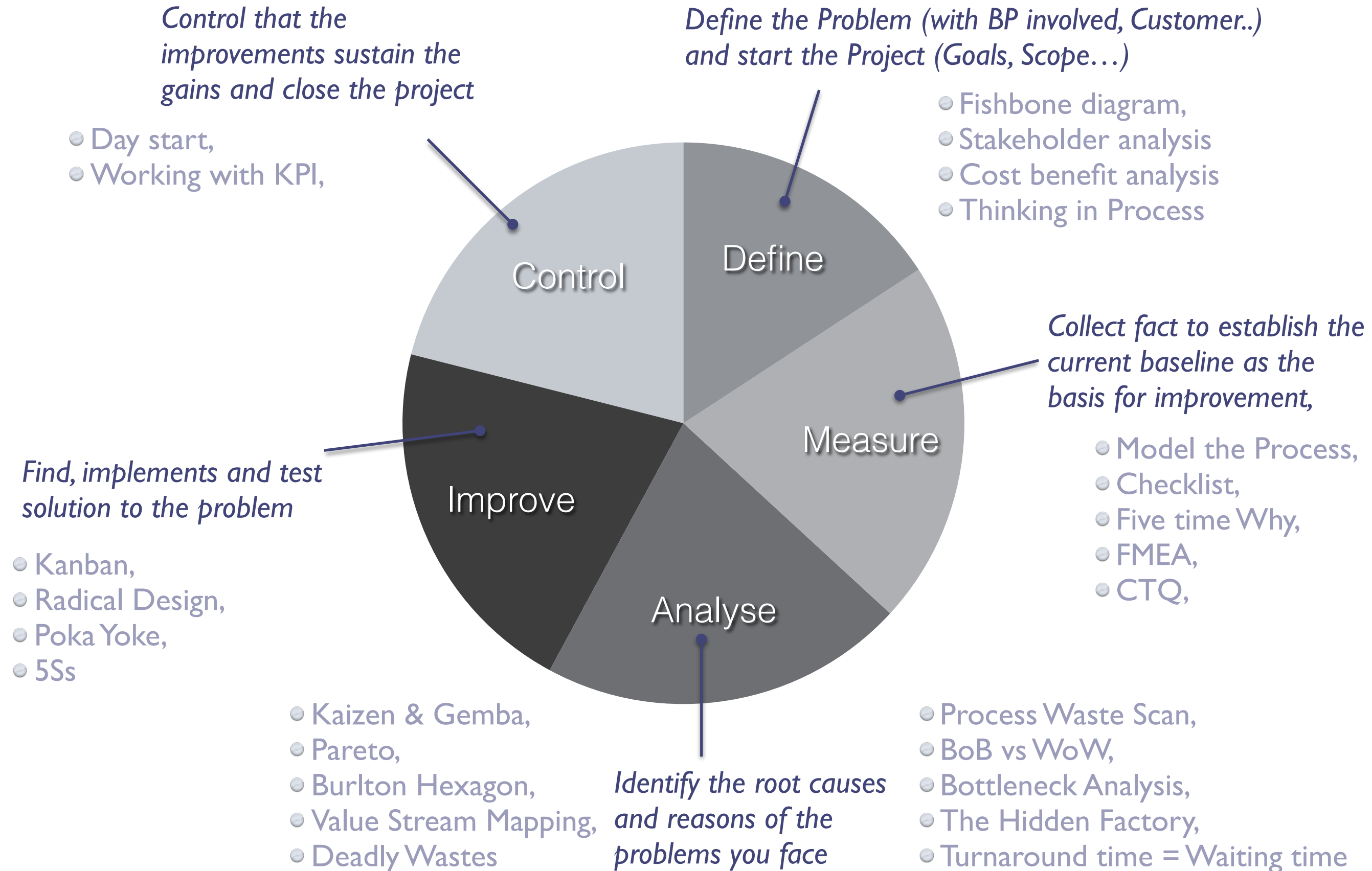


Control

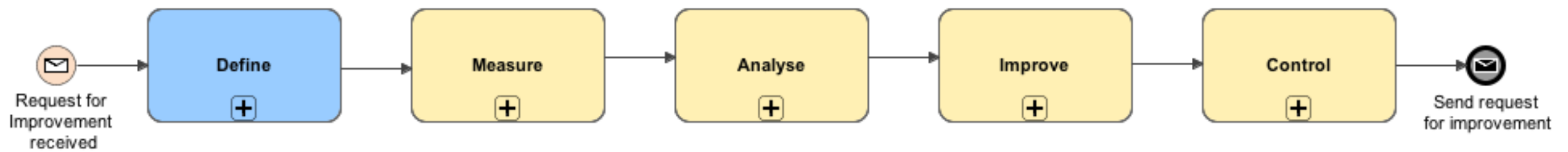
DMAIC Process

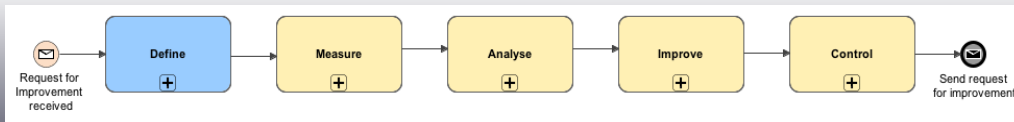
- DMAIC is a improvement process in 5 “*Phases*”
 - Define,
 - Measure,
 - Analyse,
 - Improve,
 - Control





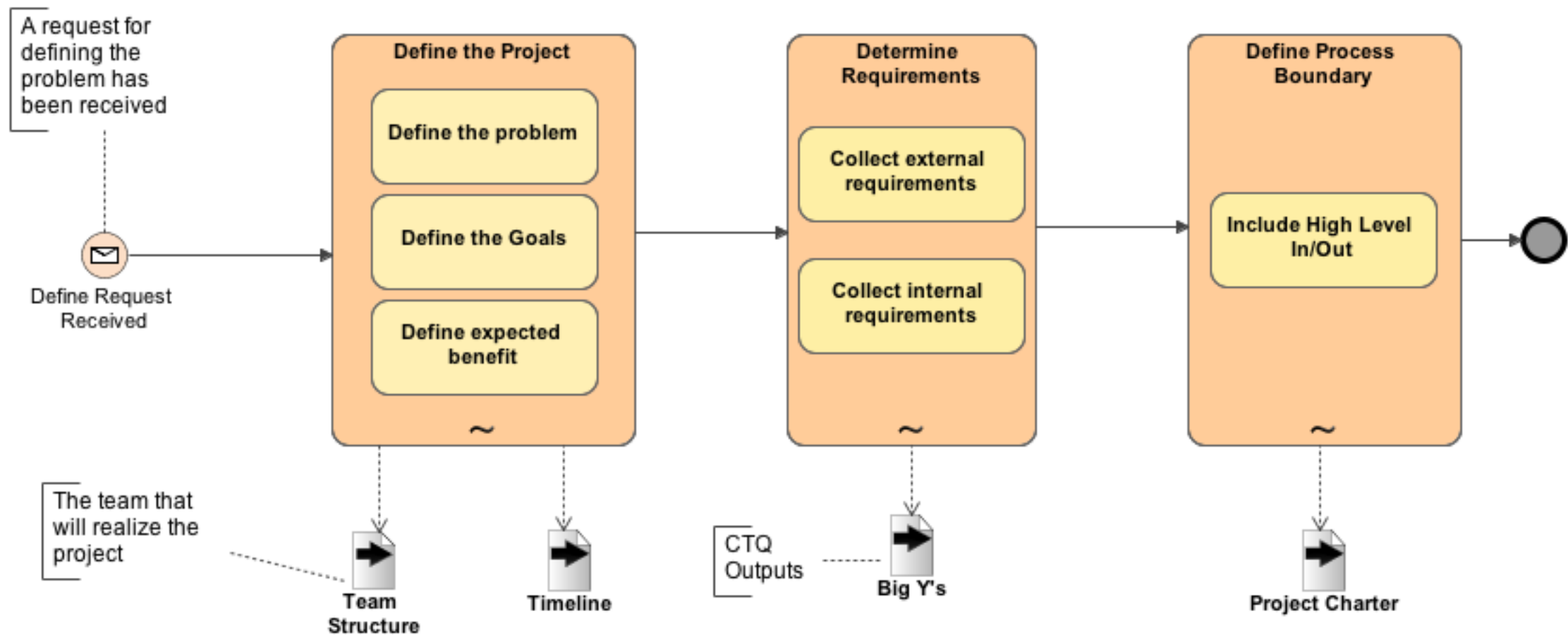
Define

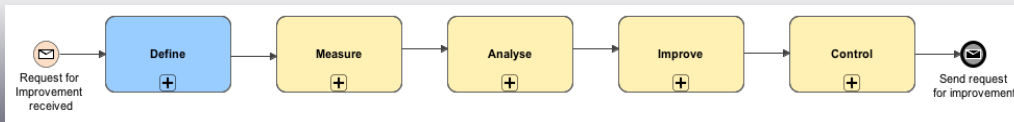




Define Phase

- Define the Problem and what the Customer requires,



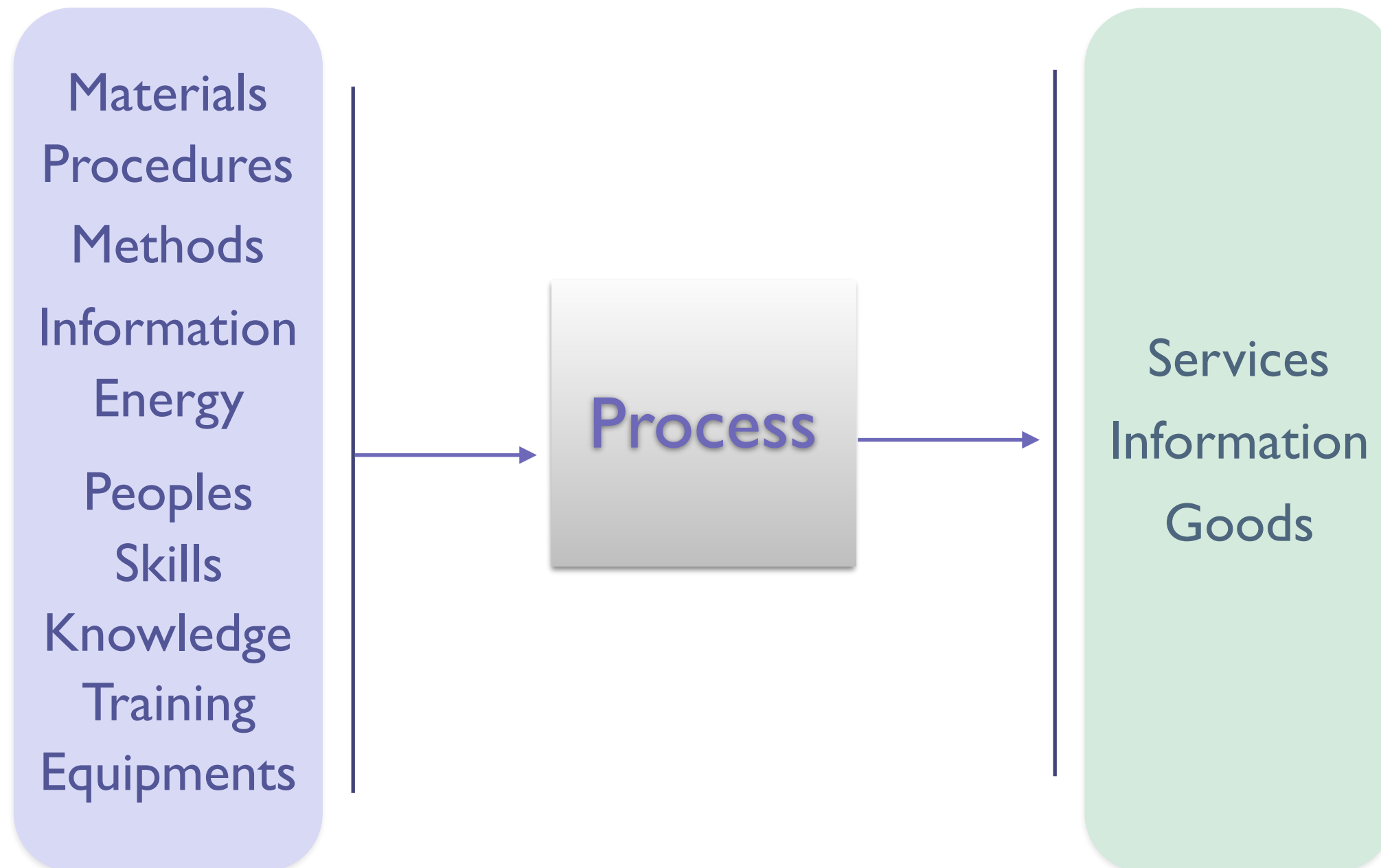


Define Phase Tools

- Project Charter,
- SIPOC diagrams,
- Fishbone Diagram,
- Stakeholder Analysis,
- Cost Benefit Analysis,
- Risk Analysis,
- SIPOC
- Voice Of the Customer (VOC)

