



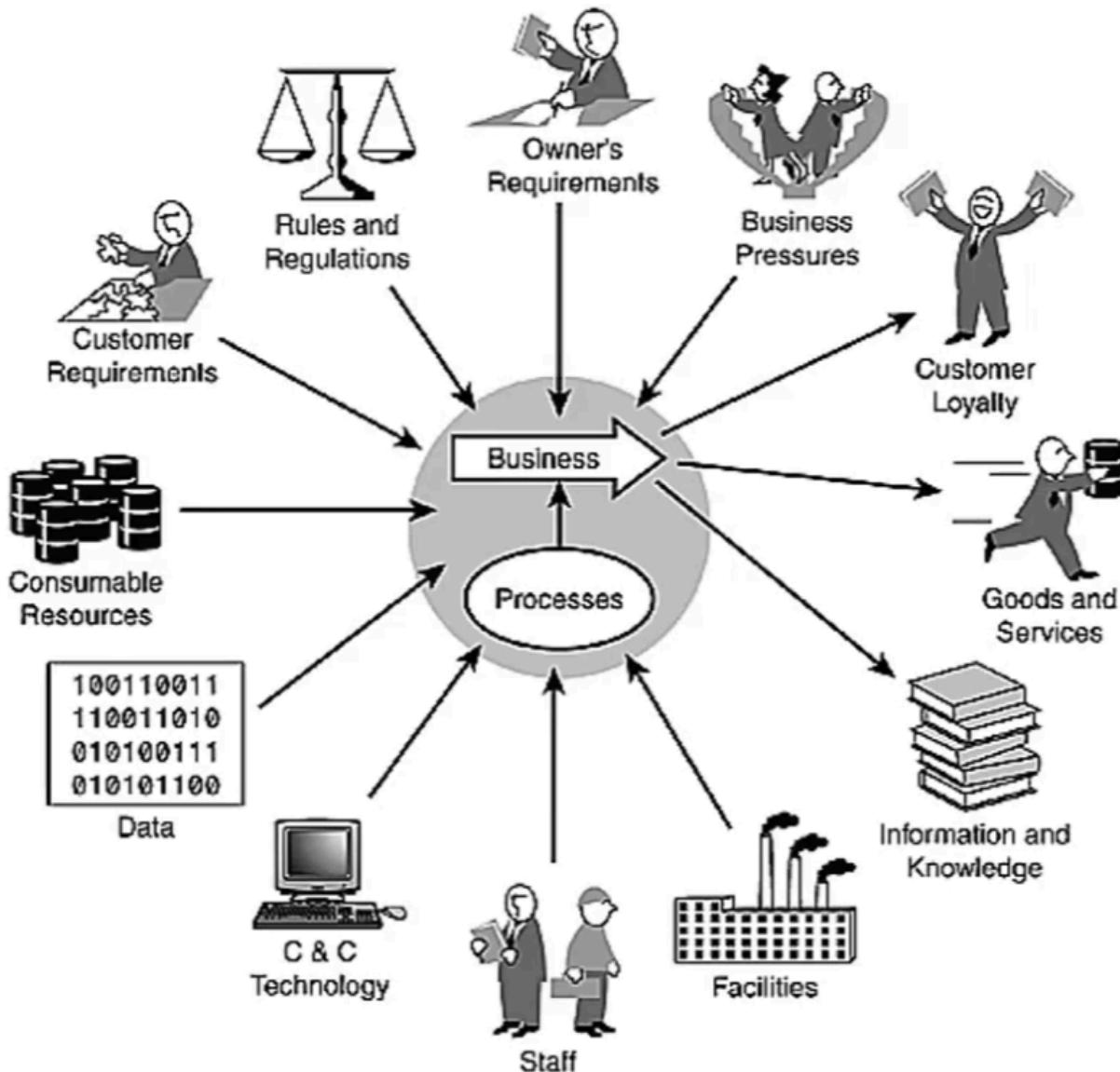
UOW
AUSTRALIA

ISIT 332 Enterprise Business Processes

Lecture 1 -

What is business in terms of BPM - (What is the purpose of a business)

Business is the transformation mechanism which does the transformation. So when certain events and conditions trigger actions, like when an order is placed, it will transform customer requirements, consumable resources and data into goods and services for the customer.



Each business department has different goals and targets. It does not align with customer needs. So people think of ways to determine the performance of employees.

Business process is the way to do the transformation, e.g. sales process to sell the product, customer service process to serve the customer. Business process is what the customer cares about.

Customer wants it to be fast, correct/no error, cheap

What is a business process?

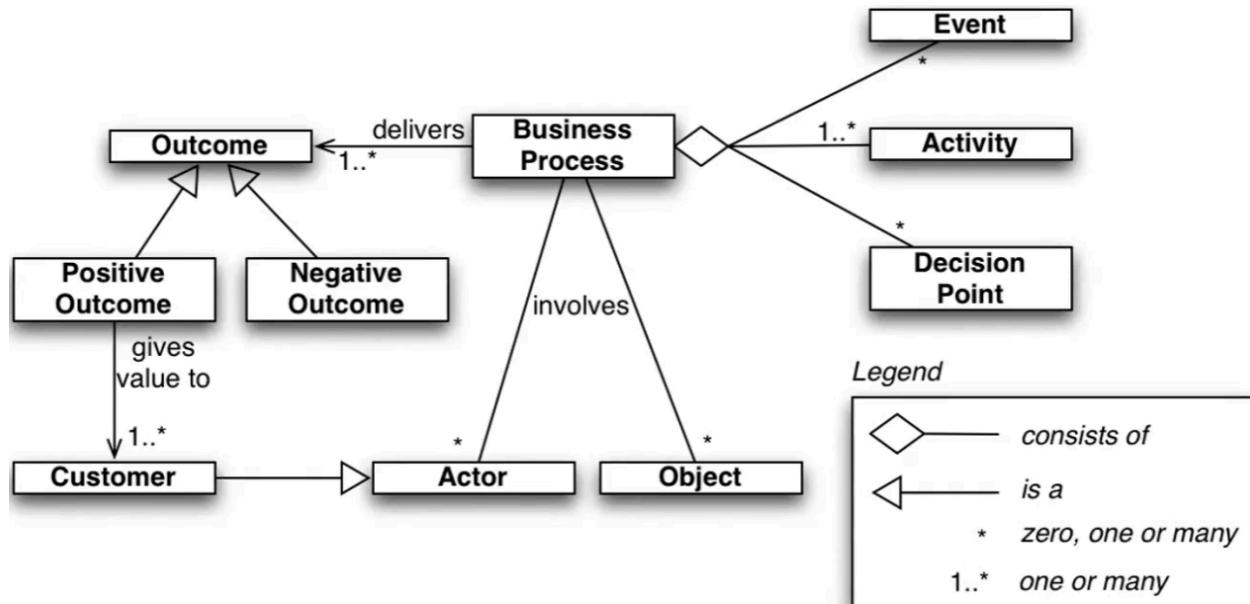
A collection of inter-related events, activities and decision points that involve a number of actors and objects, and that collectively lead to an outcome that is of value to at least one customer

Includes many elements and are connected logically to deliver one or more outcome

Contains:

1. Events - Things that happen atomically (events do not have duration)
2. Activities - Work to be performed
3. Decision points - Point in time when a decision is made
4. Actors - Includes softwares that act on behalf of humans
5. Customer - Actor who consumes output
6. Physical Objects and immaterial objects - Objects that flow through the process
7. Outcome - Positive or negative

Business Process encompasses activities, events and decision points. It delivers outcomes that can either be positive or negative. Positive outcome will give value to at least one customer who is a special actor that is involved in the business process. Objects are also involved with business processes.



Example

In order to apply for admission, students first fill in an online form. Online applications are recorded in an information system to which all staff members involved in the admissions process have access to. After a student has submitted the online form, a PDF document is generated and the student is requested to download it, sign it, and send it by post together with the required documents, which include:

- Certified copies of previous degree and academic transcripts.
- Results of English language test.
- Curriculum vitae.

When these documents are received by the admissions office, an officer checks the completeness of the documents. If any document is missing, an e-mail is sent to the student. The student has to send the missing documents by post. Assuming the application is complete, the admissions office sends the certified copies of the degrees to an academic recognition agency, which checks the degrees and gives an assessment of their validity and equivalence in terms of local education standards. This agency requires that all documents be sent to it by post, and all documents must be certified copies of the originals. The agency sends back its assessment to the university by post as well. Assuming the degree verification is successful, the English language test results are then checked online by an officer at the admissions office. If the validity of the English language test results cannot be verified, the application is rejected (such notifications of rejection are sent by e-mail).

Once all documents of a given student have been validated, the admission office forwards these documents by internal mail to the corresponding academic committee responsible for deciding whether to offer admission or not. The committee makes its decision based on the academic transcripts and the CV. The committee meets once every 2 to 3 weeks and examines all applications that are ready for academic assessment at the time of the meeting. At the end of the committee meeting, the chair of the committee notifies the admissions office of the selection outcomes. This notification includes a list of admitted and rejected candidates. A few days later, the admission office notifies the outcome to each candidate via e-mail. Additionally, successful candidates are sent a confirmation letter by post.

Who are the actors in this process?

Which actors can be considered to be the customer(s) in this process?

What value does the process deliver to its customer(s)?

What are the possible outcomes of this process?

What are the decision points?

Exercise 1.1

Who are the actors in this process?

Applicants, administration officer, admission office, committee, academic recognition agency

Which actors can be considered to be the customer(s) in this process?

Applicants

What value does the process deliver to its customer(s)?

Proper assessment of application and a subsequent decision to accept or reject the application.

What are the possible outcomes of this process?

Application is accepted after proper assessment, application is rejected after proper assessment, application is rejected due to being incomplete, application is misplaced.

What are the decision points?

Officer checks the completeness of the document and decides whether the application is complete, English test results are checked online by an officer and if it is verified, the application will be accepted and if it cannot be verified, the application is rejected.

What is BPM?

Business process is a focal point of BPM because BPM is closely related to other disciplines. BPM is inspired and supported by many disciplines and the difference between BPM and other disciplines is in every phase of BPM, the model is treated as a focal point.

BPM is a body of methods, techniques and tools to discover, analyze, redesign, execute and monitor business processes. It becomes a continuous process and ensures that all factors are in sync to deliver performance, including the technology, the people, the facilities that enable the process to deliver repeatedly and then the guidance of rules will provide the control and execute the process

Some related disciplines -

1. Total quality management - Continuously improve and sustain the quality of products and is widely used in the manufacturing domain. (BPM is in some sense a subset of TQM. In order to improve the quality of a product, BPM improves the process that makes the final product - looking at every step that contributes to the end product)
2. Operations management - How the organization is functionally and technically managed. Uses probability theory, queueing theory, mathematical modelling, decision analysis and more to improve operation. It is concerned with existing processes without necessarily changing them. (BPM perspective is to change and redesign the process)

3. Lean - Originated from Toyota, cuts all the waste and makes the process lean. Process analysis technique that can be used in BPM which is called value analysis that cuts down steps that do not contribute to the process.
4. Six Sigma - Originated from Motorola, used to improve the quality of the product. Can be used with lean as well as BPM but will focus on the improvement of quality

Why BPM

Information technology does not generate business value directly but is used to enable change that will subsequently yield business value. BPM provides a bridging of IT and business as many IT projects in enterprise aim to improve business processes through change by enabling the process.

Ford Case Study (Michael Hammer 1990 - Reengineering Work: Don't Automate, Obliterate)

Ford needed to review its procurement process to:

- Do it faster (Reduce turnaround times)
- Do it cheaper (Reduce cost)
- Do it better (Reduce error rates)

500 people were employed in the account payable department to process POs and invoices in just North America.

Initially, Ford thought of using automation, but they found out that using IT directly in the department to automate parts of the operation can improve performance but not significantly. But they decided to copy Mazda's account payable department.

In Ford's procurement process, the purchasing department will purchase and send the purchase order to the vendor and a copy of the purchase order to the accounts payable. The vendor will then send the goods together with the receiving document to the warehouse. The warehouse will then pass the receiving document to the accounts payable as well. After that the vendor will send an invoice to the account payable. The account payable team will then need to verify and ensure the numbers tally before paying the vendor.

However in Mazda's procurement process, they added a central database so that when a purchase order is made, the copy of purchase order will be put in the central database which then will be tallied with the goods received and receiving documents and flagged by the warehouse team. The accounts payable will then receive the invoice from the vendor and check it against the flagged items in the database and they can make payment quickly.

It resulted in 75% reduction in headcount, material control is simpler and financial information is more accurate, purchase requisition is faster and less overdue payments.

Exercise 1.2

Who are the actors in this process?

Purchasing department, warehouse, vendor, accounts payable department, unit that has purchasing needs

Which actors can be considered to be the customer(s) in this process?