SIPOC Diagram

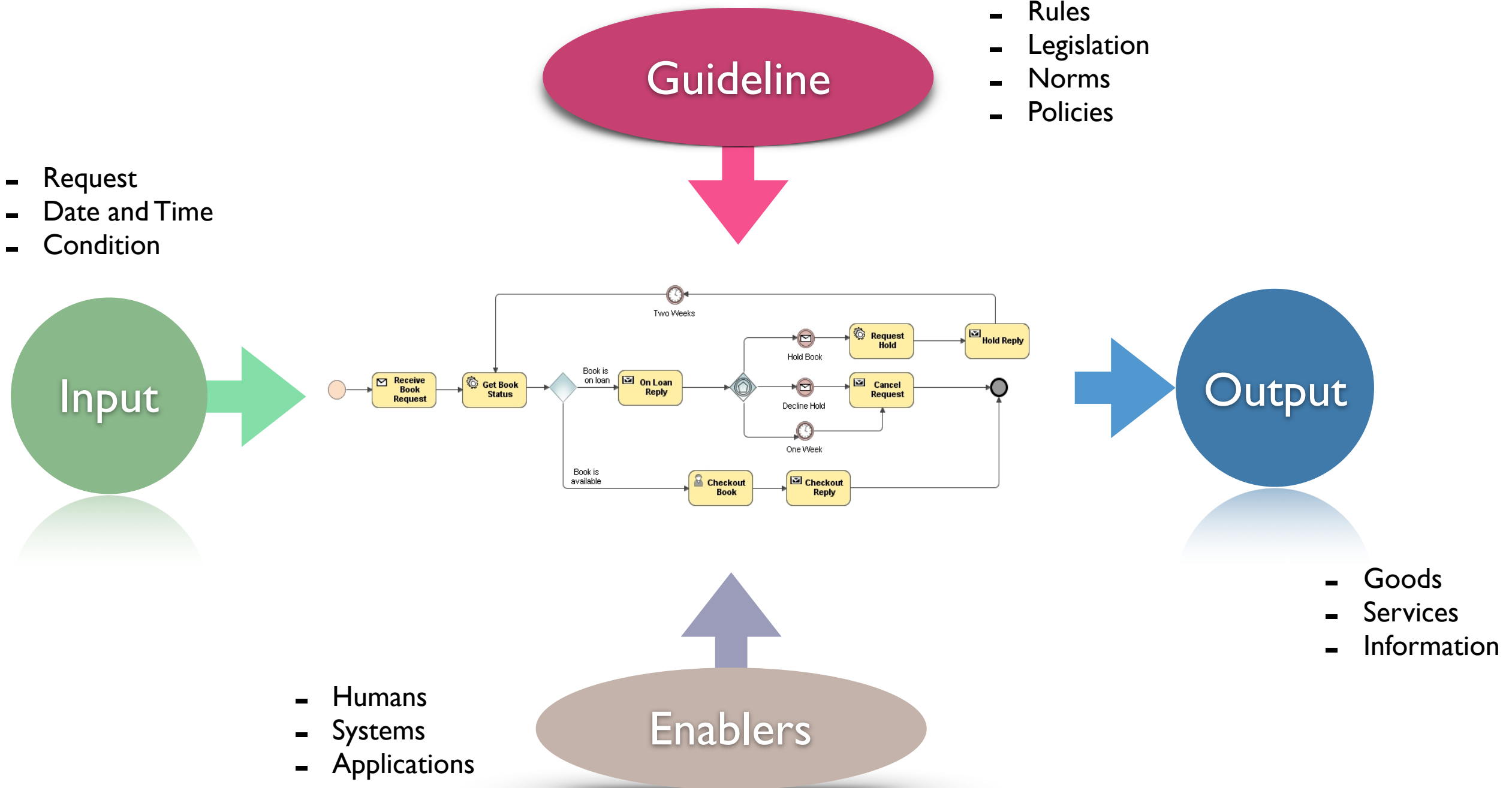
- **IPO: Input - Process - Output**



IGOE - Input, Guide, Output, Enabler

- Request
- Date and Time
- Condition

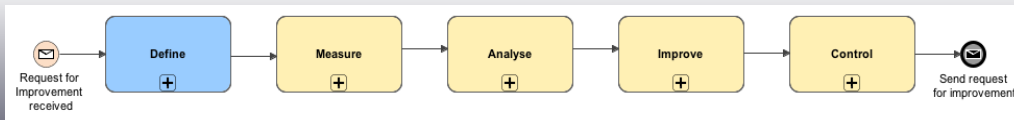
- Rules
- Legislation
- Norms
- Policies



SIPOC Diagram

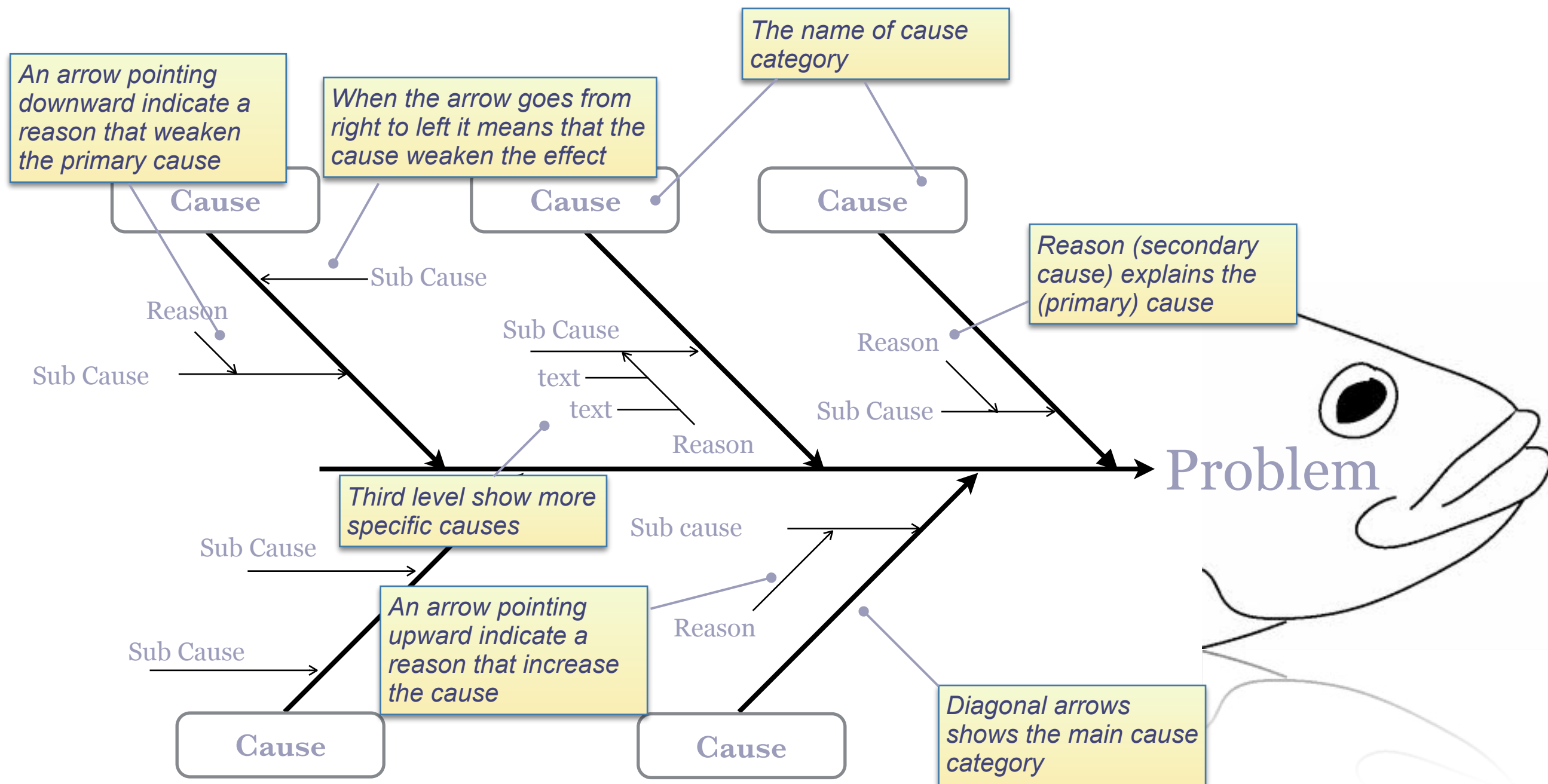
- **SIPOC: Supplier - Input - Process - Output - Customer**

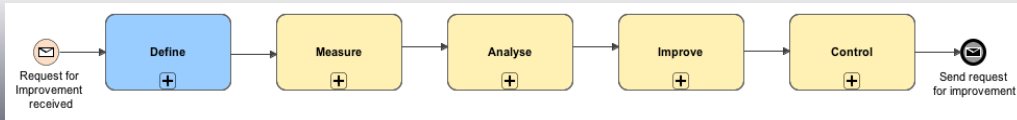
Suppliers	Inputs	Inputs Characteristic	Process	Outputs	Output Characteristic	Customers
<div>7. Who are the suppliers of the inputs?</div>	<div>6. What are the inputs of the process?</div>	<div>8. What are the characteristics of the inputs?</div>	<div>2a. What is the start of the process?</div>	<div>3. What are the outputs of the process?</div>	<div>5. What are the characteristics of the outputs?</div>	<div>4. Who are the customers of the outputs?</div>
			<div>1. What is the process?</div>			
			<div>2b. What is the end of the process?</div>			



Fishbone Diagram - Define

Identify potential factors causing a problem,





Cause Categories

Used in Service Industry

5 Ss

- Samples,
- Scheme,
- Synchronous,
- Skin,
- Search

Used in Manufacturing Industry

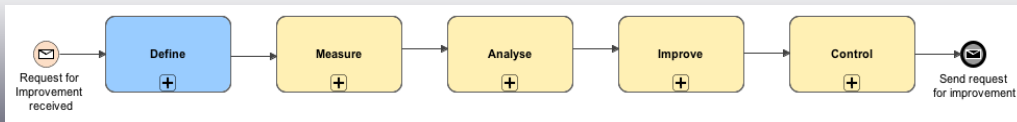
6 Ms

- Machine,
- Method,
- Material,
- Man Power,
- Measurement,
- Milieu,

Used in Marketing Industry

7 Ps

- Product,
- Price,
- Place,
- Promotion,
- People,
- Process,
- Physical Evidence



Cause Categories in IT

Used in IT Industry

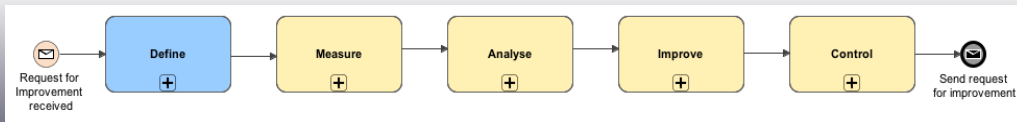
5 Ms

- Machine,
- Method,
- Man,
- Milieu,
- Management,

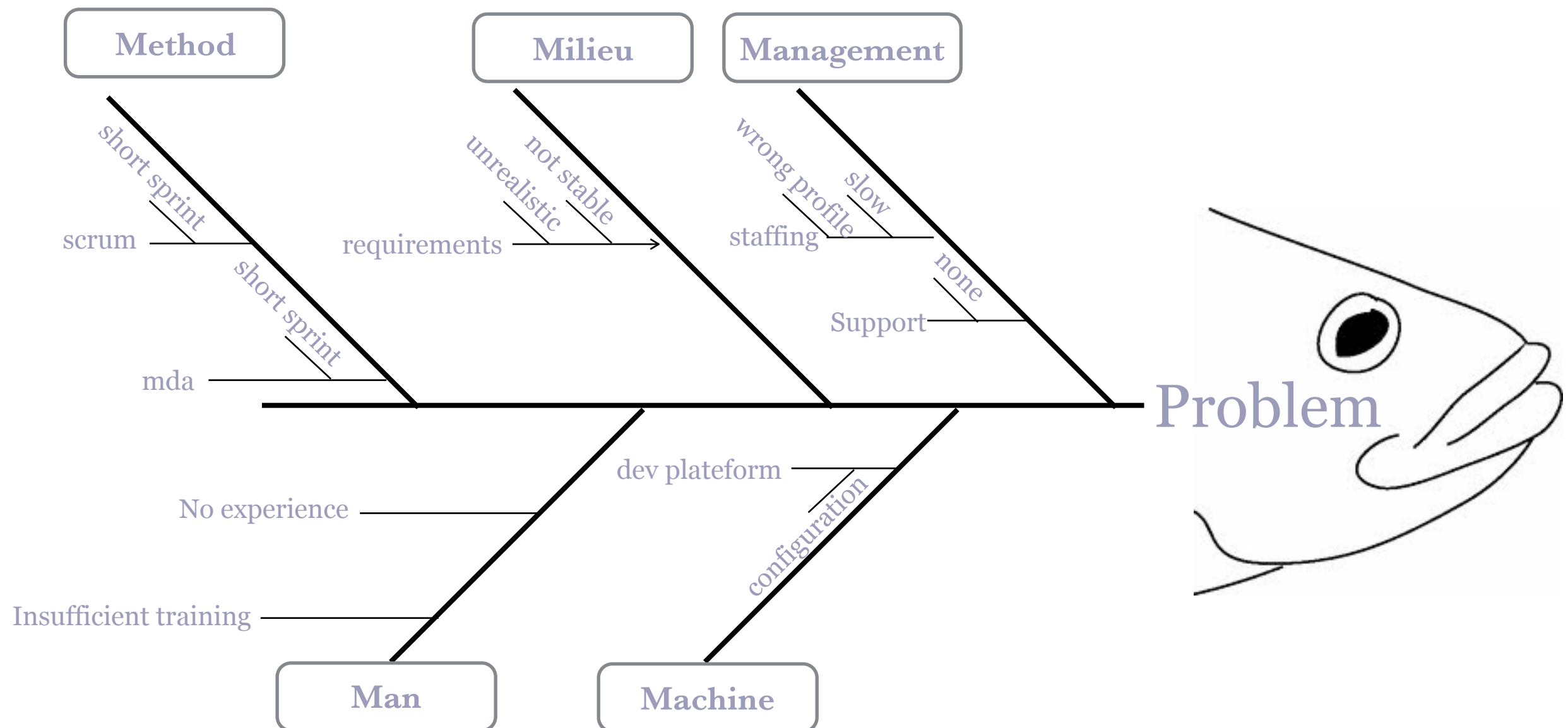
Mc Kinsley

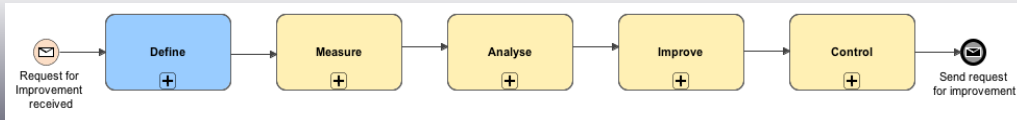
7 Ps

- Strategy,
- Structure,
- Systems,
- Style,
- Staff,
- Skills
- Shared Values,



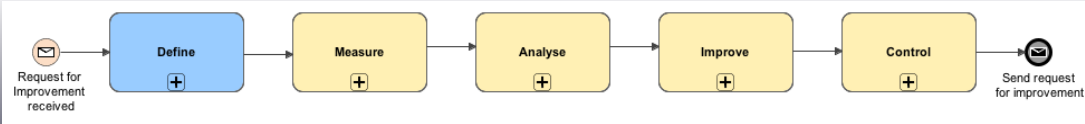
5 Ms Cause Categories





Stakeholders Analysis

- **Research and identify people or organisation that affect or are affected by a problem and or an action,**
 - Sort them by the impact they have on the problem,
 - impact may be positive or negative,
 - Sort them by the impact the problem have on them,
 - impact may be positive or negative,
 - Them, based on this sorting, select stakeholder concerns and or order that should be addressed by the project,



Stakeholders Analysis

- **Represent them graphically**
 - give a name,
 - give a score for their influence,
 - an influence may be positive or negative
 - give a score for their interest

Customer



Interest: 8
Influence: 3

Management

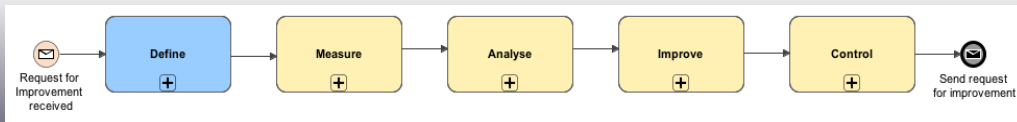


Interest: 6
Influence: 6

Employee



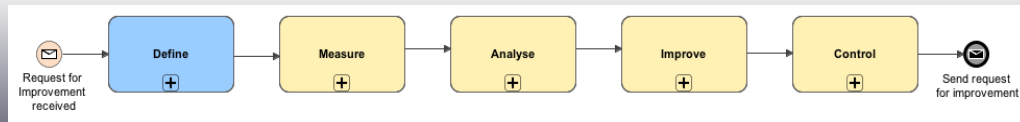
Interest: 3
Influence: 8



Cost Benefit Analysis,

- **Cost-Benefit analysis is used to manage improvement projects.**
 - To decided if the project shall start or continue the Costs are considered against the Benefits

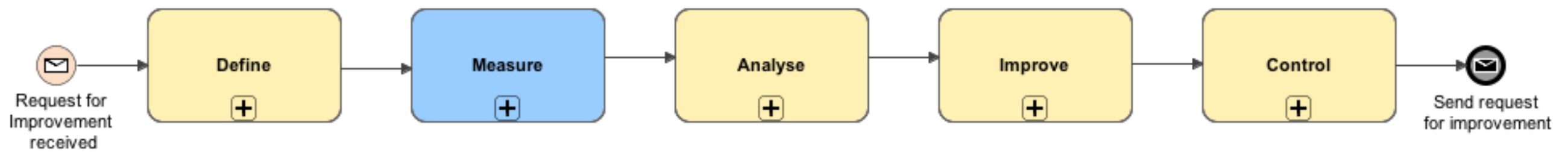


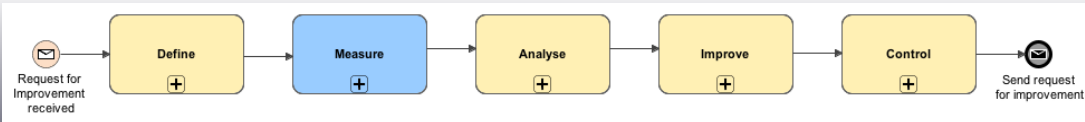


Cost Benefit Analysis

- **Example of benefits**
 - Cost saving,
 - Improved customer satisfaction
- **Example of Costs**
 - Prices,
 - Delays,

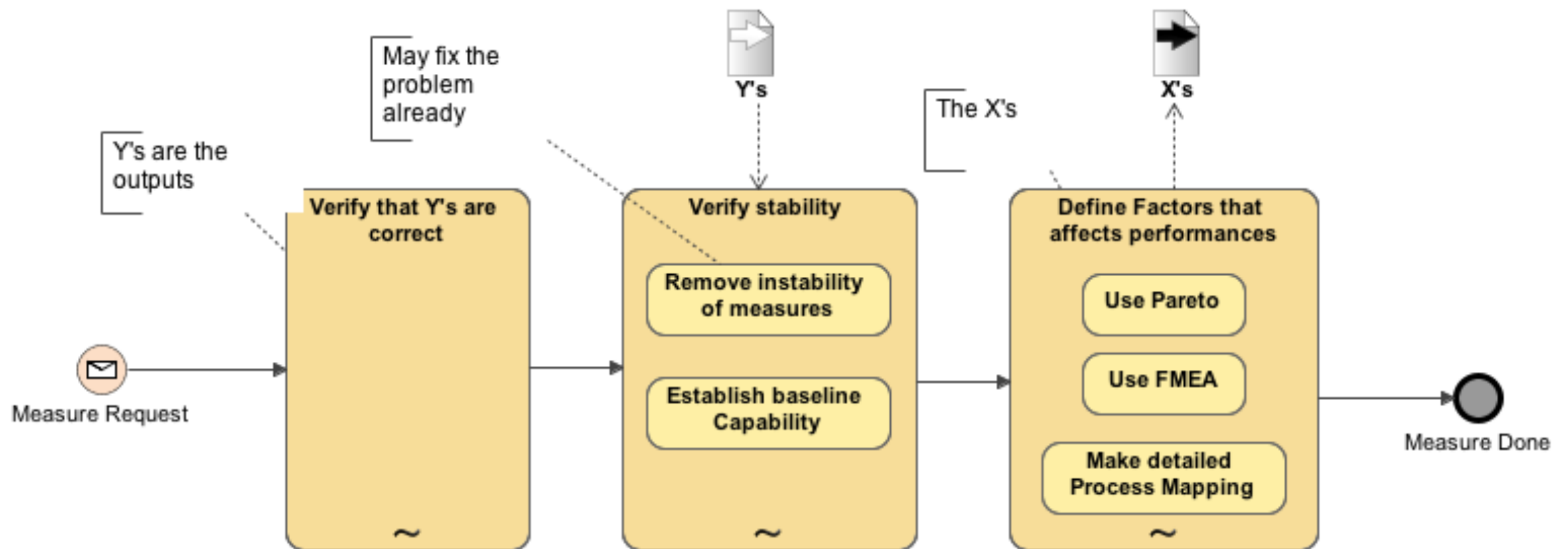
Measure

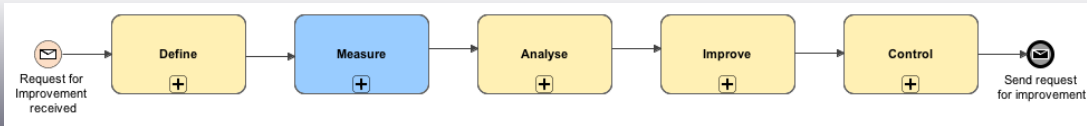




Measure

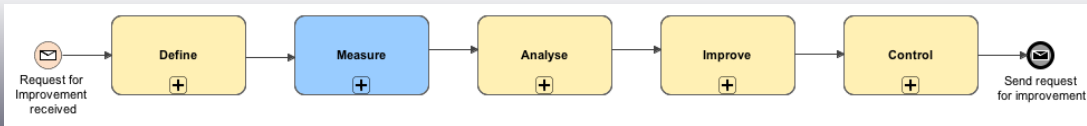
- Measure process defects and process operations,





Measure Tools

- Model the Process,
- Five time Why?,
- FMEA,
- CTQ,
- Voice Of the Customer (VOC)
- RACI Matrix



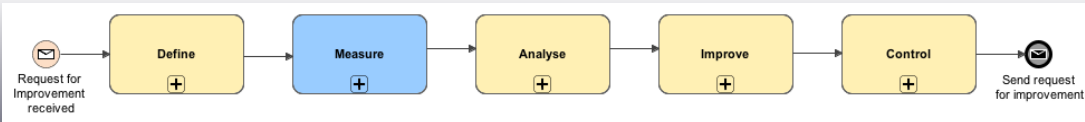
Model the Process

- If don't know how to represent your process you can't manage it.
 - You can't find issues,
 - You can't find bottlenecks,
 - You can't find hidden factory,

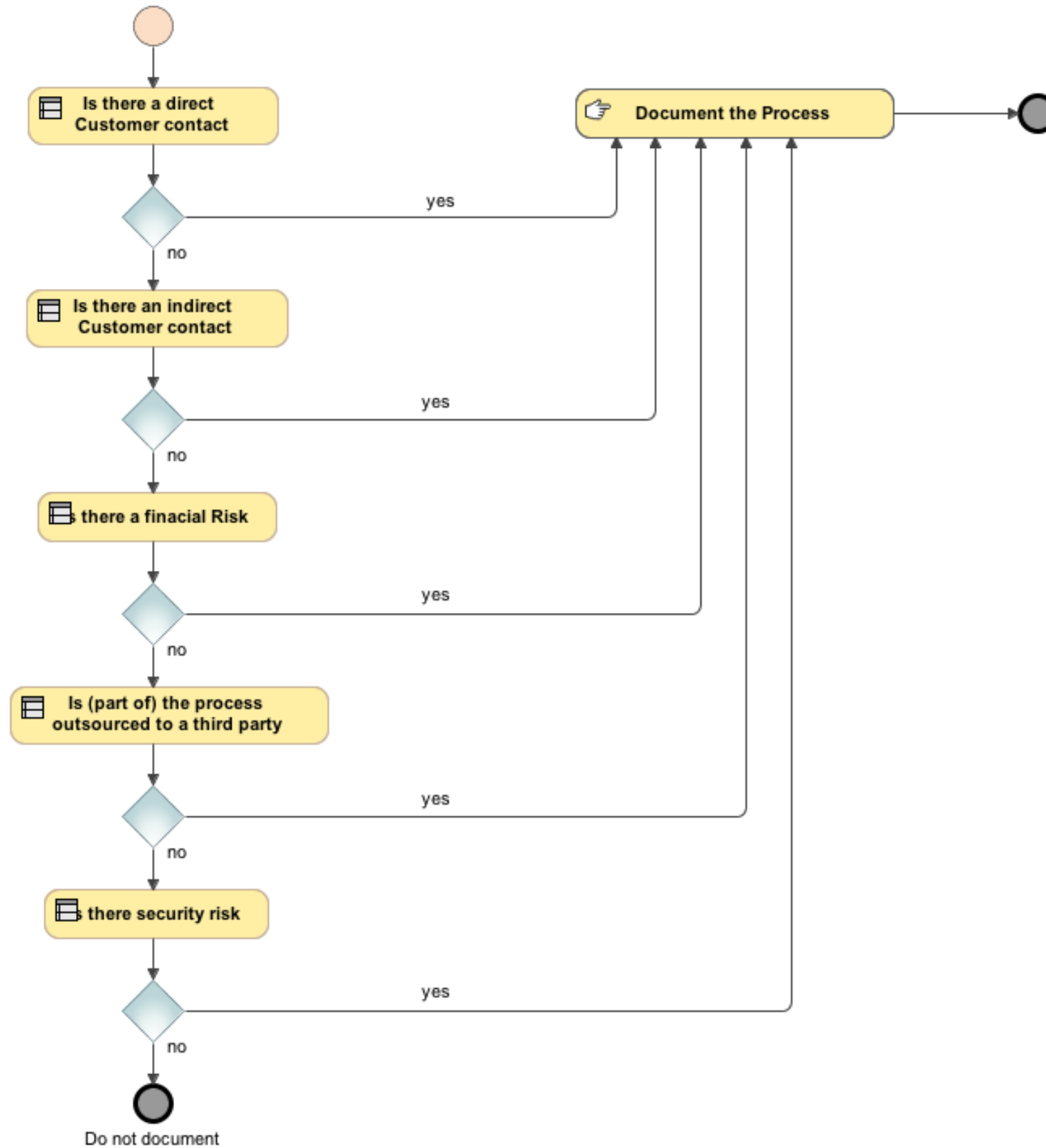


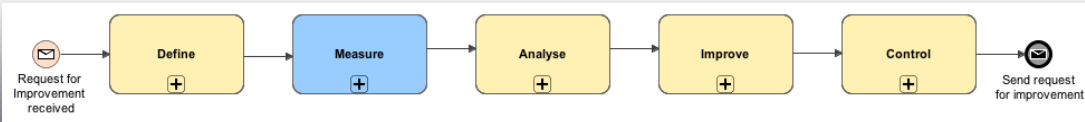
Process Modelling

- **Documenting has a cost,**
 - Not all Processes needs to be documented,
- **Reason to document**
 - They are directly linked to the Customer,
 - They have some risk (financial, security...)
 - ...
- **Reason not to document**
 - They are changing fast,
 - They need flexibility...