Unit that has the purchasing need and if the process is too long or if it is not delivered on time then they will be dissatisfied

What value does the process deliver to its customer(s)?

Timely, accurate, and cost efficient purchase of items.

What are the possible outcomes of this process?

Goods are delivered and subsequent payment is made, goods are cancelled or rejected.

How to engage in BPM

Continuous Process Improvement (CPI)

- Does not put into question the current process structure
- Seeks to identify issues and resolve them incrementally, one step at a time and one fix at a time

Has less risk and is more easily accepted by the users because it does not change the fundamentals.

Business Process Re-Engineering (BPR)

- Completely or radically redesign existing process and make big changes
- Same as the ford example

Fall of BPR

- Exaggerated expectations
- Strict focus on efficiency and technology and disregard of people in the organisation
- Early 1990s lack supporting tools and technologies for BPR

Enterprise resource planning systems -

A central database/repository for the whole organisation so that information can be quickly accessed, distributed and shared by all stakeholders

Workflow management system -

Automatically distribute to different actors on the basis of the processing, and make sure that different activities are allocated to different resources in accordance with its definition.

Coordination is automated between different resources between different stakeholders or different participants.

BPM Lifecycle -

1. Process identification and opportunity assessment (Once and the rest will be in cycle)
2. Process discovery
3. Process analysis
4. Process redesign
5. Process implementation
6. Process monitoring/controlling

Process identification

- What business processes are we intending to improve?
- What process performance measures are we using to measure the value delivered by a process?
 - Cost, cycle time, quality(error rate means the percentage of time the process ends in negative), flexibility
- Output is the process architecture

Exercise 1.3

Consider the students' admission process described in Exercise 1.1. Taking the perspective of the customer, identify at least two performance measures that can be attached to this process.

Cycle time - How long does it take for the results to come back

Cost - There is no cost since they did not state

Quality - One of the negative outcomes is the percentage of applications rejected due to being incomplete. Using this as a performance measure to measure error rates. Can also use percentage of application accepted, percentage of application rejected due to invalid english results

BPM Lifecycle

Process discovery:

as-is process models (Reflects the understanding that people have about how the work is done currently. It reflects that understanding, it can facilitate the communication and must be easy to understand)

- Textual description
- Flowcharts, e.g., BPMN

- The level of details to be included in a process model depends on the purpose.

Process analysis

- Identification and assessment of issues and opportunities for process improvement
- Assessment of issues goes hand in hand with measuring the current process
- What issues exist? What are the causes of this issue? What are the impacts of these issues? What are the priorities of these issues? What are the opportunities for process improvement?
- If these issues can be addressed, they can develop insights into how the process can be developed and improved.
- Assessment of issues goes hand in hand with the measuring of the current process and gives people an idea about how good or bad the current process is. By identifying, classifying and understanding these issues and the causes of these issues, the analysis can find what would be the most suitable way of addressing these issues.

Exercise 1.4

Consider the student admission process described in Exercise 1.1. Taking the perspective of the customer, think of at least two issues that this process might have.

Hardcopy documentations might go missing which will become incomplete documents and lead to a negative outcome. The other issue is long execution time due to the need of handing over documents to the next party.

Process redesign

- Identify the potential remedies for the issues
 - How can we improve it?
 - What are the options?
 - What are the possible remedies for the issue?
- Quantify the issue
 - When cycle time is too long, how long is long?
 - What is the average cycle time?
- A difficult job
 - Different people have different opinions
 - Without systematic approach, some options might be overlooked and there are different aspects to change the process
 - Changes made on one process might have impact other parts of the process or other process
 - Conflicting objectives to achieve, wants the process to be cheaper and faster but making it faster might mean it costs more or it might take a toll on the quality.

Process implementation

- Put the to-be process into execution
- Organisational change management

- Process automation
- Need to train employees
- Need to have a transition and training plan
- Need to have new hardware, software, infrastructure, resources, human resources, capacities

Process monitoring and controlling

- Is adjustment needed?
- Measure the improvement
- Apply necessary adjustment in order to get and sustain the benefits

Go back to discovery

Work on a new problem in the current process or work on the next process

Exercise 1.5

Given the issues in the admission process identified in Exercise 1.4, what possible changes do you think could be made to this process in order to address these issues?

First problem is long execution time which can be addressed by increasing the frequency of the committee meeting or accepting digital copy first and require verified copy once offer is given to shorten the cycle time

Conclusion

First role in any technology used in a business is that automation applied to efficient operation will magnify the efficiency

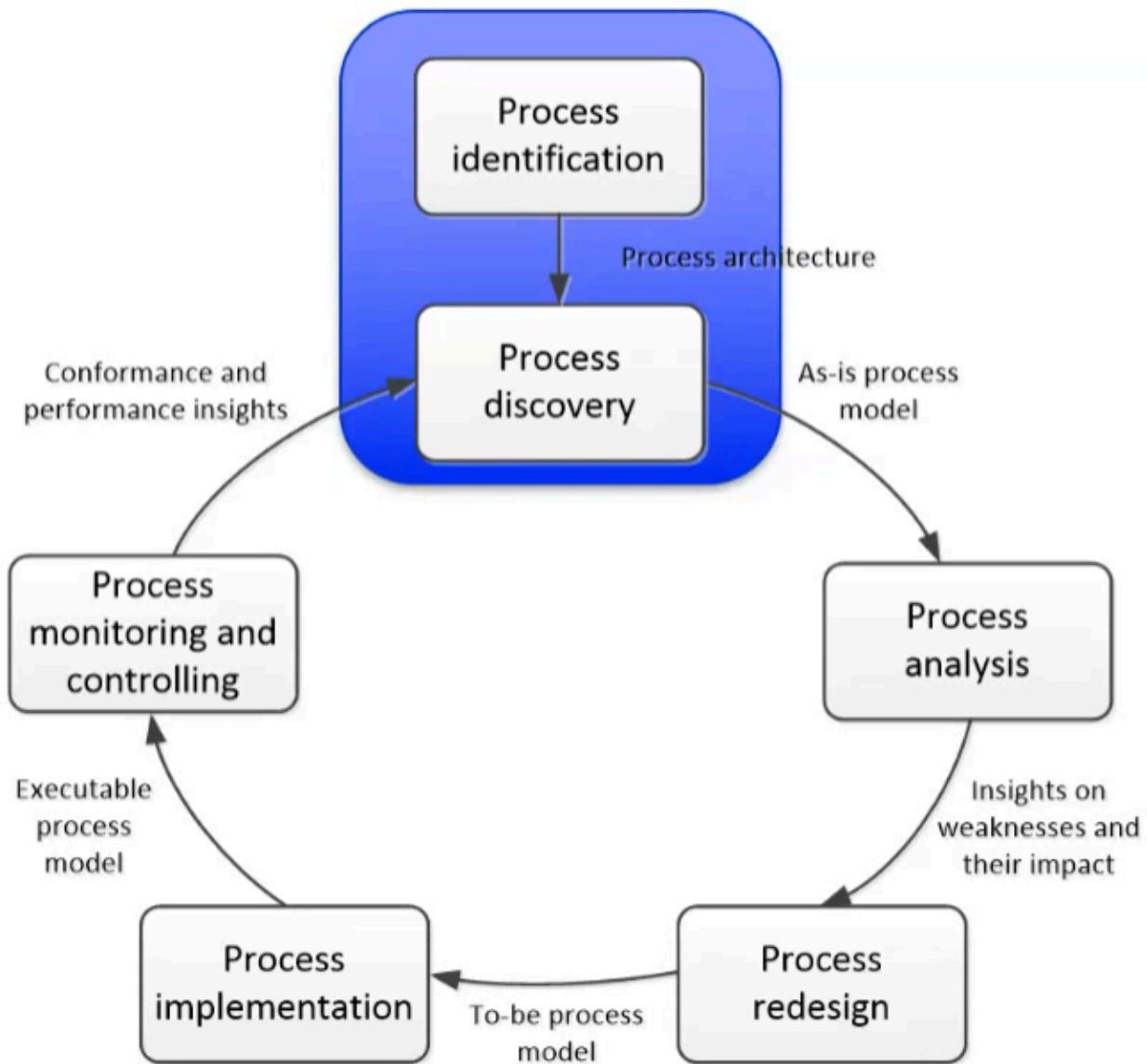
Secondly is that automation applied to inefficient operation will magnify the inefficiency.

BPM lifecycle helps us to understand what technology can do in organisations. IT is an enabler and instrument to improve processes. If used in inefficient operation, it might give cost instead of value

System engineers need to work with the process analyst to understand what the main issues are in the process and how IT can help to address these issues. This means learning how to design, analyse, improve and not just build the IT system and automate the process.

Understand when new technologies emerge, how they can be applied to existing process to enable the change and deliver the performance

Lecture 2 -



In order to improve the organisational performance we need to improve the performance of the business process because they represent how the work is done in the organisation.

BPM has a set of methods, tools and techniques to do various things on business processes. So the reason why BPM is because we hope that technology is able to yield value for business and organisations. Incorporating technology to businesses does not generate value automatically. Only when changing the process, value then will be added.

Process identification

What?

- Define an organisation's business process
- Establish criteria to prioritise the management of these processes (It is very costly so resources should be invested in processes that will return most value)

Why?

- To understand the organisation from process perspective
- To maximise value of BPM initiatives

Output: Process Architecture

- Capture business processes and their scope
- Serves as a framework for defining priorities and scope of subsequent BPM phases (e.g. modelling, redesign and automation)

Process Identification Steps

- **Designation Phase** - Understand the process of the organisation as well as their interrelations. When determining what process, activities, events, there will be different criteria that can be considered.
 - Different practices view processes differently,
 - One typical theory views an organisation to only have 3 processes, production to make product, sales to sell product and logistics.
 - Michael Porter way of classifying processes into core and supports into big blocks of processes which is easy to understand but it is not helpful when the processes are very huge and have many entities to coordinate
 - Enumerate main process (Listing)
 - Determine process scope: boundaries (horizontal and vertical) and interrelationships (order and hierarchical)

Coarse-grained view(bigger process/broad process) vs Fine-grained view (smaller process/narrow process)

- Trade off between impact and manageability
- Smaller easier to manage but lesser impact
- Identify the broad processes that need complete overhaul
- Identify the narrow process that are subject to continuous fine tuning

How many is enough?

As a rule of thumb, for small-medium enterprises, 10 to 20 processes is manageable
For larger enterprises, they might have hundreds.

Exercise 2.1

Explain how the trade-off between impact and manageability works out for broad and narrow processes respectively

Broad processes have a bigger impact and is harder to manage as it affects a larger process area as compared to narrow process which affects small part of a process but is more manageable as it does not require coordination with as much entities

Relation between processes

- **Hierarchical relations:** A process is a subprocess of another process. A management process might comprise several sub processes like order booking has billing, shipment and others.
- **Sequential relations:** A process is upstream of another or a process is downstream of another. Using the order booking e.g, billing is an upstream process compared to shipment as users will need to complete the billing process before the shipment process. Important as this relationship will show which process is dependent on the outcome of the other process. Downstream process depends on the outcome of the upstream process. Understand the impact before implementing the change

There are various industry guidance available such as ITIL (Information Technology Infrastructure Library, developed by the UK government), SCOR (Supply Chain Operation Council), PCF (Process Classification Framework Supported by APIC)

- **Evaluation phase** (Process Selection) - Prioritise among processes
 - Changing business processes is costly, therefore changes should be made where there will be great value, significant trouble presented and easiest to do. Easiest to do, meaning which is the most feasible to manage as different processes have different levels of difficulty due to many reasons (listed below)
 - This is all subjected to the dynamics of time because business entities are dynamic. Customer, involvement, everything is dynamic. When things change, the prioritisation may need to be changed as well
 - Alignment with strategic objectives
 - Health (which process is in trouble)
 - Culture and Politics
 - Feasibility to be successfully improved (How likely is it to succeed? Do you have confidence, experience, and capacity to manage them well?)
 - Risk of not improving

Criteria for evaluation

- Importance - What has the greatest impact?
- Dysfunction - Which process is in the deepest trouble?

- Feasibility - How susceptible are the processes to process management initiatives?

Do these criterias lead to the same set of processes?

Not necessarily. A strategically important process may also be the hardest one to manage because many early attempts have failed but it is strategically important so there is no choice. Either do it or you are out.

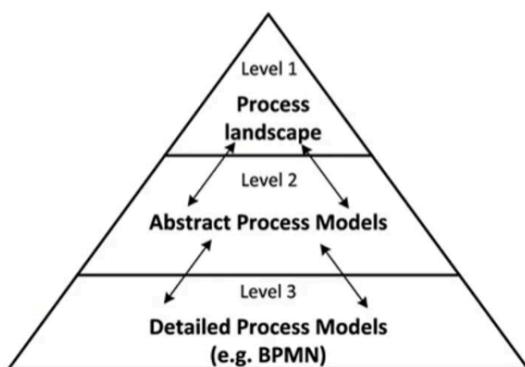
Sometimes it is better to gain credibility and experience by focusing on the easier to manage processes

Should all processes that are dysfunctional, of strategic importance and feasible to manage be subject to process management initiatives?