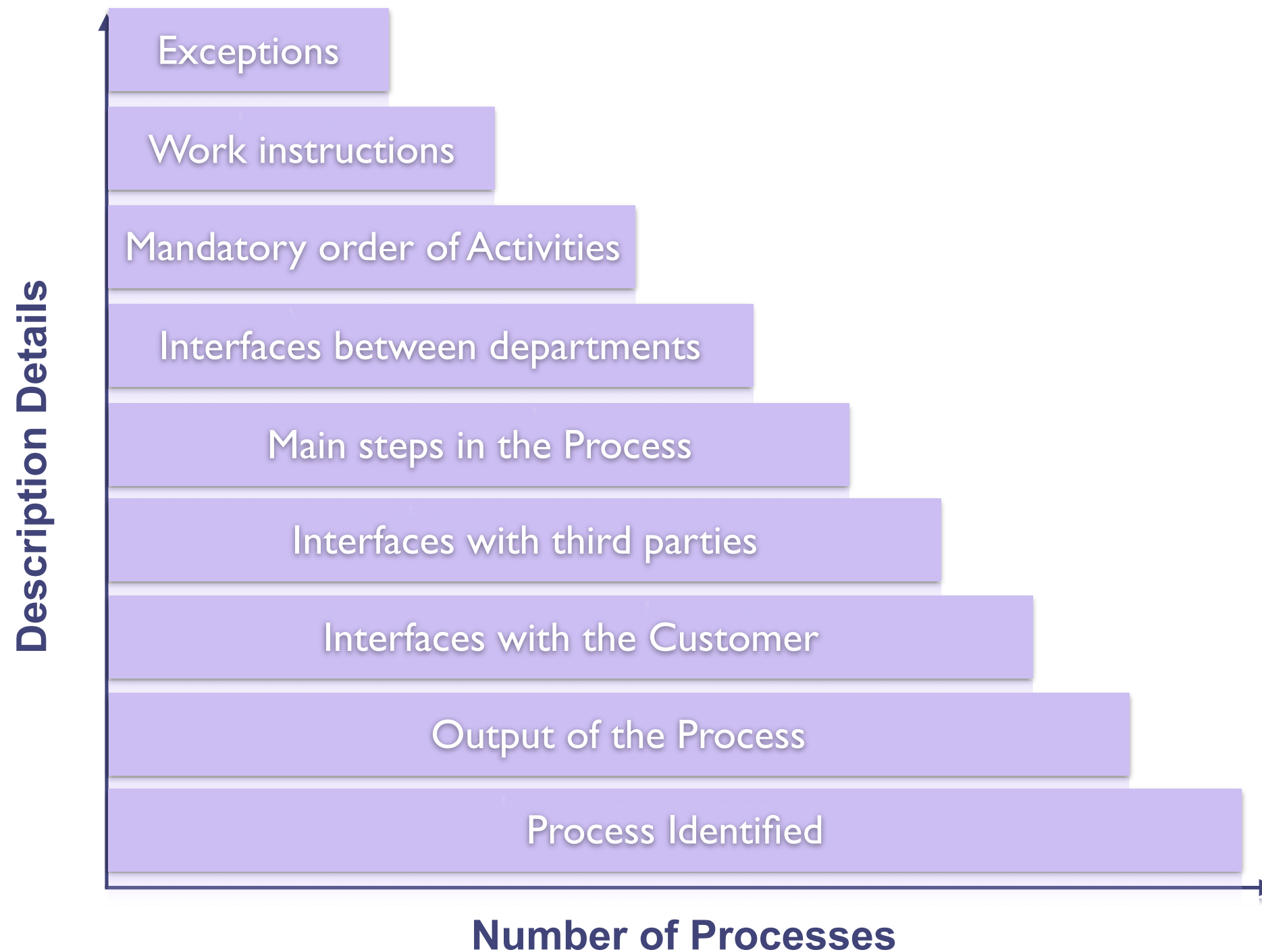


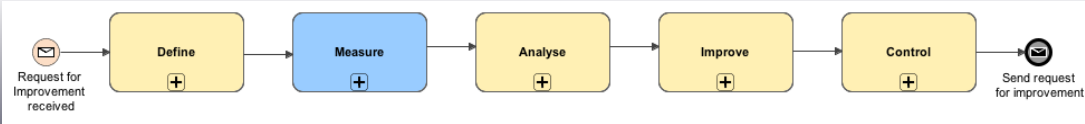
Process Doc





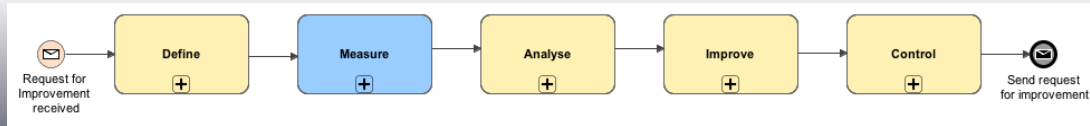
Process Details Pyramid





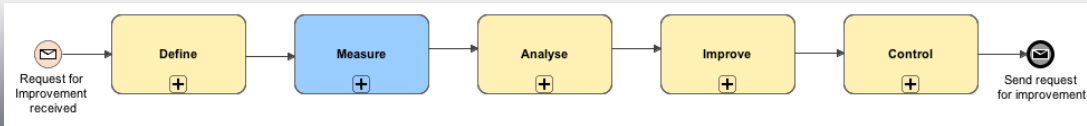
Five Time Why?

- Repeatedly asking why question (five times) will help you to discover underlying causes of problems and effect
 - aka: the toddler methods
- Identify the problem and ask people involved “why did this problem occurred?”
 - why this is happening?
 - why is that?
 - why do you do that?
 - Why...



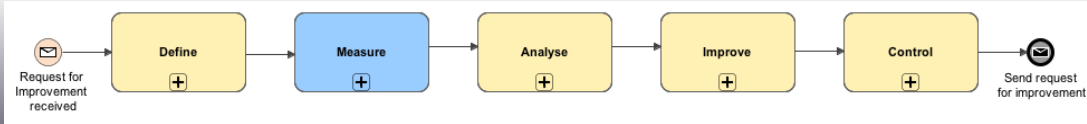
Five time why

- the model is peeled like an onion
 - you get the core causes



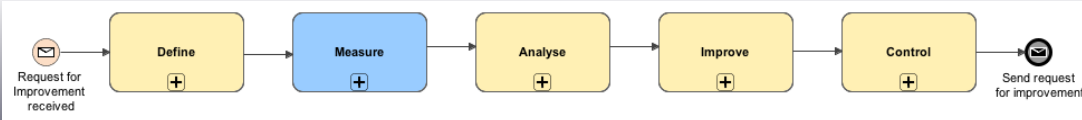
FMEA

- **Failure Mode and Effect Analysis**
 - The technique was originally created for aviation and space technology and aims at analysing possible failure and their effects



FMEA

- **Estimate and prioritise risks the following is important**
 - Likelihood of occurrence
 - Likelihood of detection,
 - the damage the problem can cause (i.e. the effect)
- **For every part and for every potential problem (risk) an estimate is made as a score**
 - Risk Priority Number = Occurrence x Detection x Effect

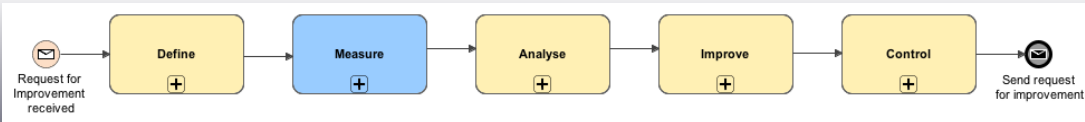


Probability (P)

- Find the Cause of failure mode and is likelihood of occurrence,
- Example of causes
 - Human errors,
 - Manufacturing induced faults,
 - Fatigue,
 - Creep,
 - Abrasive wear,
 - Vehicle failure...

Rating	Meaning
A	Extremely Unlikely
Low B	Relatively Few
C	Occasional
D	Repeated
E	Frequent (inevitable)

↓
High

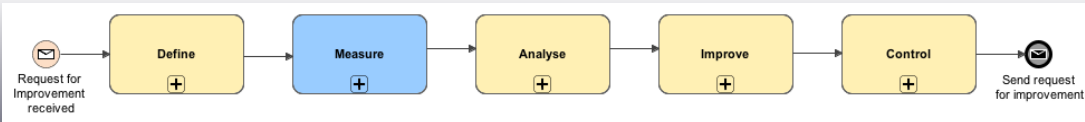


Severity (S)

- It is convenient to write these effects down in terms of what the user might see or experience,
- **Severity Criteria**
 - Cost,
 - Loss of life,
 - Quality of life,
 - Security...

Rating	Meaning
I	No relevant effect
Low II	Very minor, no damage
III	Minor, low damage
IV	Moderate
V	Critical
VI	Catastrophic

High



Detection (D)

- More the failure is easy to detect, less its impact is high,
- The means or method by which
 - Test,
 - Maintenance,
 - Normal system operation...

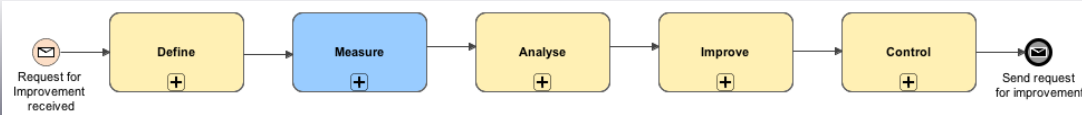
Rating	Meaning
1	Certain (testable)
2	Almost certain
3	High
4	Moderate
5	Low
6	Undetected

High



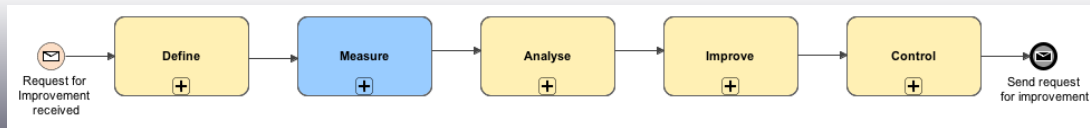
Example

- Failure: Traffic Jam,
- $P = C$,
- $S = V$,
- $D = 4$,



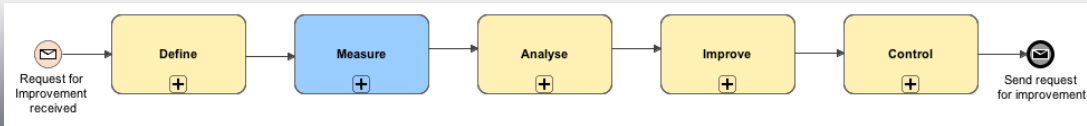
FMEA

SYSTEM _____ SAMPLE _____				PREPARED BY _____			DATE _____	
SUBSYSTEM _____				APPROVED BY _____			REVISION _____	
SUBSYSTEM ELEMENT _____							PAGE 1 OF 1	
Item Identification	Function	Failure Mode	Failure Cause	Failure Effect on			Failure Detection Method	Remarks
				Component or Functional Assembly	Next Higher Assembly	System		
Switch	Initiates Motor Power Function	Fails to Open	Release Spring Failure Contacts Fused	None	Maintains Energy to Circuit Relay	Maintains Energy to Pwr Circuit Through Relay	Motor Continues to Run Smoke-Visual When Pwr Circuit Wire Overheats	
Battery #2 (Relay Circuit)	Provides Relay Voltage	Fails to Provide Adequate Power	Depleted Battery Plates Shorted	None Battery Gets Hot and Depletes	Fails to Operate Relay Circuit	Systems Fails to Operate	Motor Not Running	
Relay Relay Coil	Closes Relay Contacts When Energized	Coil Fails to Produce EMF	Coil Shorted or Open	Does Not Close Relay Contacts	Does Not Energize Pwr Circuit	System Fails to Operate	Motor Not Running	
Relay Contacts	Energizes and De-Energizes Pwr Circuit	Fails to Open	Contacts Fused	None	Maintains Energy to Motor	Overheated Pwr Circuit Wire if Motor is Shorted and Circuit Breaker Fails to Open	Motor Continues to Run Smoke-Visual	
Motor	Provides Desired Mechanical Event	Fails to Operate	Motor Shorted	Motor Overheats	High Current in Pwr Circuit	Overheated Pwr Circuit Wire if Circuit Breaker Fails to Open and Switch or Relay Fails	Smoke-Visual	
Circuit Breaker	Provides Pwr Circuit Fusing	Fails to Open	Contacts Fused Spring Failure	None	Maintains Pwr to Motor if Relay Contacts are Closed	Maintains Energy to Motor	Motor Continues to Run Smoke-Visual	
Battery #1 (Pwr Circuit)	Provides Motor Voltage	Fails to Provide Adequate Power	Depleted Battery Plates Shorted	None Battery Gets Hot and Depletes	None	System Fails to Operate	Motor Not Running	



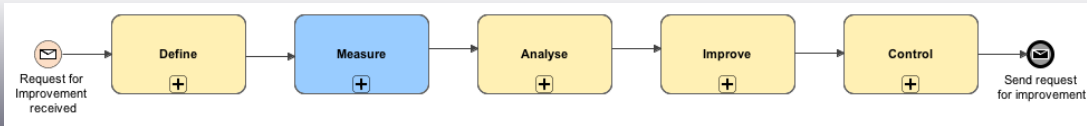
CTQ

- Critical To Quality



Stakeholders

- **A stakeholder is any person or organisation, who can be positively or negatively impacted by, or cause an impact on the actions of a company, government, or organisation. Types of stakeholders are:**
 - Primary stakeholders: are those ultimately affected, either positively or negatively by an organisation's actions.
 - Secondary stakeholders: are the 'intermediaries', that is, persons or organisations who are indirectly affected by an organisation's actions.
 - Key stakeholders: (who can also belong to the first two groups) have significant influence upon or importance within an organisation.



Stakeholder Examples

- People that will use the system,
- People that will manage the system,
- People who build the system,
- People who design the system,
- People who decided to have a system,
- People who pay...