No, as it is not feasible. The common practice is to model all important processes but we can delay the decision to perform more advanced BPM models and manage them in the future by gradually increasing control.

Process architecture

A conceptual model that shows the processes of a company and makes their relationships explicit.



Process landscape

Shows the main process of an organisation on a very abstract level and each element will point to a more concrete process on level two. It should be understandable such that employees are able to link to one or more processes on level one and say that they are working on that process. It should also represent the view of the personnel in the organisation and even the customer about how the business operate and why it exists

Method to classify using two dimensions

First dimension is called the **Case type dimension**

Case is a product or service that is delivered to internal or external customers.

It can be deliberately classified using any number of properties e.g

- Product type
- Customer type
- Channels

For Apple, it could be a Mac, IPad. Apple identifies all the cases they handle by using an attribute or a property for product type. Different organisations handle different cases differently.

For banks, they offer credit cards, home loans, insurance, debit cards etc. When a customer wants to open an account with the bank, they do not do the same process for credit card or home loan or insurance. There are certain criterias to meet, for insurance, health report is needed, for credit card, other information is needed. So the process the bank uses to handle the same function for their products is very different. That is why we can use product type as an attribute to classify different cases.

Productive type is not the only way to classify cases. Customer type can be classified as well. There are 2 types of customer in a bank context, one is retailing and another is VIP customer. The bank does not handle both types of customers in the same way.

Location can also be used to classify cases. The bank can operate in 2 different countries but the way they operate is different due to the local regulations, law and requirements. So the bank may do same functions differently

Channel is how the organisation interacts with the customer. For bank, there is internet banking, face to face, telephone banking and so if the bank does functions differently in different channels, they can be classified separately as well

Second dimension is called the **Function dimension**

Functional dimension defines or classifies what the organisation does. A function is what an organisation does. Eg. an organisation can have many different functions like production, purchasing and so on. If an employee is asked “what do you do?”, they will often tell you the function they are involved in.

The functions can be hierarchically decomposed so that functions can have sub functions and so on

Once the two dimensions are identified, a matrix can be created.
Case types horizontally and functions vertically.

		case type			
		Sea	Road	Rail	Inland
business function	pre-arrival	notify ETA			
		notify authorities	Inbound Planning		
		reserve tow-boat			
	arrival		Inbound Handling		
	trans-shipment	stacking/handling			
		payment			
	departure	infrastructure info		Outbound Handling	
		notify ETD			

Steps for developing a process architecture

- Identify case types
 - Product type
 - Service type
 - Channel
 - Customer type
 - Location
- Identify functions for case types
 - Use reference models like APQC's PCF
 - Can also interview different people in the organisation (Interviewees might use different terms but reference the same function or same term for different functions)
 - Functions can be further decomposed. In a function of a organisational unit, function can be further decomposed to the level of roles for individual members/sectors
 - Eg. in a procurement department, there are 2 roles, one is for selecting vendors and one is to manage vendor relations. Since they are doing different thing, the procurement function can be decomposed into 2 smaller functions.

- Construct one or more case/function matrices
 - If the function can be performed on the case, a X is placed in the cell

		Private Customers	Corporate Customers	Internal Customers
Management	Process			X
	Line			X
	Project			X
Operations	Savings	X	X	
	Loans	X	X	
	Checking	X	X	
Support	HRM			X
	ICT			X
	Finance			X
	Marketing			X

- Identify the process
 - Entire matrix forms one big process which will be split up when rules apply
 - Horizontal splits process between columns
 - Vertical split process between rows
 - Determine which combinations of the business functions and the case types will form a business process
 - In order to split, the matrix is treated as a whole first. Guidelines will be checked one by one and the process will be repeated until it has all been checked.

Matrix guidelines -

G1 - If a process has different flow objects, it can be split vertically

1. A flow object is an object that flows through a business process and each business process typically has a single flow object.
2. Flow objects for eg. product development and mortgage brokering is different therefore, the process can be split

G2 - If the flow object changes multiplicity, the process can be split vertically

1. Multiple flow objects of the same type are sometimes used (eg. batch processing) and if the number of flow objects that is processed per activity differs, then it can be split
2. Eg. For mortgage collection, multiple mortgage applications will be used for this part as processing therefore it will be counted as batch processing.

G3 - If a process changes transactional state, it can be split vertically

1. A business process goes through transactional states: initiation (initial contact with client), negotiation, execution (delivering products and services) and acceptance (customer make payment)

2. Eg. In bank, client risk assessment, selecting mortgage, offering, contracting and payment. First 4 is negotiation and payment is execution.

G4 - If a process contains a logical separation in time, it can split vertically

1. If its parts are performed at different time intervals. Eg. once per day or once per month
2. Some processes are scheduled monthly like newspaper subscription or customer can just buy one whenever they feel like it

G5 - If a process contains a logical separation in space, it can split horizontally

1. Organisations should aim to make their process uniform across different locations but sometimes there is no other choice due to law, rules and regulations.

G6 - If a process contains logical separation in another relevant dimension, it split horizontally

1. Dimension might be customer type, or channels etc.

G7 - If a process is split up in a reference model, it can be split up

1. A reference process architecture is an existing process architecture that is predefined as the best practice solution

G8 - If a process covers more functions in one case type than in another, it can split horizontally

1. If a process has many more crosses in one column than in another.

		case type				
		Netherlands		Belgium		
business function	risk management	product risk assessment	X	PD NL	X	PDX BE
		client risk assessment	X	Composite Mortgage Application NL	X	Simplex Mortgage Application BE
	mortgage brokering	selecting	X	Composite Mortgage Application NL	X	Mortgage Application BE
		offering	X	Simplex Mortgage Application NL	X	Simplex Mortgage Application BE
	finance	contracting	X	X	X	X
		payment	X	Mortgage Payment NL	X	Mortgage Payment BE
		collection	X	Mortgage Collection NL	X	Mortgage Collection BE
	product development		PDX NL			PDX BE

Completing the process architecture

Processes on level one is missing the consumer-producer relationship

- Which process when changed, has direct implication it has on the other process
- Which consumer-producer relationship existed between processes with respect to the same flow object.

Process discovery

- The act of gathering information about an existing process and organising it in terms of an as-is process model.
- Modelling a process is a part of process discovery
- To create models that are both correct and complete, 2 types of skills are needed and is hardly unified in the same person
 - Understand the operations of a business process
 - Represent it in an appropriate BPMN model

Four phases of process discovery

- Defining the setting: Assembling a team that have either of the 2 skills needed
- Gathering information: Build an understanding of the processes using different discovery methods
- Conducting the modelling task: Organising the creation of the process model based on the information gathered
- Assuring process model quality: Guarantee that the resulting process models meet different quality criteria. Follows the syntactical rules of BPMN, should be semantically correct, and easy to read, understand, modify, upgrade, transfer.

Parties involved are a group of domain expert (Individual who has good knowledge about how the process works) to be able to cover all activities of the processes and process analyst (Knows how to do the model)

Challenges that an analyst will face:

1. Fragmented process knowledge
 - a. Gathering from many different experts means that analysts will often get inconsistent and different information. Sometimes the information is conflicting because they operate with different assumptions.
 - b. Solution is to have a few rounds of talk to clarify any questions.
2. Domain experts think on instance level
 - a. They will explain how they handle a single individual case but the information needed should be generalised. The information needed is the definition of the process and not an individual case of the process.
 - b. Solution is to ask “what if” questions. Eg. “What if this is not completed? What if this is false? What if the condition does not hold? What if the deadline is not met?”
3. Knowledge about process modelling is rare

- a. Show the diagram to the domain expert and ask if the diagram correctly shows the process.
- b. Experts will not understand the model. Therefore the solution is to explain it to them.

Exercise 2.4

Imagine you would be assigned the task of modelling the process of how a book order is processed by your favourite online book retailer. How can you systematically gather the required pieces of information about this process?

Buy a book to observe part of the process as a customer. As a customer, I can see how long my order is taking and the status of the order and to understand what is being done in the customer facing part of the process.

Talk to someone that is working in the book retailer to get the information because they have the knowledge about how the process works.

Get approval from the manager and observe their work processes.

Ask if there is any documentation or training materials for how the process will be executed.

Discovery methods

Evidence-based discovery

- There are various pieces of evidence in an organisation available for studying how an existing process works.
 - Document analysis
 - Documents points to existing roles, activities and business objects
 - Formal documentation in terms of
 - Organisation chart (Information regarding which department is related to which processes)
 - Employment plan
 - Quality certificate report
 - Internal policies
 - Glossaries and handbook
 - Form (Some forms will give more information about the process than others. They will require signatures from certain departments and in which order etc.)
 - Work instruction (Gives information on how the process work)
 - Potential issues
 - Most documentation is not organised in a process oriented way. So they do not reveal how the process works directly and analyst would need to read and imply.
 - Level of granularity (detail) of the material might not be appropriate. Work instructions might be too detailed for the

- process model and other documents might be too abstract and give too little information.
- Documents are partially trustworthy and do not reflect the reality of the process. Documents can be outdated. Documents also state things should be done and not how people do it. Model should show how things are done by people.

Observation

- Requires approval
- Observe what people do at their workplace
- Eg. go to a restaurant and order food to observe how long the order is taking. They can measure how long it takes for the order to be delivered. They can observe how other customers order food in the same restaurant. If they have a glass panel that shows the kitchen, observation of the kitchen can also be done
- Potential issues
 - People might act differently when they are aware that they are being observed.
But we want to know how they do things in the normal way

Automatic process discovery

- Related to process mining.
- Makes use of event logs that are stored by different information systems that are used to support the business process. Each log can be related to an individual activity in a case and it has a timestamp. With this information, analysts can do automatic process discovery to construct the process automatically.
- Potential issues
 - Immature area and is still an area subjected to research
 - May not be accurate
 - Generated model may be very complex and may not be directly understandable. There are many variations and the process might become very large and complex

Interview based discovery

- Can do it in two different ways -
 - Start backwards from the product or the results of a process
 - Makes it easy to consider what has to be done/achieved before a specific activity can be conducted/carried out.
 - Start at the beginning by proceeding forward
 - Follows the flow of the process in the order of how it unfolds.
 - Useful to understand which decisions are taken at a given stage.
 - Do it in different iterations, do not forget exceptions to tackle 2 challenges
 - Fragmented knowledge
 - Domain experts will think on instance level
- Four steps

- Interview
- Model
- Verify
- Validate
- Use unstructured interviews so domain experts can expand on what they are sharing.
When using structured interviews, domain experts will not share enough information and it is like running a checklist.
- Share the same terminology between analyst and stakeholder to make it more productive. It enables both parties to understand each other.
- Ask question at identifying deviations from standard processing

Workshop-based discovery

- Needs a facilitator to take care of organising the verbal contributions of the participants/domain experts. Limit talk time of talkative participants and encourage the introverted participants.
- Tool operator will work in the workshop so that the information can be transferred into the model directly.
- Multiple sessions may be needed
- Provides rich and detailed information and can be put into model immediately
- Problems
 - Organisational culture where boss say certain things, workers will just agree
 - Provide a safe space for workers to share and do not invite managers or bosses if they will not allow workers to share safely.

Strengths and weaknesses of discovery methods

Method	Strength	Weakness
Document Analysis	<ul style="list-style-type: none"> - Structured information - Independent from availability of stakeholders 	<ul style="list-style-type: none"> - Outdated material - Wrong level of abstraction
Observation	<ul style="list-style-type: none"> - Context-rich insight into process 	<ul style="list-style-type: none"> - Potentially intrusive - Stakeholders likely to behave differently - Only few cases
Automatic Discovery	<ul style="list-style-type: none"> - Extensive set of cases - Objective data 	<ul style="list-style-type: none"> - Potential issue with data quality
Interview	<ul style="list-style-type: none"> - Detailed inquiry to process 	<ul style="list-style-type: none"> - Requires sparse time of process stakeholders - Several iterations required before signoff

Workshop	<ul style="list-style-type: none"> - Direct resolution of conflicting views 	<ul style="list-style-type: none"> - Not able to synchronous availability of several stakeholders
----------	--	--

Effort to process discovery

The more effort placed in discovery, the higher the quality of information that can be gathered

Process modelling method

To not miss important information, follow these steps and read the whole text before starting.