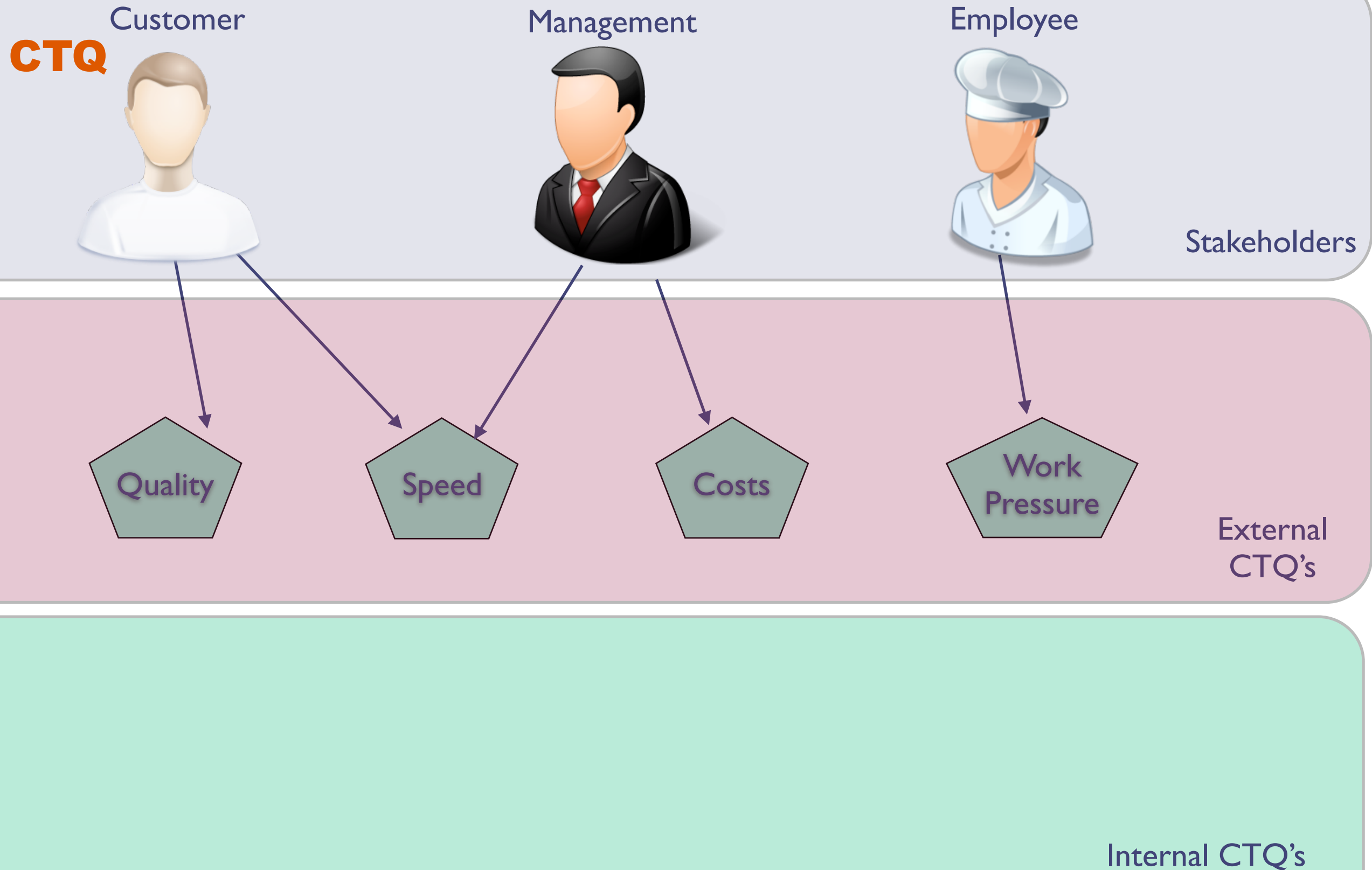
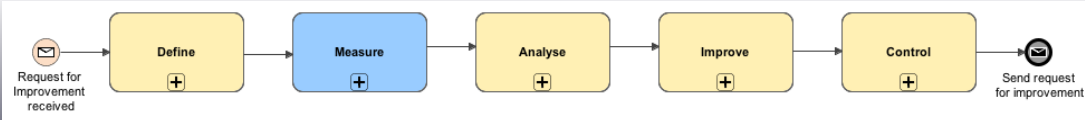
Concerns

- **Concerns are simply things the stakeholders care about, the things that allow the system to have value to its stakeholders, or those attributes of the system that affect their willingness to engage in its development**



Concerns

- **Cost,**
- **Security,**
- **Availability,**
- **Performances,**
- **Maintainability,**
- **Easy to use,**
- **Services...**



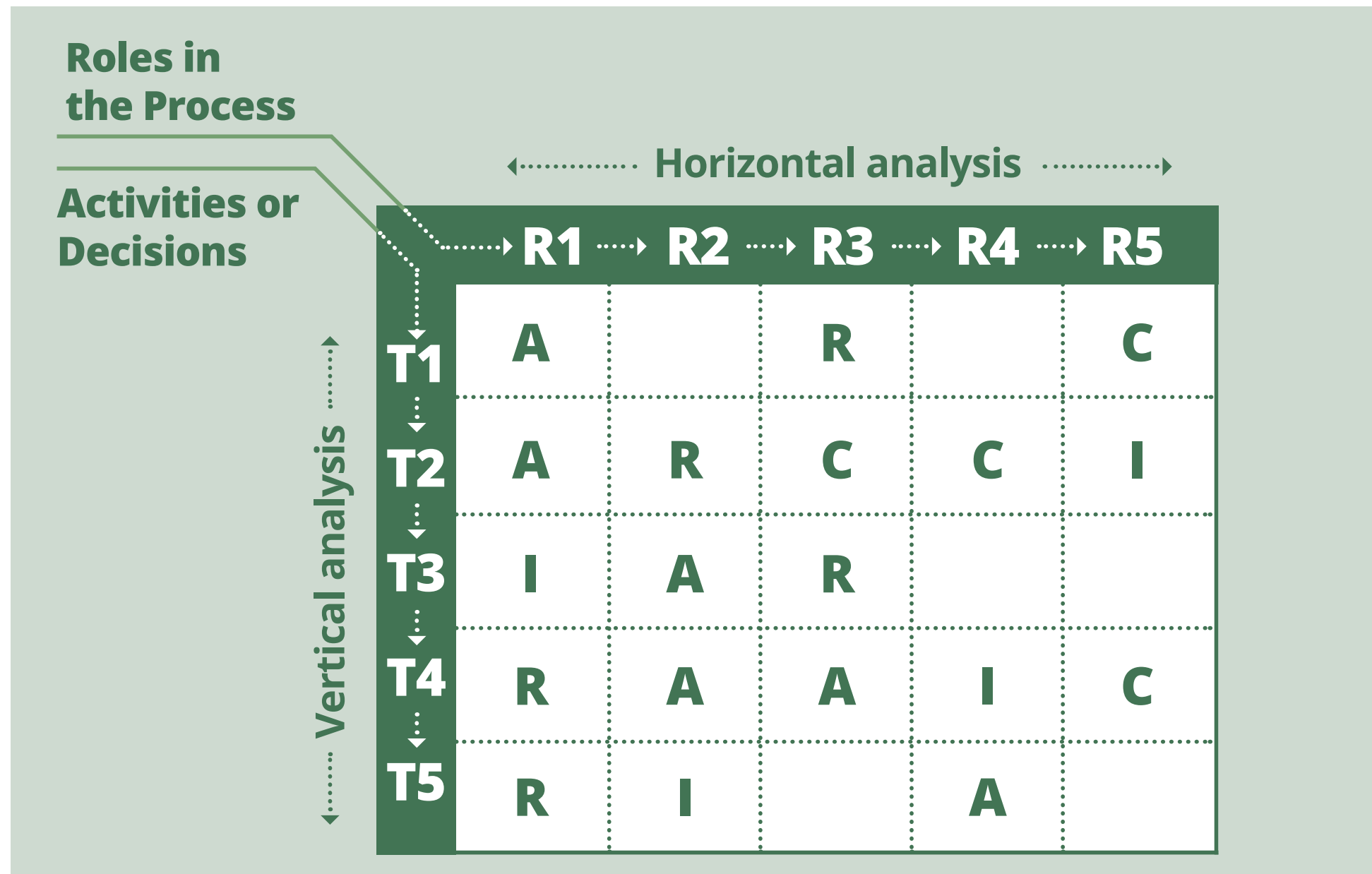
RACI Matrix

- It is a Responsibility assignment Chart indicating the participation of different roles in a Process, Organisation or System,

RACI Roles

- **R: Responsible**
 - The person who does the work to perform activity,
- **A: Accountable**
 - The person who is accountable for the completion of the task,
- **C: Consulted,**
 - the Person who advices on the activity
- **I: Informed**
 - The Person who must be notified of decision

RACI Matrix



RACI Matrix Analysis

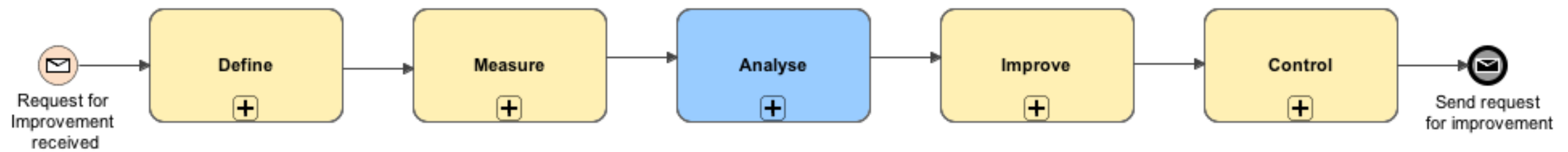
RACI Matrix Analysis

VERTICAL ANALYSIS

HORIZONTAL ANALYSIS

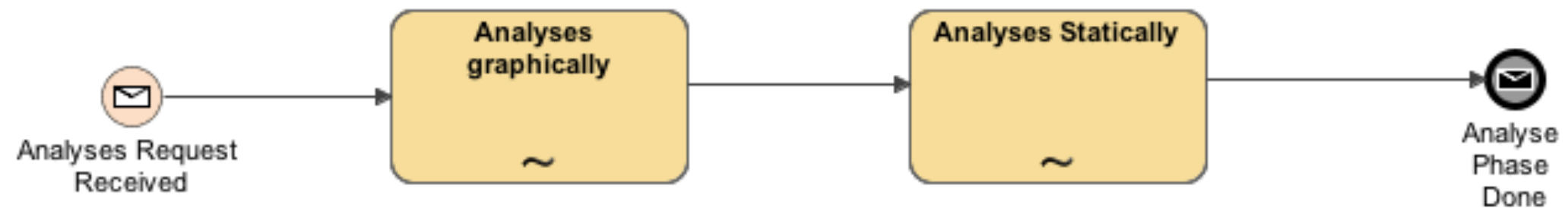
R	Lots of 'R's'	Can the person stay on top of all these tasks? Can the tasks be divided or maybe assigned to other roles?	Why are so many people responsible for the task? It seems that there are too many people involved or that they are more concerned with throwing the task over the wall than completing it.
	No 'R's'	(In combination with no A's) Can this role be eliminated or reassigned?	Are the roles clear? Who should be responsible for the task? There should always be an R. Or maybe the task isn't value added?
A	Lots of 'A's'	Should this role be accountable for so many tasks? Does this cause a bottleneck in the process?	Does the process run smoothly? A's usually want to have their say in the process. This might cause delays and problems in its execution.
	No 'A's'	(In combination with no R's) Can this role be eliminated or reassigned?	Who is accountable for the task? Why is it done? There should always be an A (and usually only one).
C	Lots of 'C's'	-	Do all the roles need to be consulted? What is the added value? Lots of C's slow down the process.
	No 'C's'	-	Do all the roles always need to be informed? Or only in exceptional circumstances? Lots of I's slow down the process.
I	Lots of 'A's'	Does the person need to be involved in so many tasks? Look for opportunities where a C can be changed to an I or an I can be eliminated.	Aren't too many people involved in the process? Usually there will be lots of C's and I's which could be eliminated. Or C's that can be changed to I's.
	No 'A's'	Does the degree of participation (R, A, C or I) fits the qualifications of the role?	-

Analyse



Analyse Phase

- Analyse Data and discover the causes of the Problem,

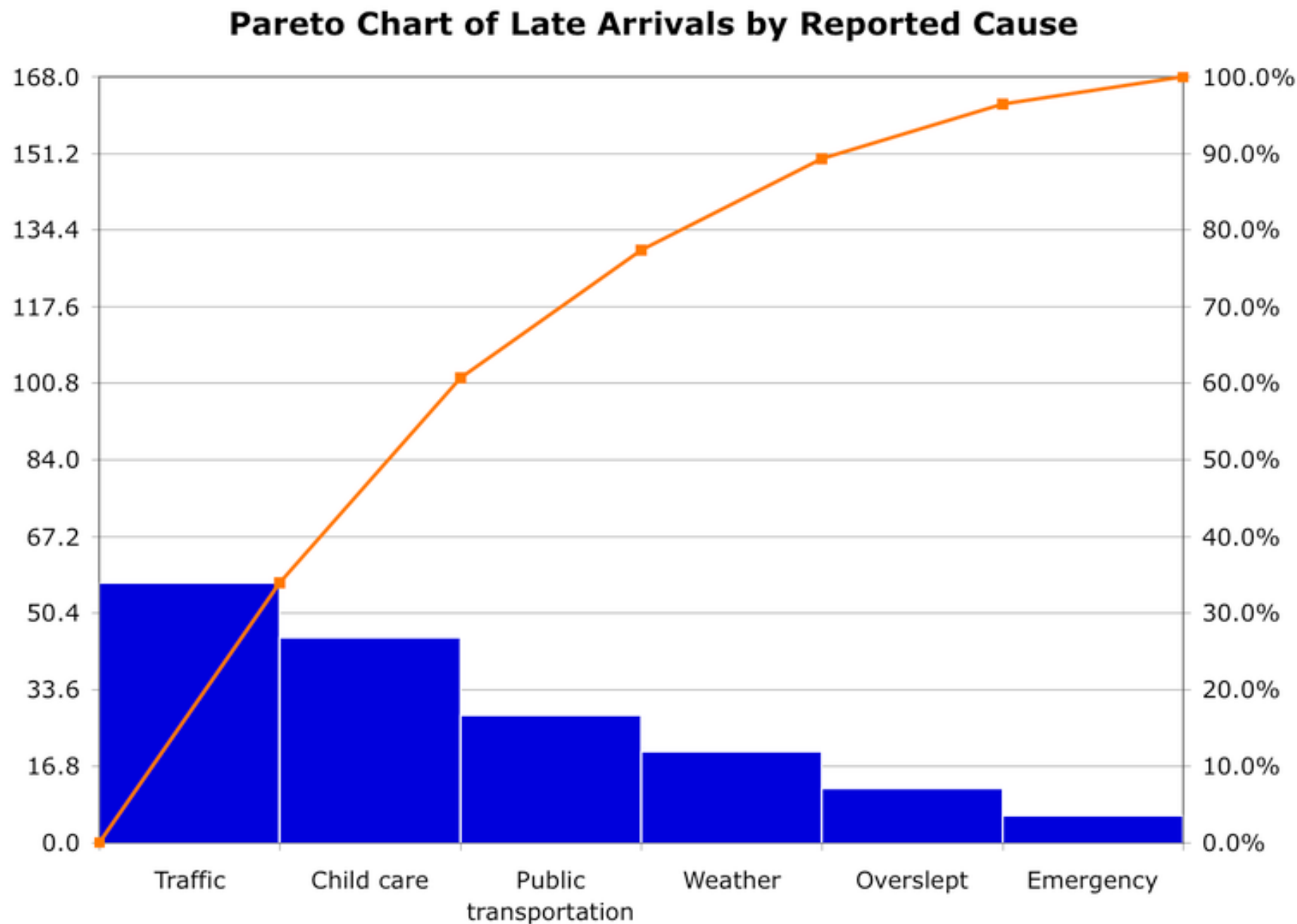


Analyse Tools

- Pareto,
- Burlton,
- Regression Analysis,
- Value Stream Mapping,
- Process Waste Scan,
- The Hidden Factory
- Fishbone Diagram,
- Five Why,

Pareto Chart

- The Pareto Principle states that 80% of effects come from 20% of causes,

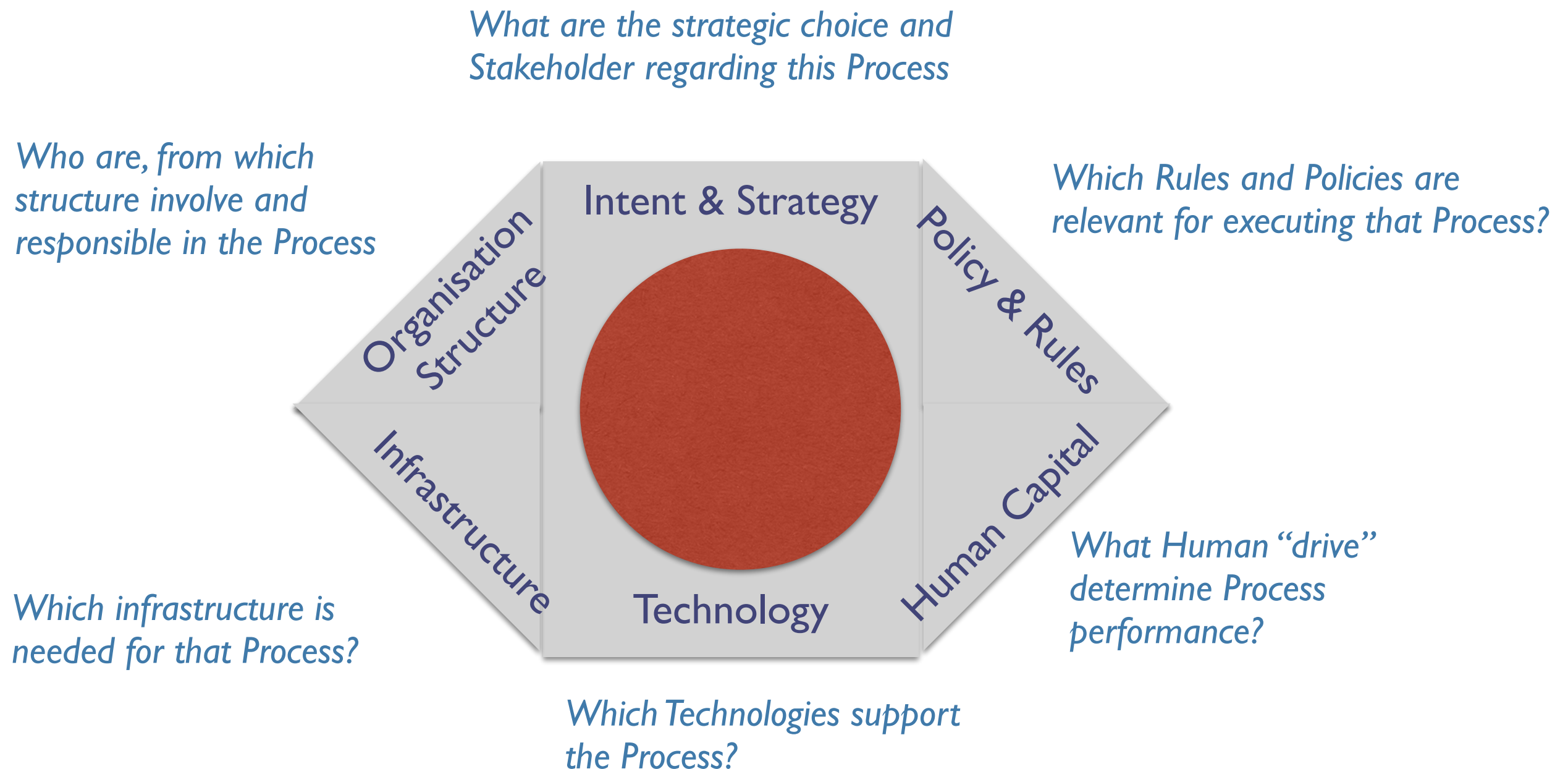


Pareto Charts

- Use the Pareto for problem analysis,
- The technique focus the attention and the means on the biggest cause,

Burlton Hexagone

- The Burlton Hexagone focus on the environment of the Process



Burlton Hexagone

- **The Burlton Hexagone focus on the environment of the Process**
 - Many projects focus explicitly on the process and on technological matters, while many causes of problems lie on rules, structure and motivation,

What are the strategic choice and Stakeholder regarding this Process

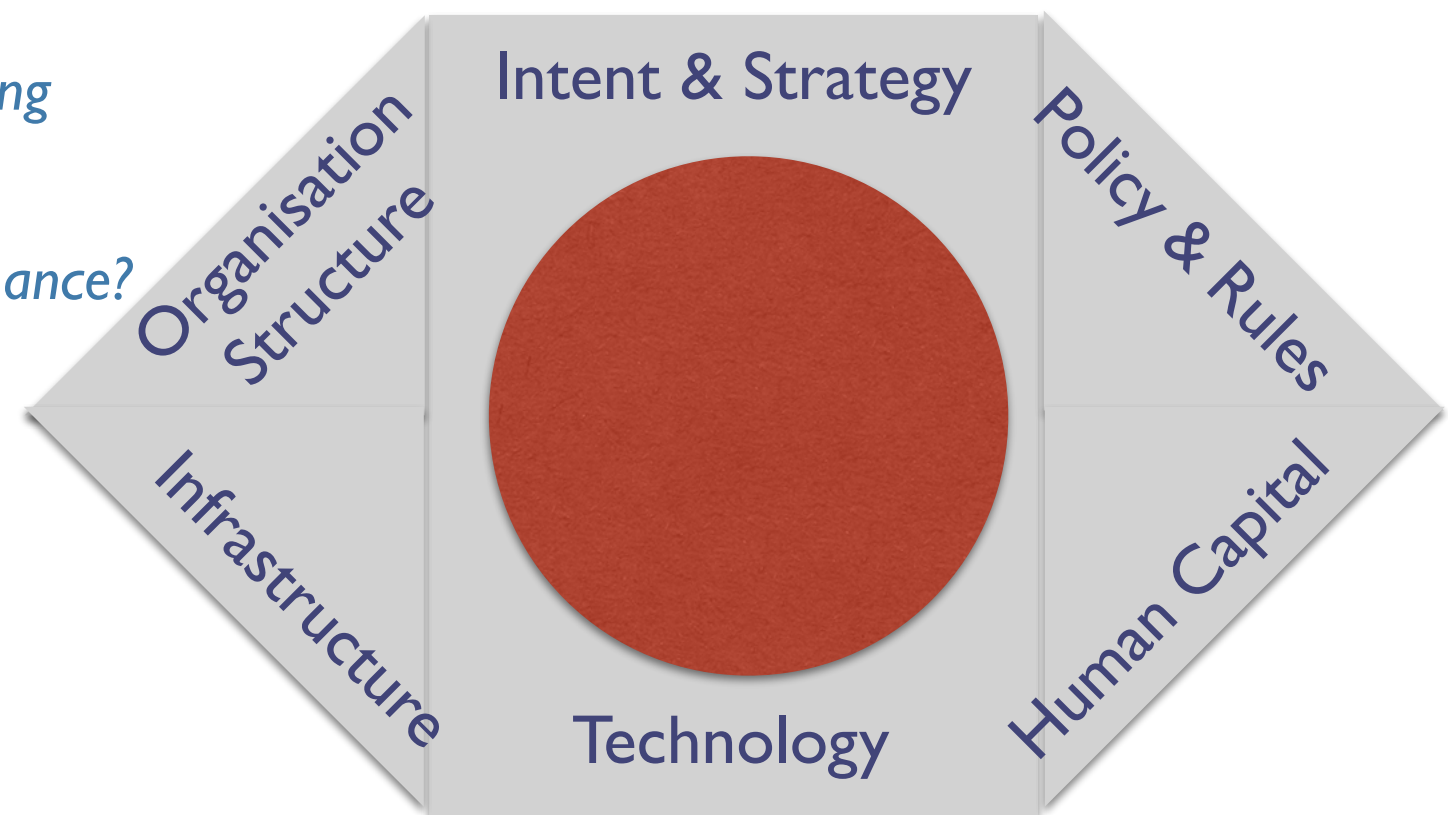
Which Rules and Policies are relevant for executing that Process?

What Human “drive” determine Process performance?

Who are, from which structure involve and responsible in the Process

Which infrastructure is needed for that Process?

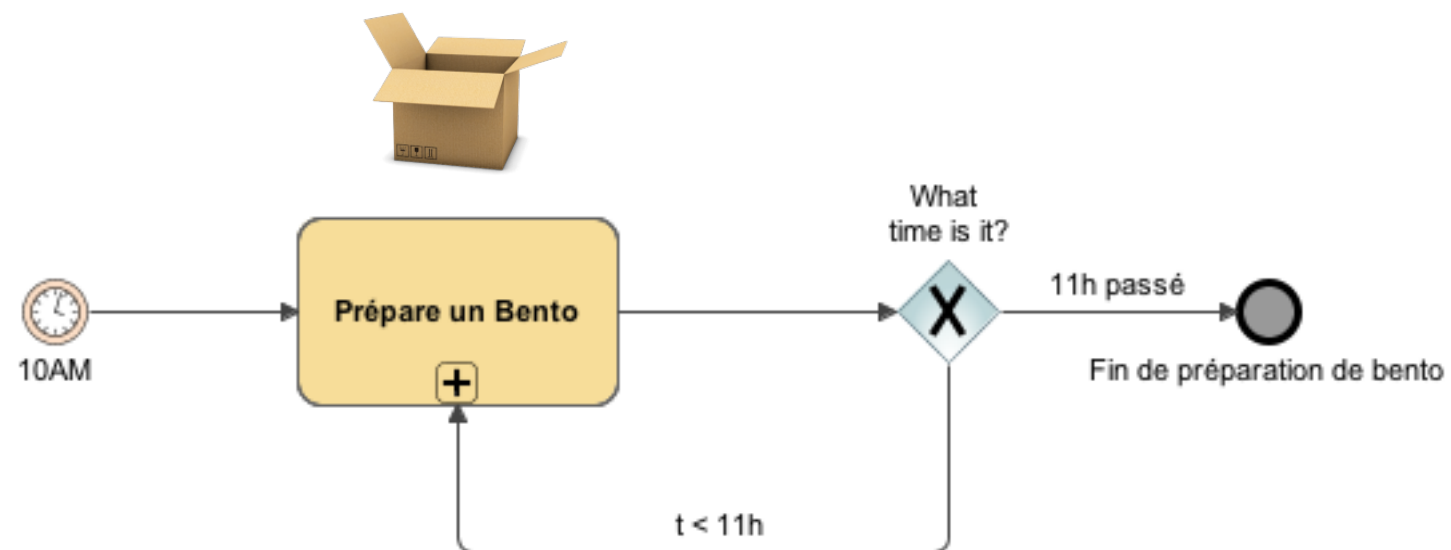
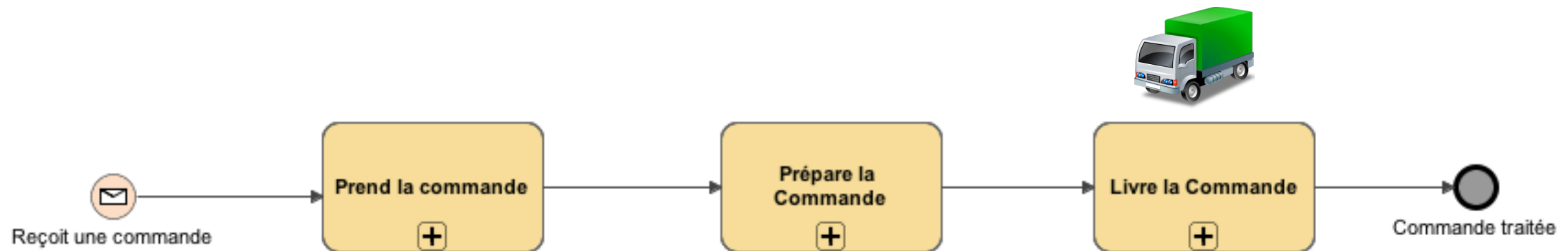
Which Technologies support the Process?