1. Identify the process boundaries
 - a. What condition does the process start?
 - b. Which results does it end?
 - c. What perspective do you assume?
2. Identify activities and events
 - a. Main activities of the process (What they are doing)
 - b. Events that occur during the process (Conditions)
3. Identify resources and their handovers
 - a. Who is responsible for the activities
 - b. Where is work handed over from one resource to another?
4. Identify the control flow
 - a. When and why activities and events are executed
 - b. Order dependencies, decision points, concurrent execution of activities and events, potential rework and repetition
5. Identify additional items
 - a. What are the involved artefacts?
 - i. Data objects, data stores, their relations to activities and events
 - b. Exception handler
 - i. What exceptions may occur?
 - ii. How are these exceptions handled?
 - c. Annotations, depending on the scenarios
 - i. Performance data
 - ii. Risk information
 - iii. Etc

Abstract Process Model

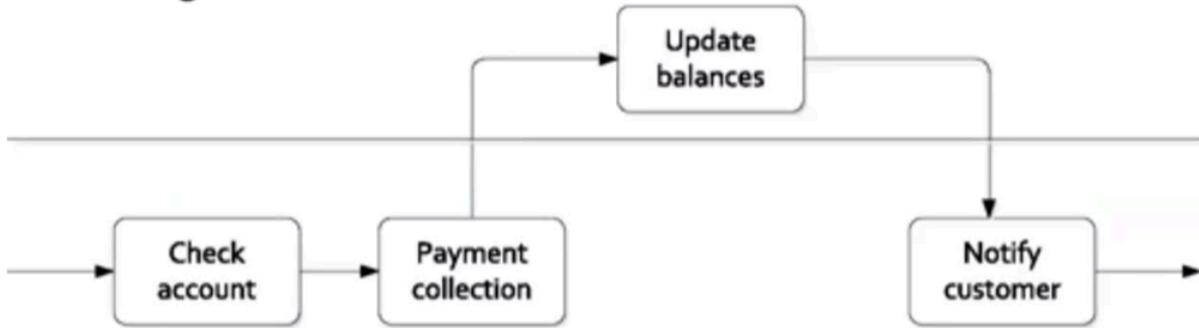
Adds some details but still abstract and will point to a more concrete process on level three.

Details include -

- Various steps are taken within each process
- Organisational units that are involved in carrying these out

Example of mortgage payment process -

Accounting



Billing

Detailed Process Model

Most detailed process that is created using the language like BPMN. It is detailed for us to understand, to communicate and to improve.

Details include -

- Alternative paths, potential exceptions, iteration, etc.
- Data that are being handled
- Systems that are being used

What is a business process model

It is a documentation of a business process using a combination of text and graphical notation. It tells the viewer who, what, when and how. Who is involved in producing a product or service, when they are involved in producing a product or service, what they do in the production of the product or service and how they do in producing the product or service.

Depicts the process that people employ to provide value to their customer with a strong emphasis on how the work is done

Establish the interdependencies, prerequisites, inputs, outputs and conditional branches to create a process flow

A mature organisation, a business process model should be a part of the overall business architecture or overall business analysis library

Business Process Model and Notation

Standard for business process modelling developed by Business Process Management Initiative (BPMI) and is currently maintained by Object Management Group (OMG).

The goal is to provide a notation that is readily understandable by all business users, from business analysts to technical developers who are responsible for implementing the technology.

The second goal is to ensure the XML based modern language, BPEL, can be converted into the graphical notation BPMN. BPMN is used by business analysts while BPEL is used by

technical analysts. BPEL is also used to enable computers to understand the business process through XML. (Second goal is not covered in this module)

BPMN intent is to standardise business process notation and provide a graphical notation for specifying business process in a business process diagram based on a flowcharting technique similar to activity diagram. It is a simple diagram made up of a set of graphical elements that depicts a business process

Widely accepted, replaces numerous process modelling languages notations and methods, simple to learn yet powerful enough to depict the potential complexities of a business process, there are a lot of vendors supporting this standard

Learn by practising and reading other people's model

Private and public business process

Private business process is internal to a specific organisation and does not interact with external parties

- Can be executable and non-executable

Public process represents the interactions between a private business process and another process or participant. The external process can be modelled as a black box or white box

- Shows to the outside world the message flows and the order of the message flows that are needed to interact with that process
- Black box means analyst is unsure about the internal behaviours of the external processes and cannot model it
- White box means the collaborating organisations are close to each other and are willing to share the internal behaviours with each other. So analyst can model the process of the collaborating partner

BPMN Elements

Consists of 5 types of elements

- Flow objects

- Event is represented by a circle and is something that happens during the process
- Activity is represented by a rounded corner rectangle and is a generic term for work that a company performs in a process
- Gateway is represented by a diamond shape and is used to control the divergence and convergence of sequence flow
 - Exclusive decision/Merge (Exclusive Or, XOR)
 - Indicate locations within a business process where the sequence flow can take two or more alternative path but only one of the paths can be taken
 - Depicted by a diamond shape that may contain a X marker
 - XOR join gateway is a passthrough gateway as it will pass the token to the next element immediately after receiving it

- Create default pass and make sure that one and only one of the conditions will be true
- Parallel Fork/Join
 - Provide a mechanism to synchronise parallel flow and to create parallel flow
 - Depicted by a diamond shape that must contain a marker that is shaped like a plus sign
 - An AND-split gateway when omitted.
 - And-join gateway requires all token to reach the gateway before it is passed to the next element
- Inclusive Decisions
 - Indicates locations within a business process where one or more branches need to be taken after a decision activity.
 - Depicted by a diamond shape that contains a marker that is shaped like an "O"
 - Eg. if there are 2 warehouses and the order consists of items from Amsterdam and Hamburg. The process will check where the items are located from and then the token will be generated and passed to the corresponding activity for execution.
 - A condition is attached to each flow but it is not exclusive to one another. So when one token arrives at the gate where they check the condition attached to each flow and if it is true, then the token will be generated and will be passed to the corresponding activity execution. The number of tokens will be used to generate a number of tokens and this number is equivalent to the number of output conditions that are true. At least one condition must be true.
 - For the join gateway, it is inclusive and it will wait for the token to arrive from each of its active incoming flows and this is called the synchronising merge
- Token is the object that flows through the process and transforms from raw material to a completed product/service
- Connecting objects
 - Sequence flow which is top arrow is used to show the order that activities will be performed in a process
 - Message flow which is the second arrow is used to show the flow of messages between two participants that are prepared to send and receive them. (Business process with customer/partner)
 - Association which is the last arrow is used to link information and artefacts with BPMN graphical elements
- Data
- Swimlanes
- Artefacts

Lecture 3

Labelling BPMN -

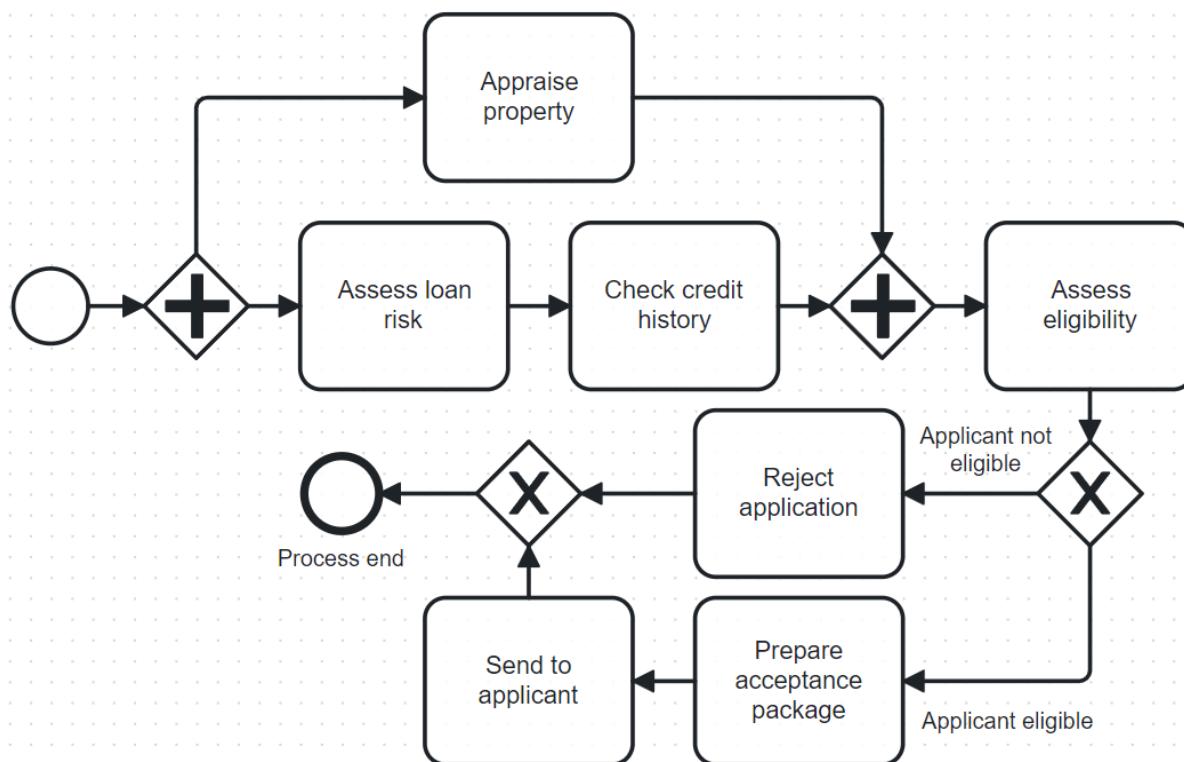
For activities, the label should begin with a verb in the imperative form followed by a noun, e.g. "Approved order". Noun is usually the object that the verb will perform on

For events, the label should begin with a noun and end with a verb in past participle form, e.g. "Invoice emitted". Events indicate that something has already happened.

To name process model we should use a noun by normalising the verb describing the main action of a business process, e.g "order fulfilment" (do not capitalise the first word of a process name to differentiate it with an activity)

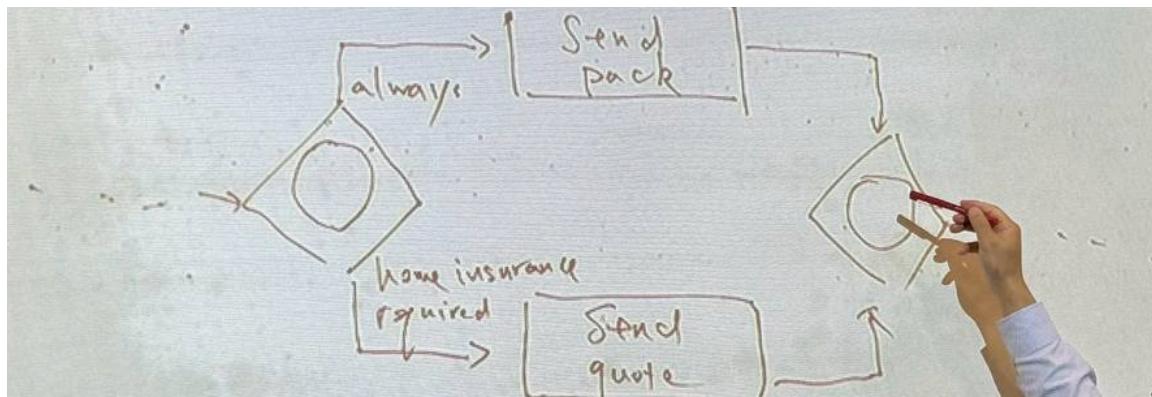
Exercise 3.3

A loan application is approved if it passes two checks: (i) the applicant's loan risk assessment, done automatically by a system, and (ii) the appraisal of the property for which the loan has been asked, carried out by a property appraiser. The risk assessment requires a credit history check on the applicant, which is performed by a financial officer. Once both the loan risk assessment and the property appraisal have been performed, a loan officer can assess the applicant's eligibility. If the applicant is not eligible, the application is rejected, otherwise the acceptance pack is prepared and sent to the applicant.



Exercise 3.4

A loan application may be coupled with a home insurance which is offered at discounted prices. The applicant may express their interest in a home insurance plan at the time of submitting their loan application to the loan provider. Based on this information, if the loan application is approved, the loan provider may either only send an acceptance pack to the applicant, or also send a home insurance quote. The process then continues with the verification of the repayment agreement.

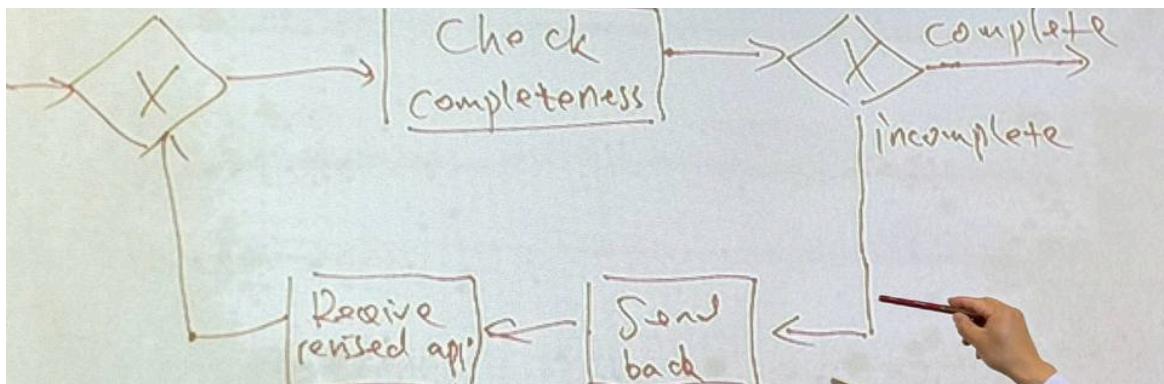


Rework and repetition (Loop)

- Sometimes we may require to repeat one or several activities, for instance because of a failed check
- Firstly identify the fragment of the process that can be repeated: repetition block
 - Last activity must be a decision activity
- Then use an XOR-split with two outgoing branches, one to continue and one to rework
- Finally merge the loopback branch of a repetition block with an XOR-join

Exercise 3.5

Once a loan application is received by the loan provider, and before proceeding with its assessment, the application itself needs to be checked for completeness. If the application is incomplete, it is returned to the applicant, so that they can fill out the missing information and send it back to the loan provider. This process is repeated until the application is found complete.

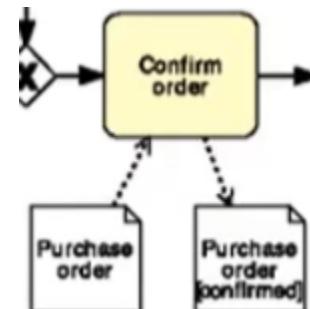


Data Aspect of BPMN

Data aspect indicates which information artefacts (any document, file, raw material, physical products, etc.) are required to perform activity and which ones are produced as a result of performing activity. Information artefacts can be digital or physical.

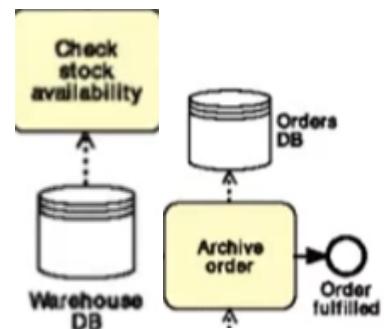
Data object

- Data object represents information flowing in and out of activities and is depicted as a document with the upper-right corner folded over and linked to activities with dotted arrow with an open arrowhead which is known as data association
- The direction of the data association is used to establish whether a data object is an input or output for a given activity.
- To represent the state of the data object, append the name of the state in a square bracket to the data object label.
- A shorthand notation for passing an object from an activity to the other is by directly connecting the data object to the sequence follow between two consecutive activities via an undirected association



Data store

- Data store is a place containing data objects that need to be persisted beyond the duration of the process instance
- Process activities can read/write data objects from/to data stores

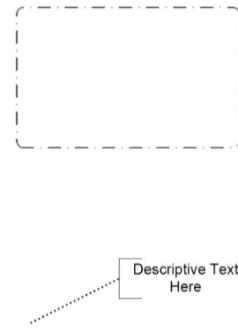


- Data stores are represented as an empty cylinder (the typical database symbol) with triple upper border
- Data stores are connected to activities via data associations
- This does not have to be a database. It can be a warehouse and data objects in this case will be raw materials or finished products etc. It can also be the file cabinet that will store paper documents.

BPMN Artefact: Group and Text annotation

A group is a grouping of graphical elements that are within the same category but it does not affect the sequence flows within the group. It does not have semantic meaning and is mainly used for documentation or analysis purposes. It is often used to highlight a certain section of the flow model.

Text annotation is a mechanism for the modeller to provide additional text or comments for the reader of the diagram



Resources

Resource is a generic term to refer to anyone or anything involved in the performance of a process activity

A resource can be

- Process participant
- Software system
- Equipment

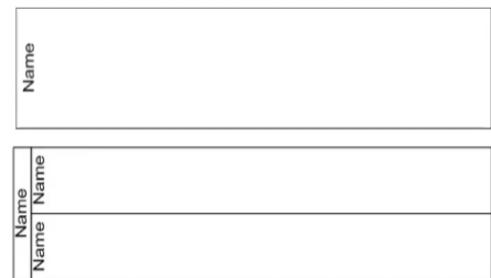
We are interested in active resources that can autonomously perform an activity (Eg. In a photocopy document process, and I require someone to photocopy the document. Someone is an active resource and when I photocopy, the photocopier is a passive resource. Modelling is based on the active resources)

We do not refer to one individual resource at a time, instead, we refer to a group of resources that are interchangeable, eg. Receptionist, analyst, management and not an individual like sam

Swimlanes

Pool represents a Participant(Whole Organization) in a process. It also acts as a graphical container for partitioning a set of activities from other Pools. Usually used in the context of B2B situations

Lane is a sub-partition within a Pool and will extend the entire length of the Pool, either vertically or horizontally. Lanes can be nested in multiple levels. Lanes are used to organise and categorise activities



It is important to place activities and events within the right pool/lane. It is not relevant where data objects are placed, so they can be placed close to the associated activities. XOR-split and

OR-split gateways are placed under the same lane as the preceding decision activity. However, it is not relevant where AND-split gateways are placed as there is no decision made.

Message flow arrow is used to represent the interactions between two or more pools.



Black box and White box

Black box

- Collaborating organisation is modelled as a pool without exposing the internal behaviours
- Message flow does not cross the boundary of the pool (meaning sends information to the organisation and it stops there as we do not know what is done to the information)

White box

- Internal behaviours(activities) of collaborating organisation is also modelled
- Message flow may cross the boundary of the pool and connect directly to an activity or event within the pool
- Send activity: an activity that is the source of a message. The message is only sent upon completion of activity.
- Receive activity: an activity that receives a message. The execution of activity will not start until the incoming message is received.

Sub processes

- An atomic activity, also called a task, is an activity capturing a unit of work that cannot be further broken down.
- A sub process represents a self contained, composite activity that can be broken down into smaller units of work
- A sub process is an activity whose internal details have been modelled using activities, gateways, events and sequence flows
- A sub process is a graphical object within a Process
- Sub process starts with at least one start event and one end event
- It can be hidden by marking an activity with a small square with a plus sign (+) inside
- Sub process can be “opened up” to show a lower-level process

When to use subprocess

When a model becomes too large that is hard to understand. Especially when it has more than 30 flow objects.

When parts of a process model can be reused by another process model in the same organisation. (Border is thicker to show that it is a global process)

How to model a sub-process

Identify groups of related activities which together achieve a particular goal
Encapsulating these activities and their connecting gateways in a sub process
Add start event(s) and end event(s) for the sub processes.

By default a sub process is embedded within its parent process model but it can also be a global process model that is not embedded within any process model and as such can be involved by another process model within the same collection.

A call activity in BPMN is a collapsed sub-process activity with a thicker border

BPMN extended element - Activities

Standard Loop



Multi-instance - Parallel



Multi-instance - sequential



Compensation

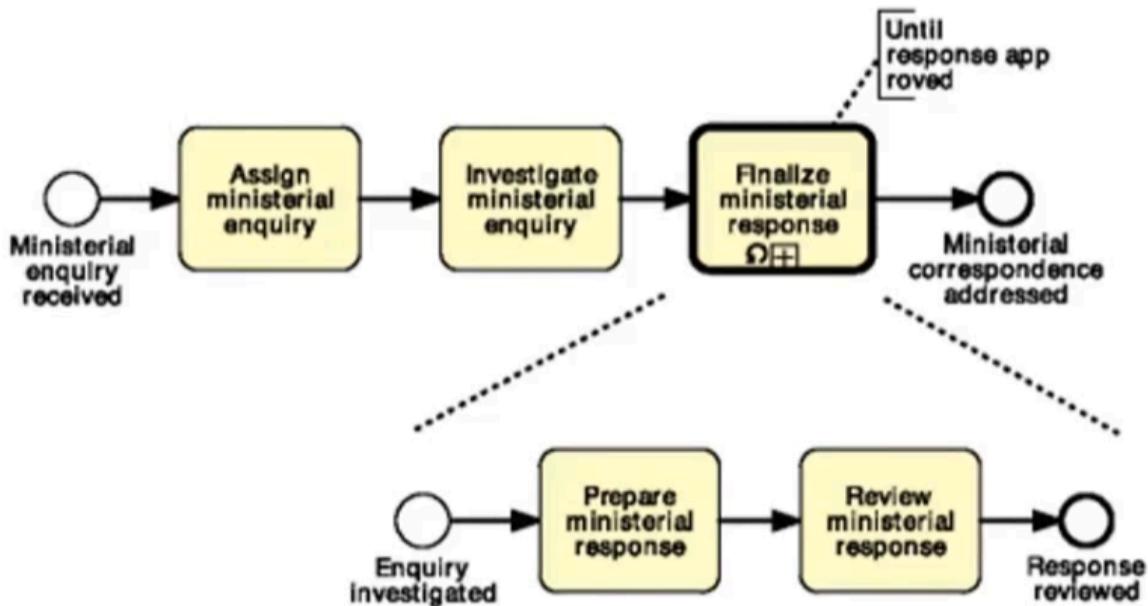


Ad-hoc



Standard loop

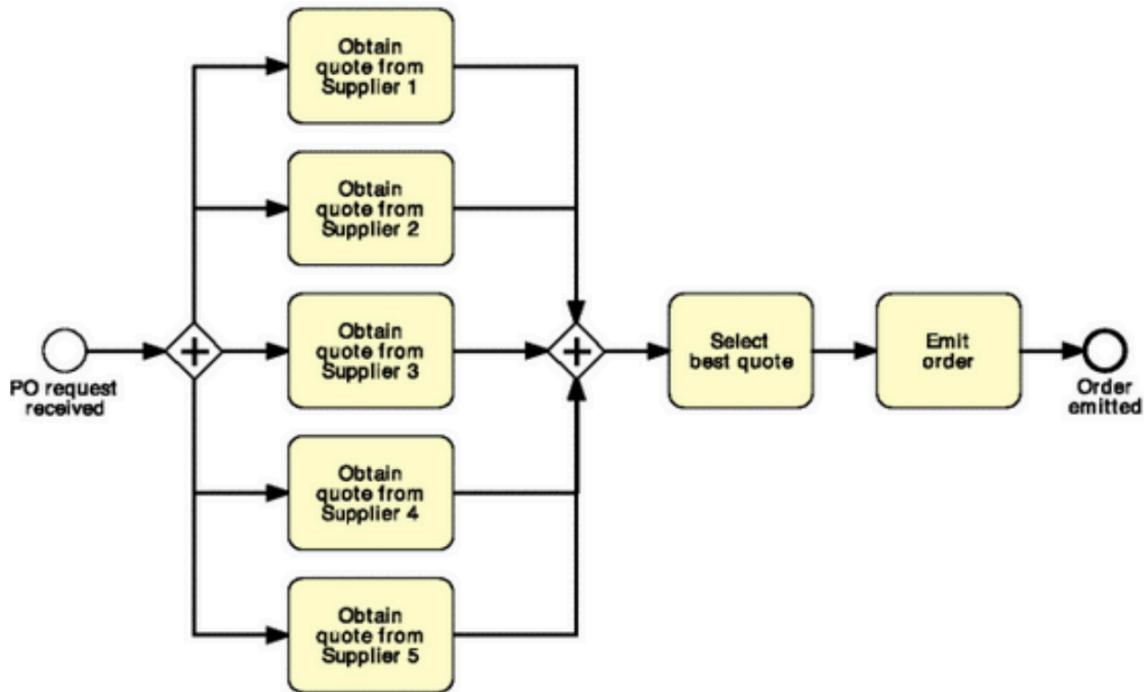
This means that the activity may be repeated or this sub process may be repeated. This works like rework. XOR gateways are removed and the annotation is the condition that will terminate the loop. This can only be used to replace a loop that has only one entry and one exit point.