Process Waste Scan

- **In the Process Waste Scan, standard types of waste are identified and visualised in a Process Map**
 - Use some kind of icons to represent “move”, “transport”, “
- **Some type of Waste are automatically revealed in the Process design,**
 - example “Shipment of Sushi” is Transportation,
- **Other types of waste become visible only in Process analysis**

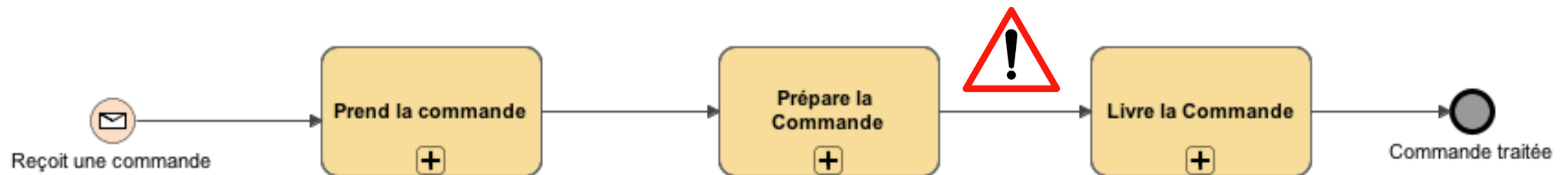
Process Waste Scan



Hidden Factory

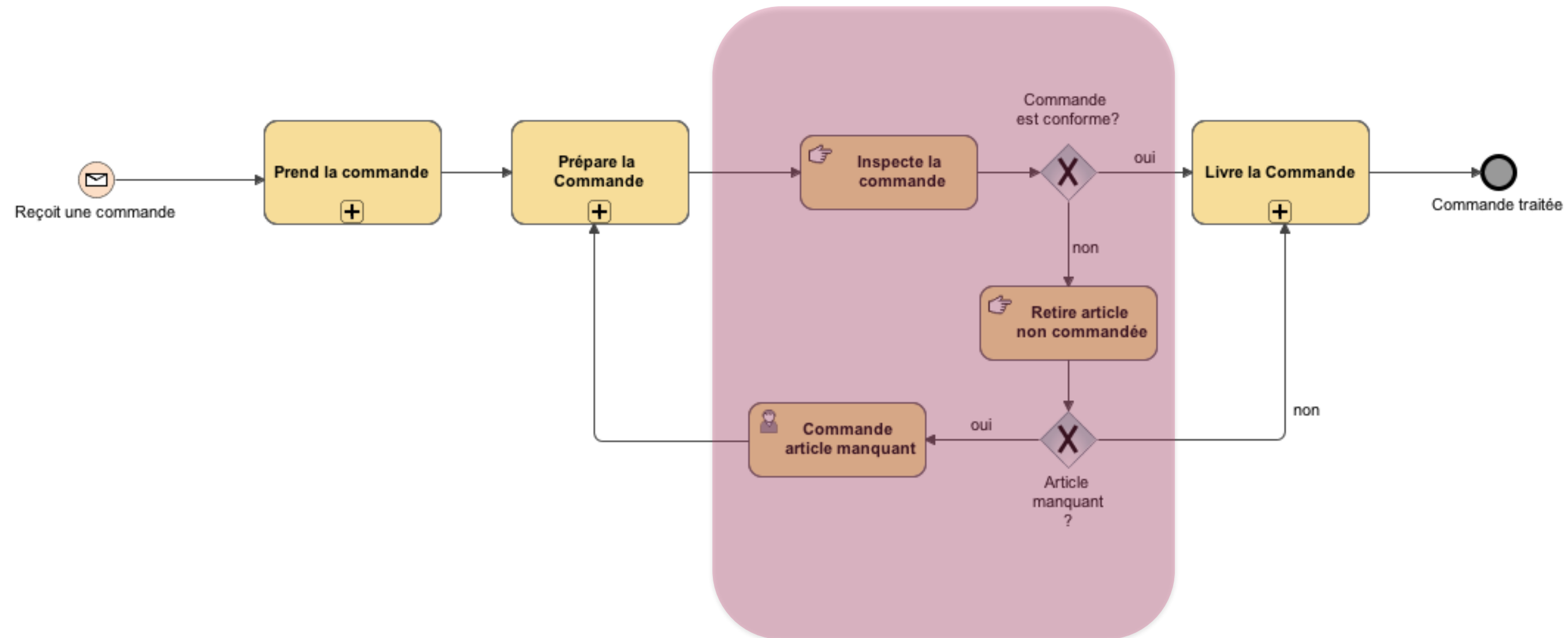
Hidden Factory

Risk!! Command not conform

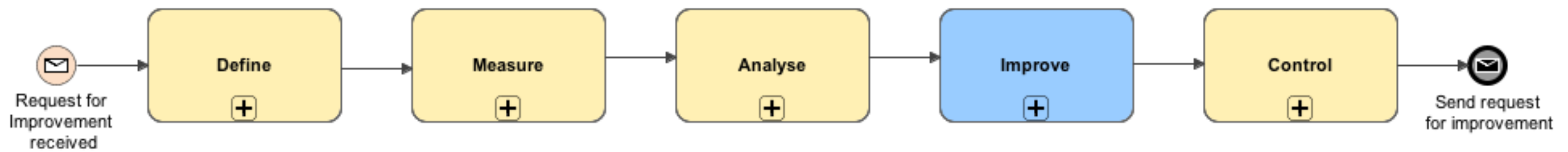


Hidden Factory

This is an Hidden Factory



Improve

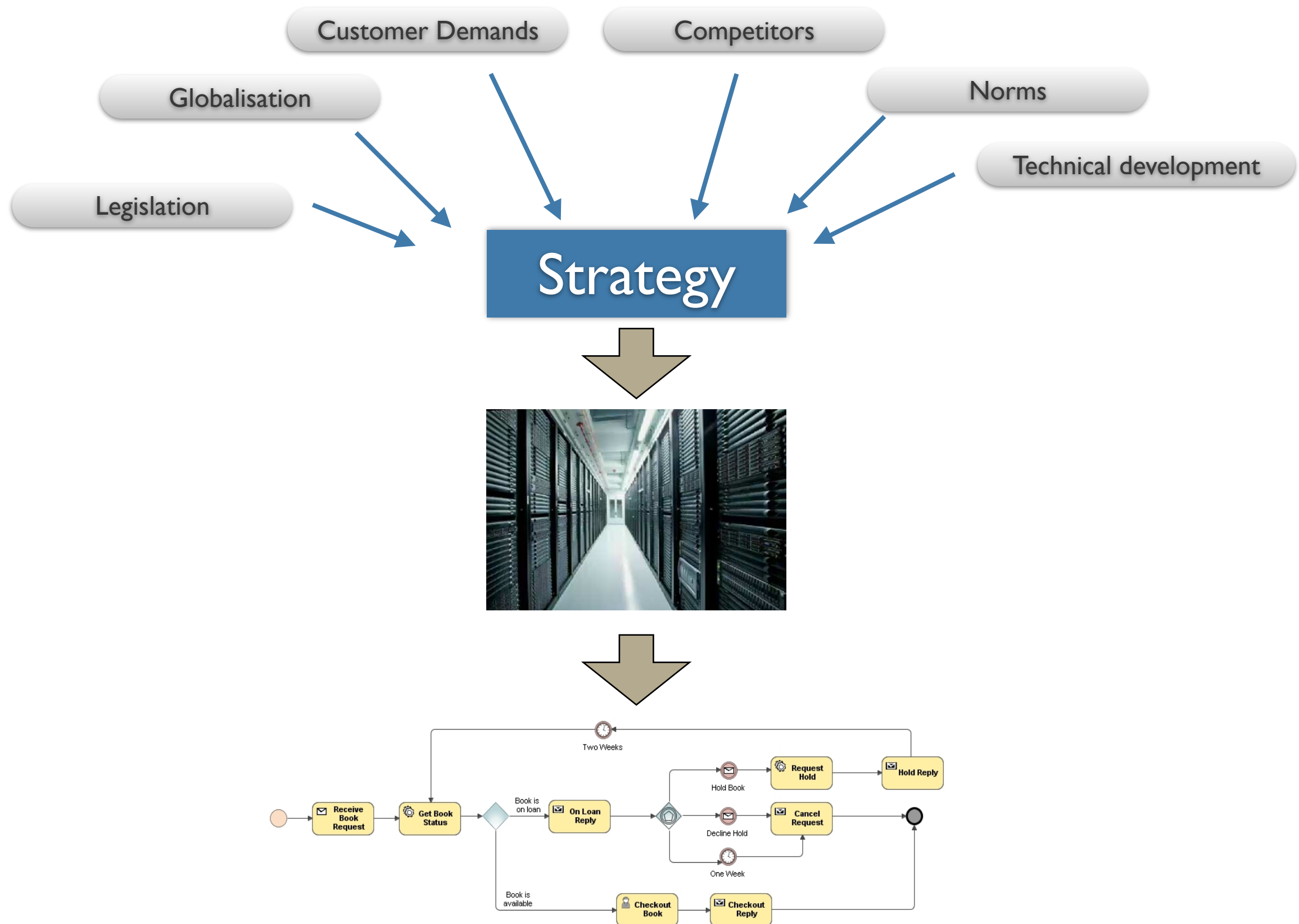


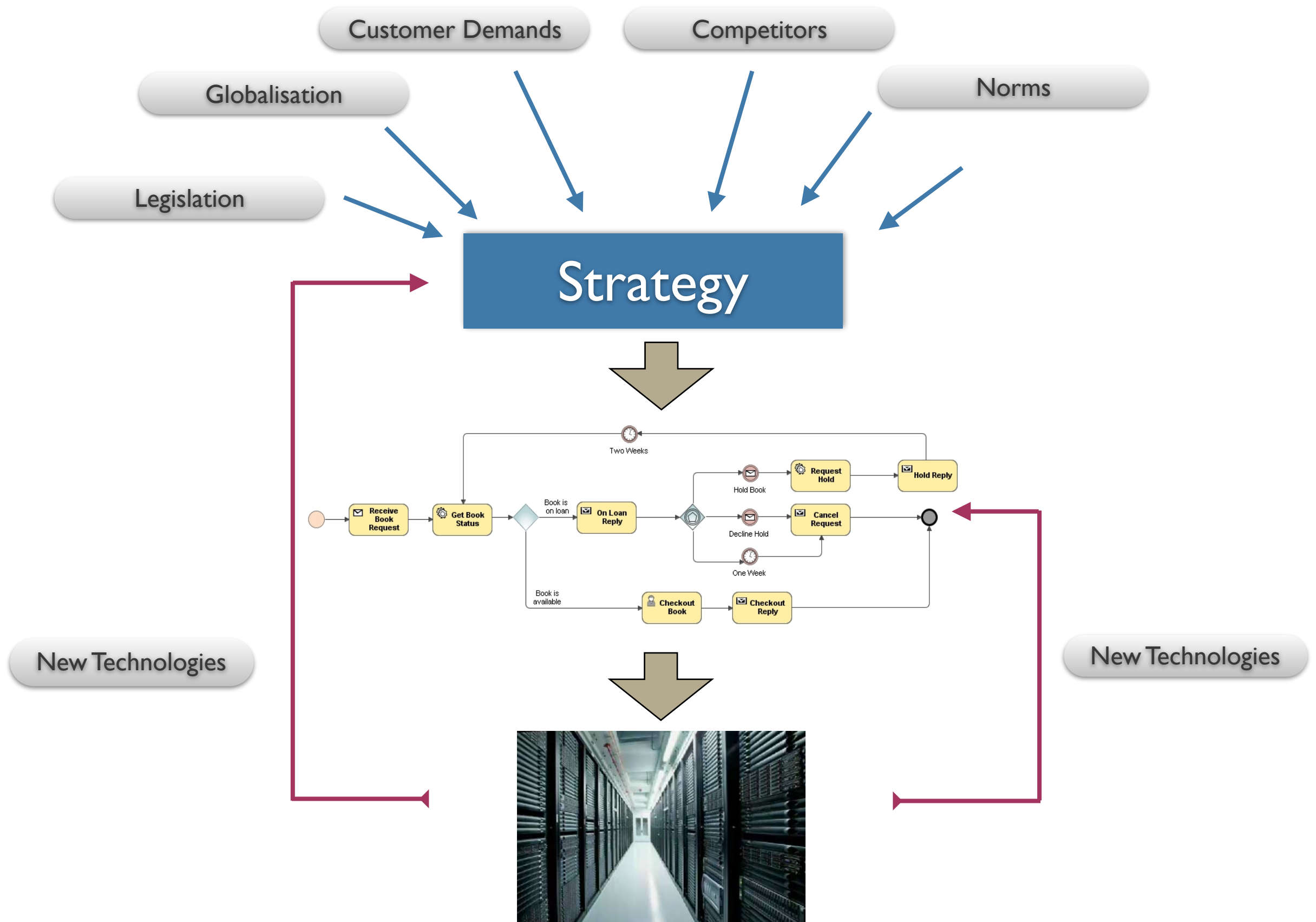
Improve Phase

- **Improve the Process to remove the causes of defects,**

Improve Tools

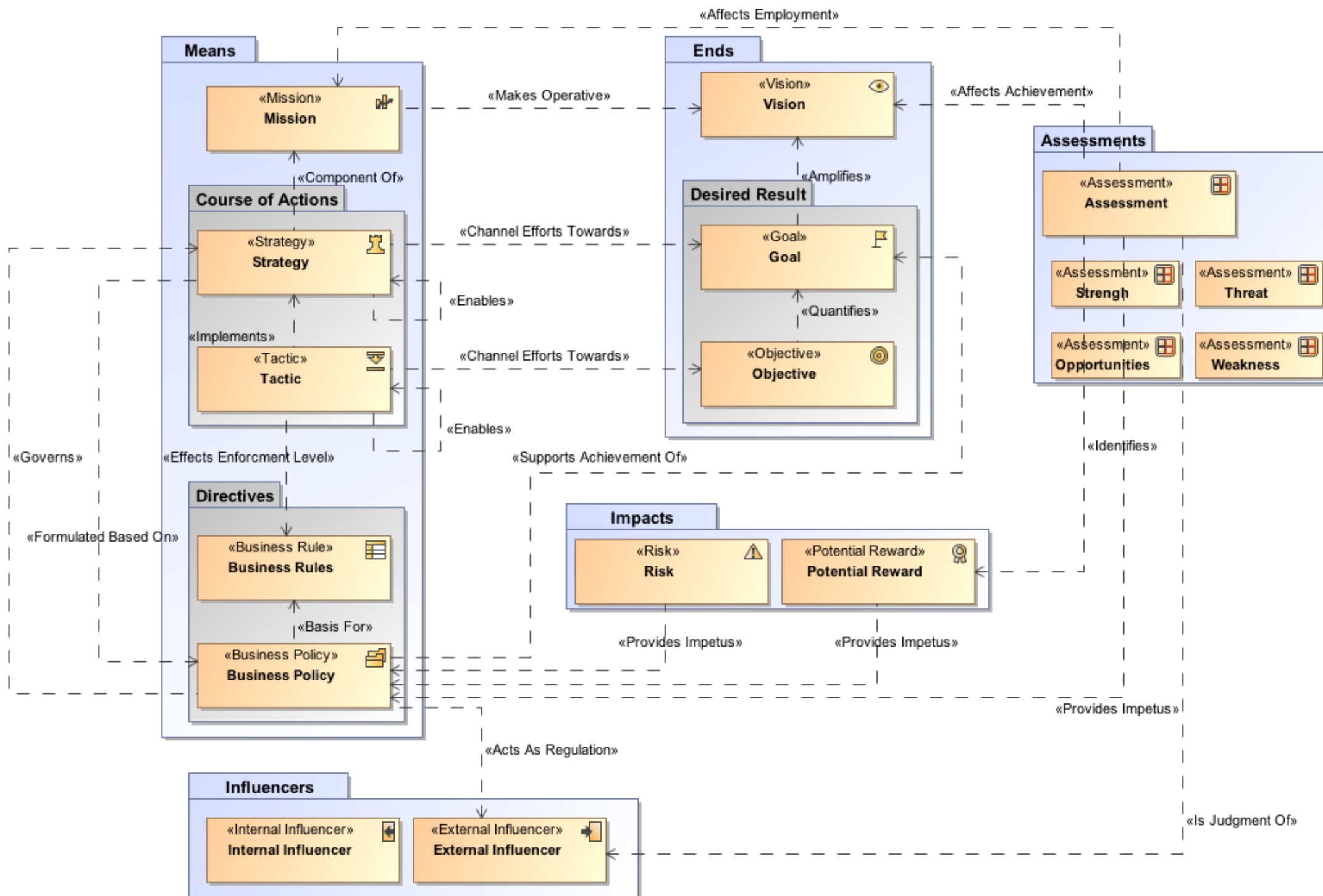
- **Strategy diagram,**
- **Radical Design,**
- **Poka Yoke,**
- **5 S,**
- **Brainstorming,**
- **Mistake Proofing,**
- **House of Quality**
- **FMEA**



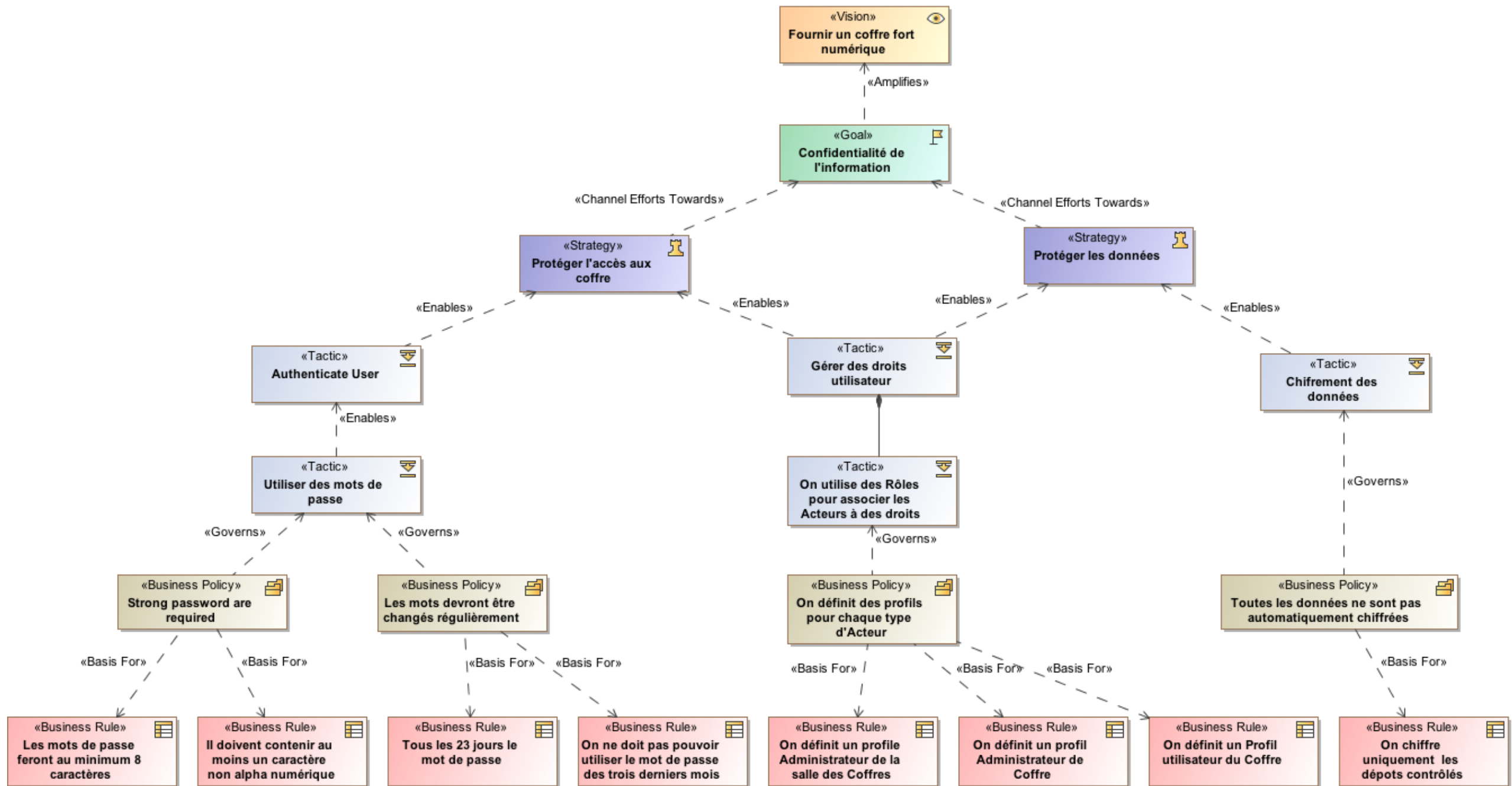


Strategy, Tactic, Rules and Policies

Strategy Model



Strategy Model Example



Decision

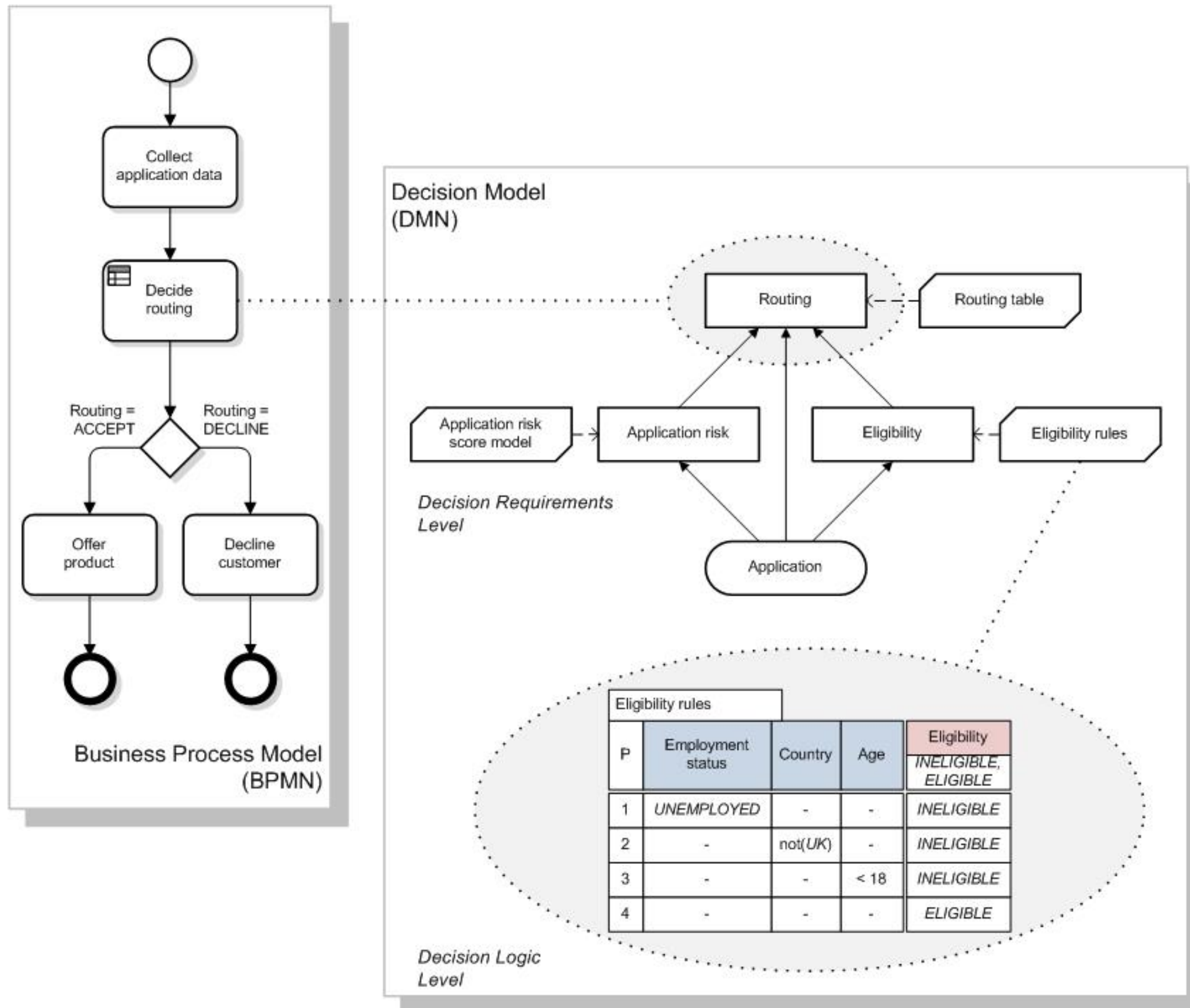


Figure 1: Aspects of modeling

Radical Design

- **Radical Design is a creative brainstorm technique for generating solutions**