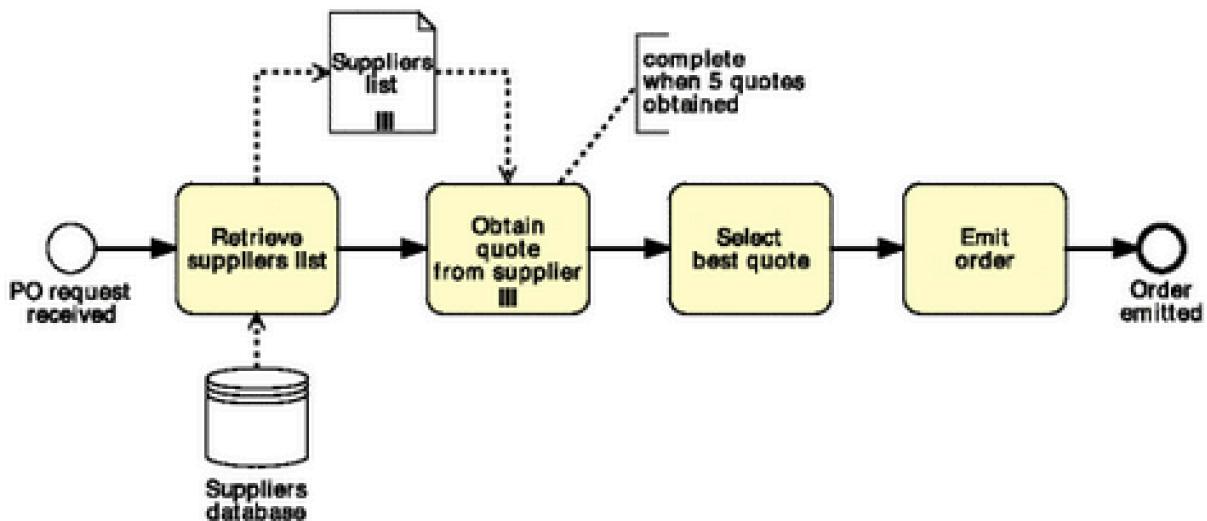
Multi-instance - Parallel

This means that multiple instances of this activity will be executed in parallel. Used when multiple instances of the same activity need to be executed in parallel.

Below shows a diagram that is not flexible. If there are more or less quotes obtain from supplier, changes to the diagram needs to be made



The updated diagram uses a multi instance data object and a multi instance activity both depicted with the three lines at the bottom. The multi instance data object is the input of the multi instance activity, therefore it will determine the number of activity instances. Annotation states that it is complete after 5 quotes are obtained but it can be changed to 10 but it will only need 5 to complete this activity.



Multi-instance - Sequential

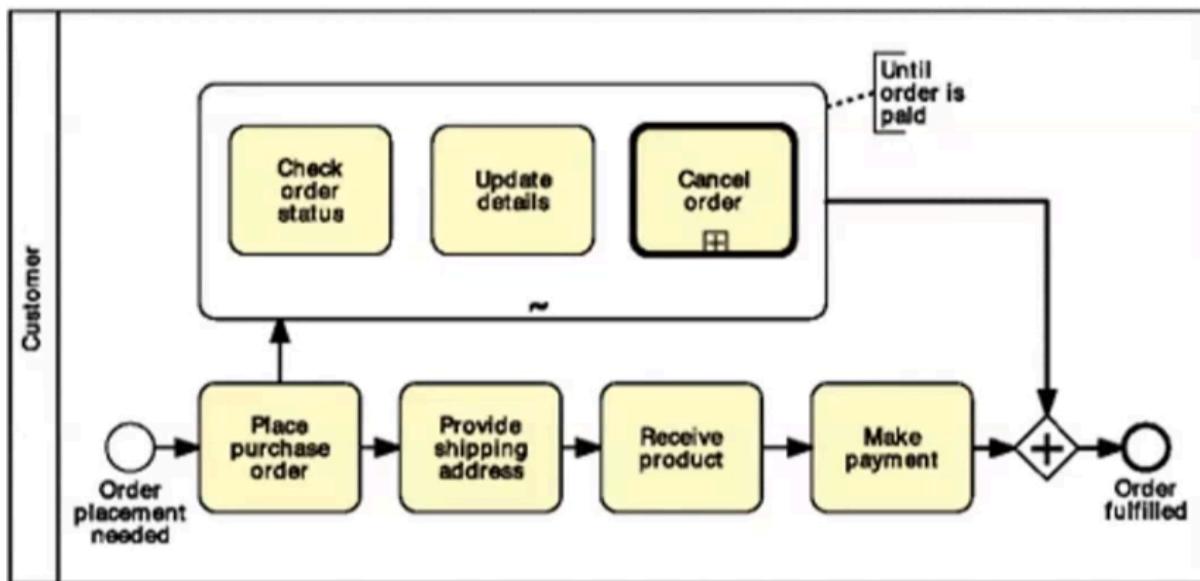
This means that multiple instances of this activity will be executed in sequence

Compensation

This means that the activity is used to undo a process or activity.

Ad-hoc (Uncontrolled repetition)

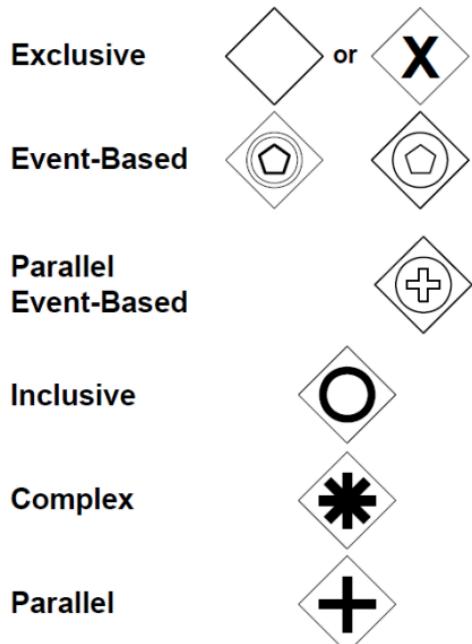
- Ad-hoc does not follow the rule where the element must be on the path from the start to the end and as it can only be executed because the token will only move along the path.
- It cannot represent start and end events.
- The order can be partially established or have no order at all.
- This is used when one or more activities may need to be executed multiple times without a specific order. These activities are often triggered from external events.



BPMN extended elements - Events

	“Catching”	“Throwing”	Non-Interrupting
Message			
Timer			
Error			
Escalation			
Cancel			
Compensation			
Conditional			
Link			
Signal			
Terminate			
Multiple			
Parallel Multiple			

BPMN extended elements - Gateways

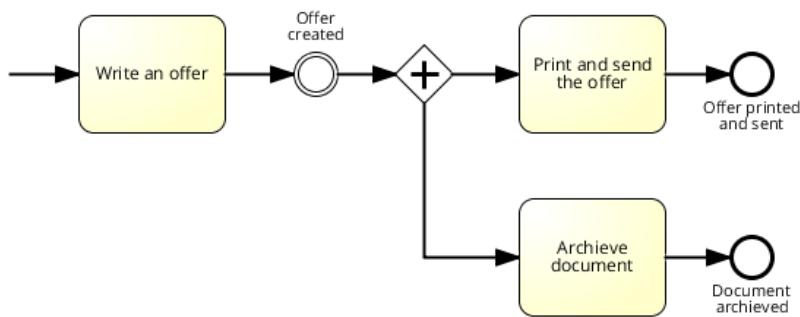


Intermediate Events

When an event occurred during a process the event is called an intermediate event
A token remains trapped in the incoming sequence flow of an intermediate event until the event occurs

The token then traverses the event instantaneously

It is represented as a circle with double border



Throwing event and Catching event

Throwing event is an event that throws a trigger from within the process. Throwing is generating the trigger so that someone else reacts to it

- An event type marker with dark fill

Catching event is an event that catches a trigger. Catching is reacting to the trigger

- An event type marker with no fill

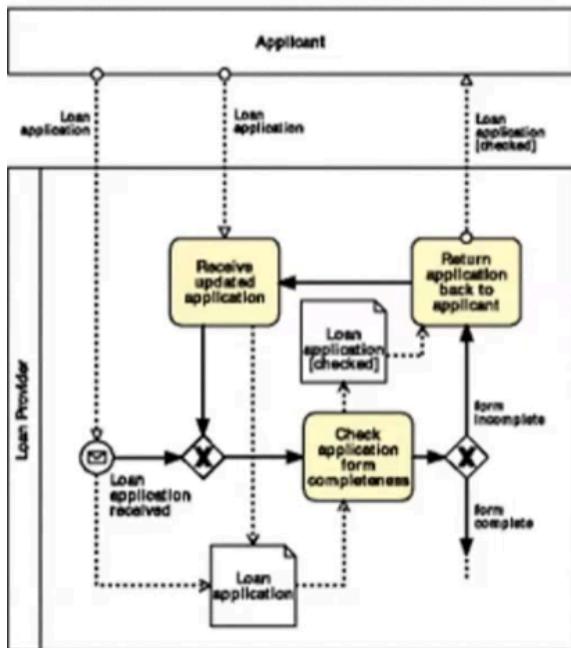
It is like during coding when exceptions may happen and another block of codes needs to respond to it. The throwing events throw a message/token to the catching event when the condition is met. When the catching token receives it, it will perform the process.

Message Events

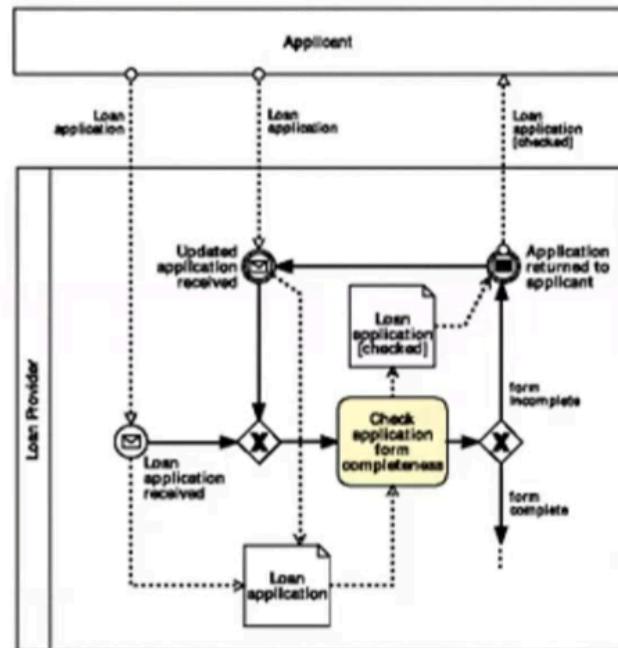
- A start message event (an empty envelope in a circle) specifies that new process instances are triggered by the receipt of a message. (Catching event)
- An end message event (a darkened envelope in a circle) signals that a process concludes upon sending a message (Throwing event)
- Message events can replace activities that are solely used to send or receive message

A reworked into B using message event

a



b



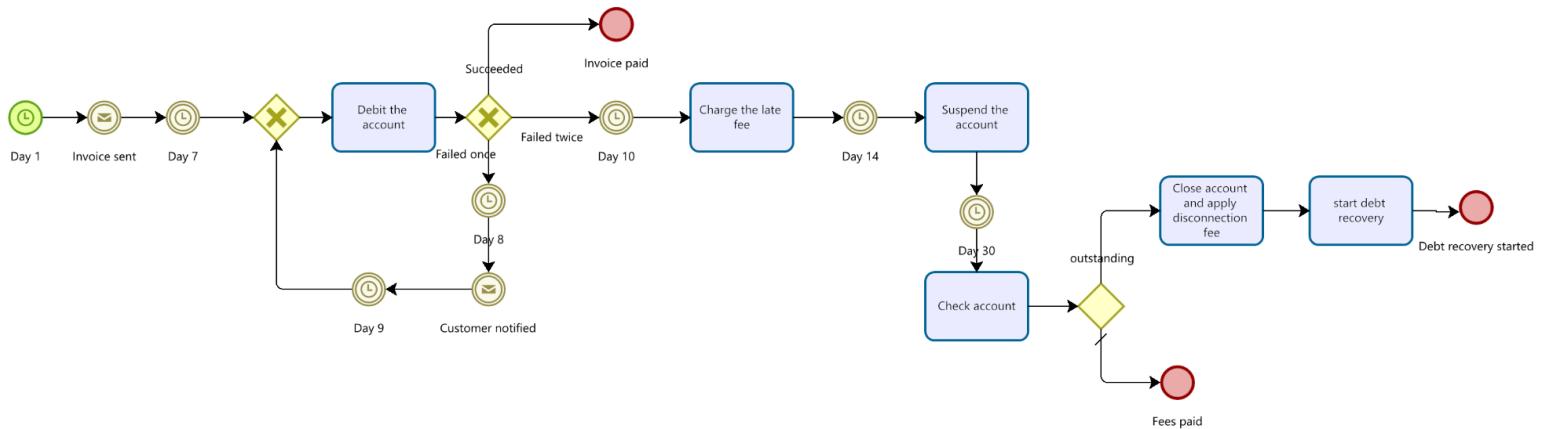
Temporal Events

- A start temporal event indicates the process instances start upon the occurrence of a specific temporal event
 - Every Friday morning, every morning at 7am
- An intermediate temporal event models a temporal interval that needs to elapse before the process instance before it can proceed
- There is no end temporal event
- It is a catching event

Exercise 3.6

Model the billing process of an ISP

The ISP sends an invoice by email to the customer on the first working day of each month (Day 1). On Day 7, the customer has the full understanding amount automatically debited from their bank account. If an automatic transaction fails for any reason, the customer is notified on Day 8. On Day 9, the transaction that failed on Day 7 is re-attempted. If it fails again, on Day 10 a late fee is charged to the customer's bank account. At this stage, the automatic payment is no longer attempted. On Day 14, the Internet service is suspended until payment is received. If on Day 30 the payment is still outstanding, the account is closed and a disconnection fee is applied. A debt-recovery procedure is then started.



Lecture 4

Conditional event

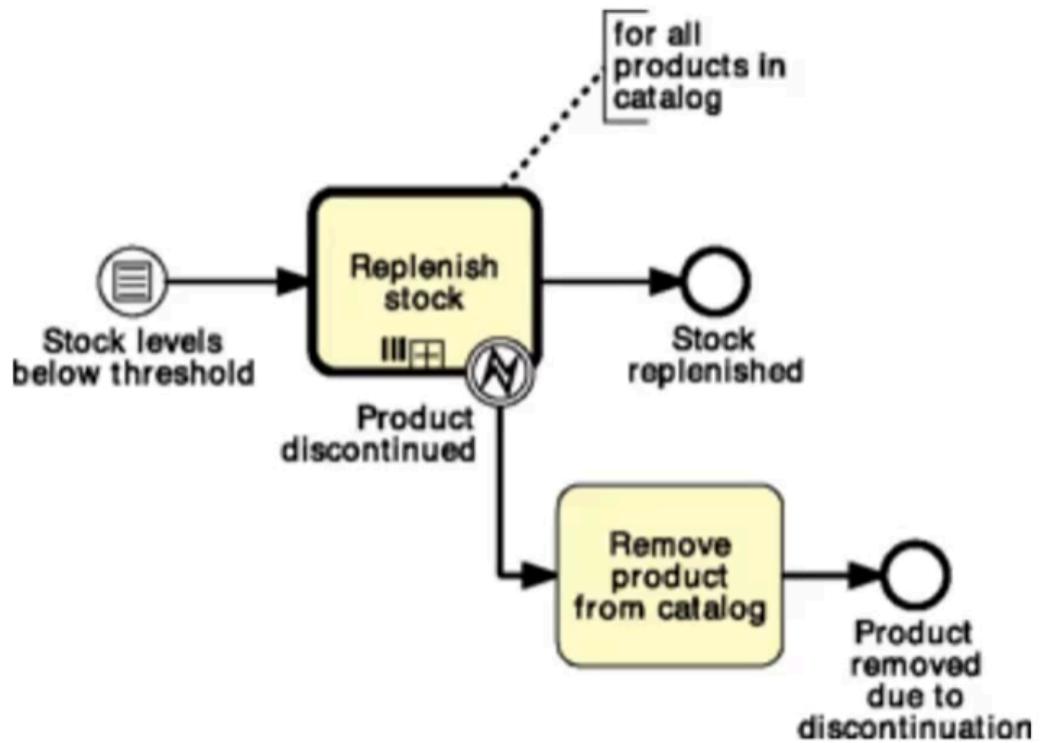
- Conditional event is used to model a business rule that implements an organisational policy or practice.
- Conditional event causes the activation of its outgoing flow when the respective business rule is fulfilled.
- A conditional event can be either a start event or an intermediate event.
- It is either a catching event or a throwing event or both.
- The condition is often a business rule that implements organisational policy or organisational practices. Eg. When the stock level is below 20%, the procurement process needs to start the process.
- The conditional event causes the activation of its outgoing flow when the respective business rule is fulfilled when the respective condition is true.

Intermediate conditional event vs Condition on the flow

Condition on the flow is something that is seen in the eg. XOR gateway has a condition attached to the outgoing flow and when the condition is true, the path is selected.

Intermediate conditional event is when a condition needs to be tested and if it is true, the flow will activate.

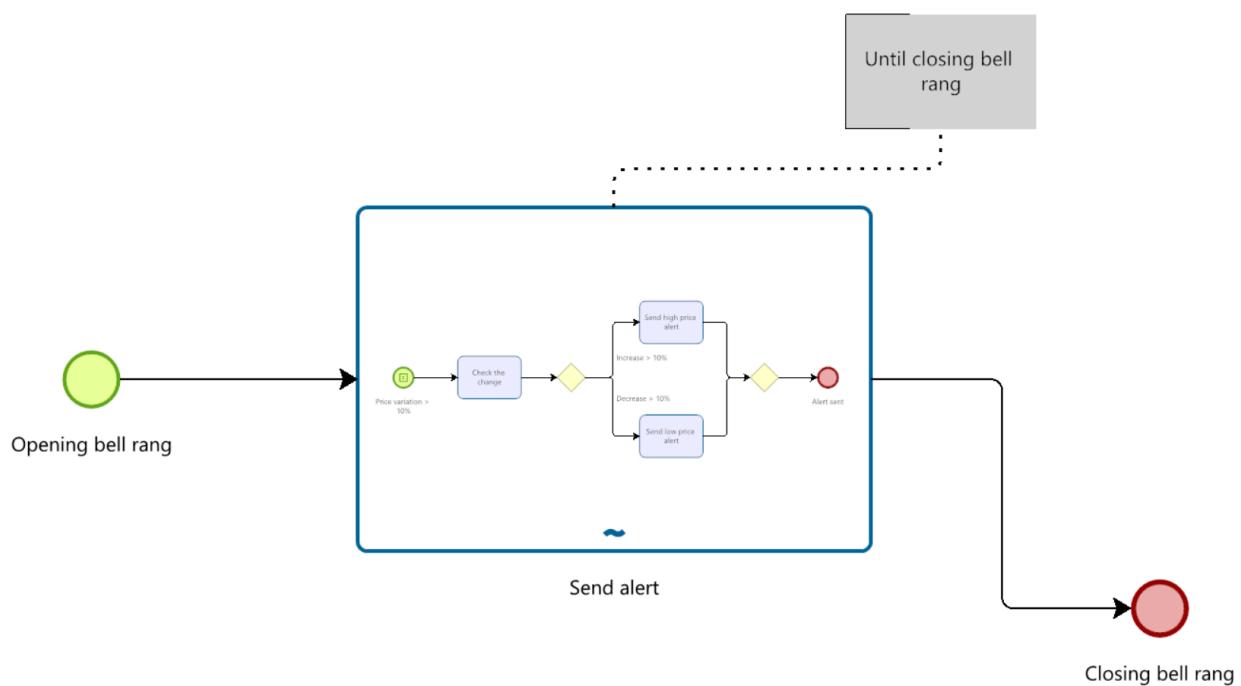
In XOR gateway for example, the condition will only be tested once and if it is true, it is selected, if it is not true, then the next condition is tested. For intermediate conditional events, the condition will be tested again and again until the rule is satisfied.



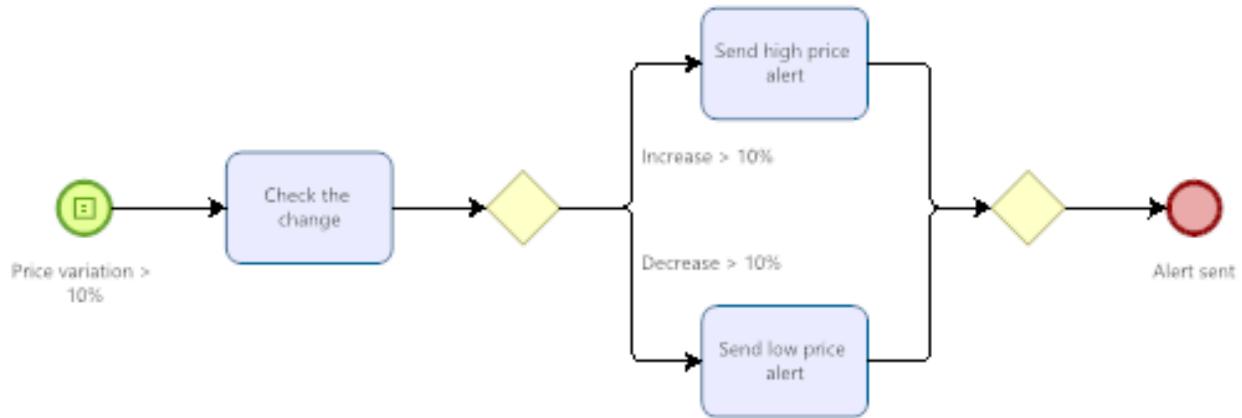
Exercise 3.7

Model the following business process.

In a stock exchange, stock price variations are continuously monitored during the day. A day starts when the opening bell rings and concludes when the closing bell rings. Between the two bells, every time the stock price changes by more than 10%, the entity of the change is first determined. Next, if the change is high, a “high stock price” alert is sent, otherwise a “low stock price” alert is sent.

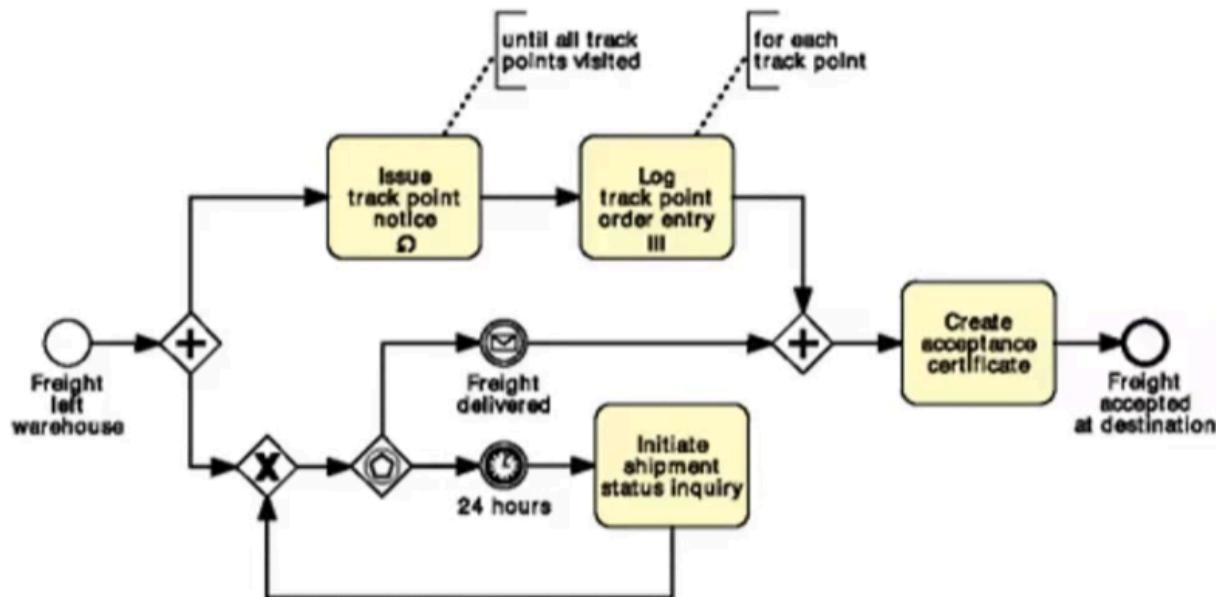


Subprocess



Racing events

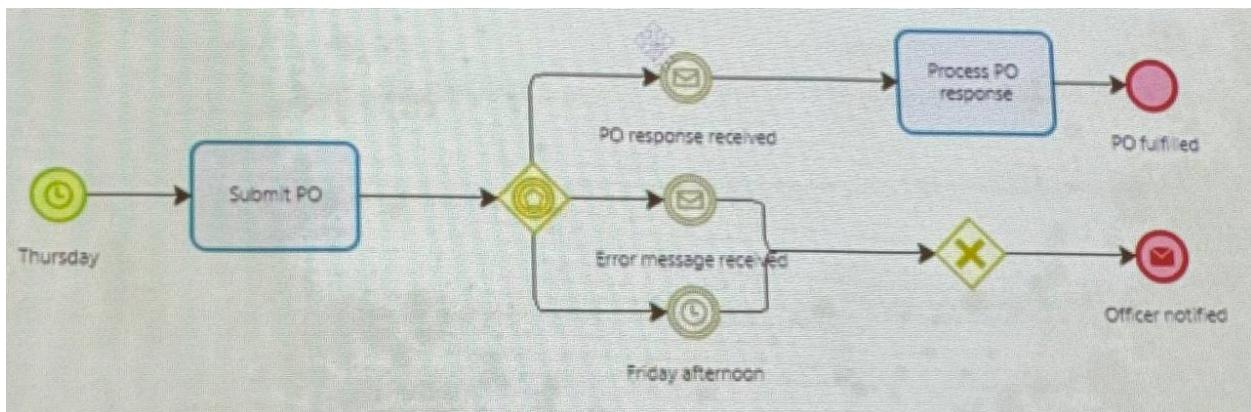
- Scenario where two (or more) external events race against one another.
- It is a gateway so it is inside a diamond with an immediate event that contains a pentagon
- The first of the two (or more) events that occurs determines the continuation of the process
- This race is captured by means of event-based exclusive split (Event based gateway)
- Merges with normal XOR-join
- Different from XOR split as it differs the decision until one of the events happens. The decision when the token reaches a normal XOR split is already available and can be made when it reaches the gateway.