 - Participants have to think outside the box
 - not to confuse with *out of the box*,
 - They are asked to think about solutions regardless of “real world” boundaries and restrictions
 - It is often hard for people to really think outside the box,
 - But it simulates creativity and provides some fun^^
 - Extreme solutions aren’t always directly applicable but parts are often useful

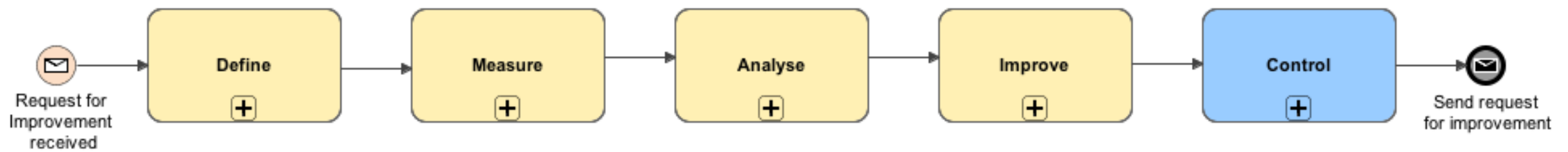
Poka Yoke

- **As many mistakes are due to human factors, the Poka Yoke technique focused on designing the production process in such a way that it is almost impossible to make mistakes**
 - a.k.a : Mistake Proofing
 - FMEA may be used to find more frequent mistakes
- **Examples**
 - Sim card that fits in your cellphone just one way,
 - Forms on websites,
 - Color in wiring,
 - USB connector

5s

- **5S is used to create a standardised, organised and neat work environment**
 - sorting: What you don't really need can go,
 - Setting in order: What you do need gets a fixed place,
 - Shine: Create a clean work environment,
 - Standardise: Come to an agreement about a standard way of working,
 - Sustaining the practice: Discuss and correct

Control



Control Phase

- **Control the Process to make sure defects do not recur,**

Control Tools

- **Control Charts,**
- **Cost Saving calculation,**
- **Control Plan,**