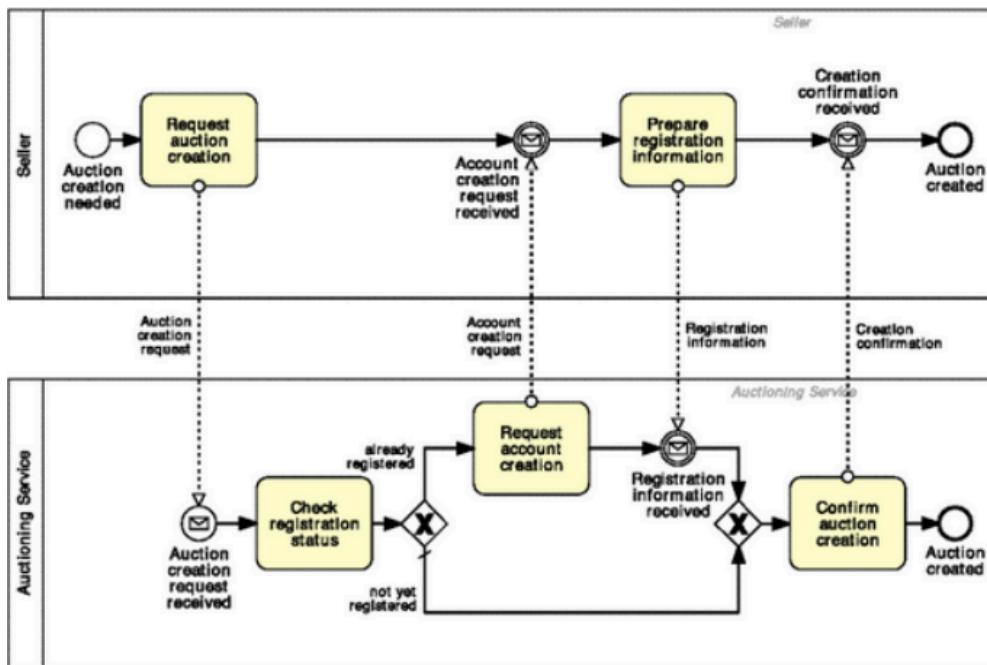
Exercise 3.8

Model the following process.

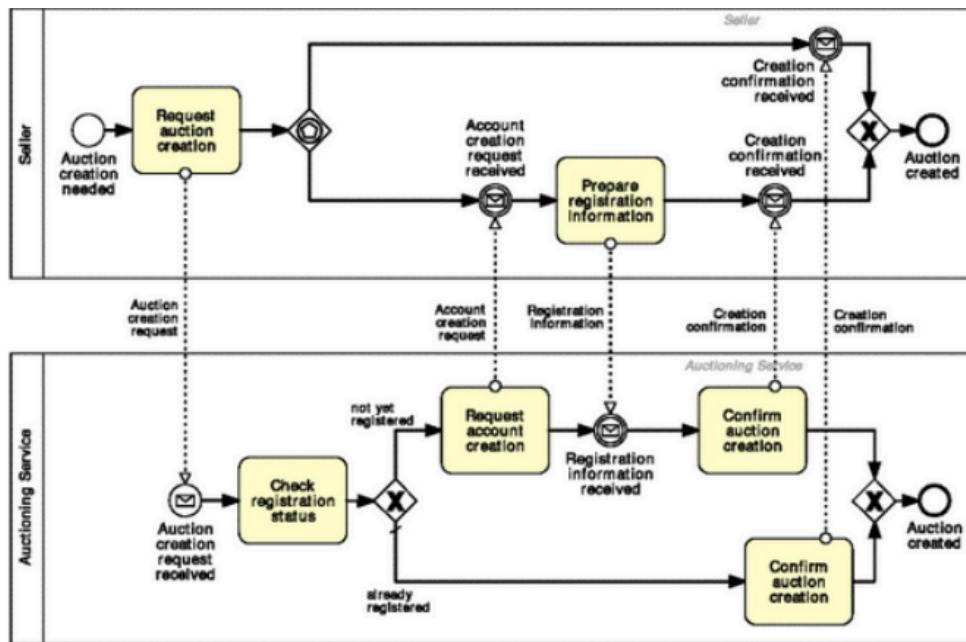
A restaurant chain submits a purchase order (PO) to replenish its warehouses every Thursday. The restaurant chain's procurement system expects to receive either a "PO Response" or an error message. However, it may also happen that no response is received at all due to system errors or due to delays on handling the PO on the supplier's side. If no response is received by Friday afternoon or if an error message is received, a purchasing officer at the restaurant chain's headquarters should be notified. Otherwise, the PO Response is process normally



Avoid deadlocking collaboration



Fix



Parallel event-based gateway

- Type of race condition that starts a process
- When the first event is triggered and the process is instantiated the other events of the gateway configuration are not disabled
- Other events are still waiting and expected to be triggered before the process can (normally) complete

Complex gateway

- Can be used to model complex synchronisation behaviour
- Complex activation conditions can be specified
- The number of token produced by the gateway is determined by the conditions on the outgoing sequence flow as in the split behaviour of the inclusive gateway
- If token arrives later on the two remaining sequence, the tokens cause a reset of the gateway and new token can be produced on the outgoing sequence flows
- Can set the amount of tasks that user wants to complete before receiving more request on the finished processing flows

Boundary events

- Some events may occur during the execution of an activity or a sub process which is modelled via a boundary event (an event is attached to an activity)
- Boundary events are usually often used for exception handling

Handling exception

- Exceptions are events that deviate a process from its normal course and it happens frequently
 - Business/Technology faults, etc.
- Exceptions must be identified in order to identify all possible causes of problems
- Exception handling must be modelled in order to ensure the consistency in process business

Exception handling - Process Abortion

End termination event - Causes the immediate termination of the process instance at its current level. It kills all tokens and aborts the process

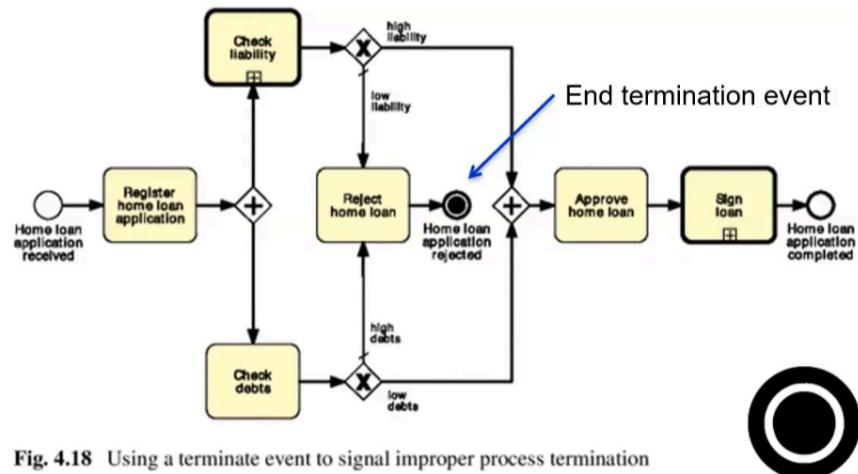
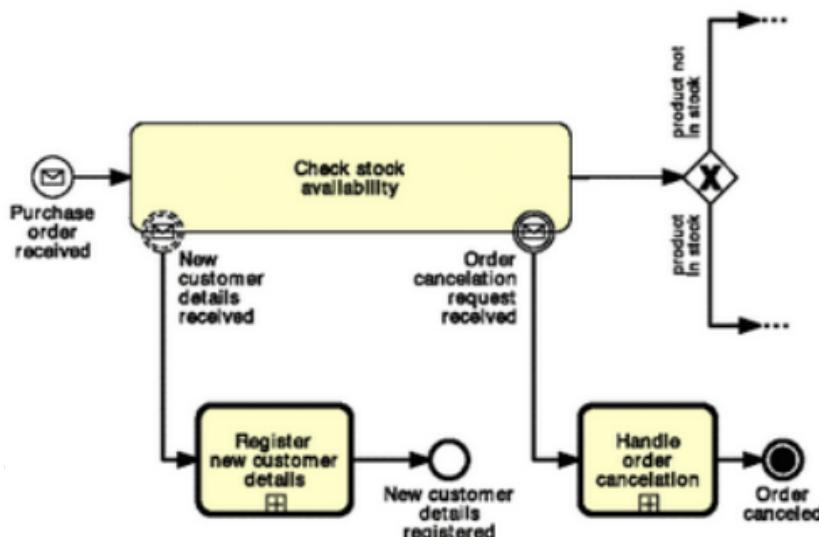


Fig. 4.18 Using a terminate event to signal improper process termination



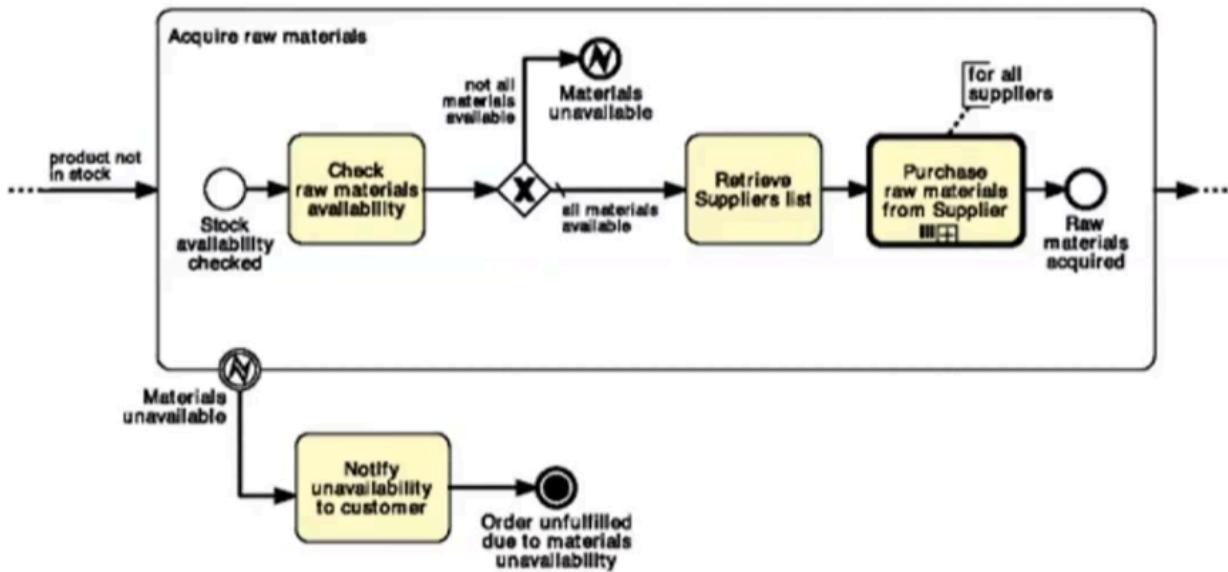
Interrupting vs Non interrupting events

If it is an interrupting event which means that when this event happens it will stop the activity. If it is a non interrupting event, it means that the event happens without interrupting the enclosing activity. It is depicted as a circle with a dashed double border.



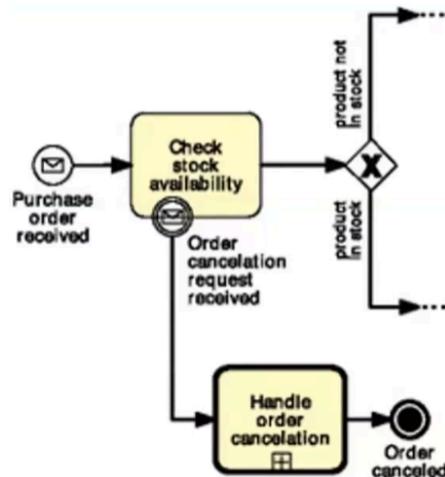
Exception handling - Internal Exception (Error event)

- Interrupting event
- Comes in pairs. One is catching and one is throwing
- Interrupt the activity that has caused the exception by using an end error event of a sub-process
- The exception is captured by an intermediate catching error event which is attached to the boundary of the same process
- This boundary event triggers the recovery procedure through an outgoing branch which is called exception flow



Exception handling - External Exceptions

- Exceptions originated externally to the process are called unsolicited exceptions
- What is the scope for being receptive to this event? (When do we need to respond to a customer's cancellation request?)
The scope of being receptive to is the activity to check stock availability. Once the activity is completed and the token moved to the next event, it will not need to activate.
If the request cancellation is needed for a larger scope, create a sub process and attach the message event to the boundary of the sub process.

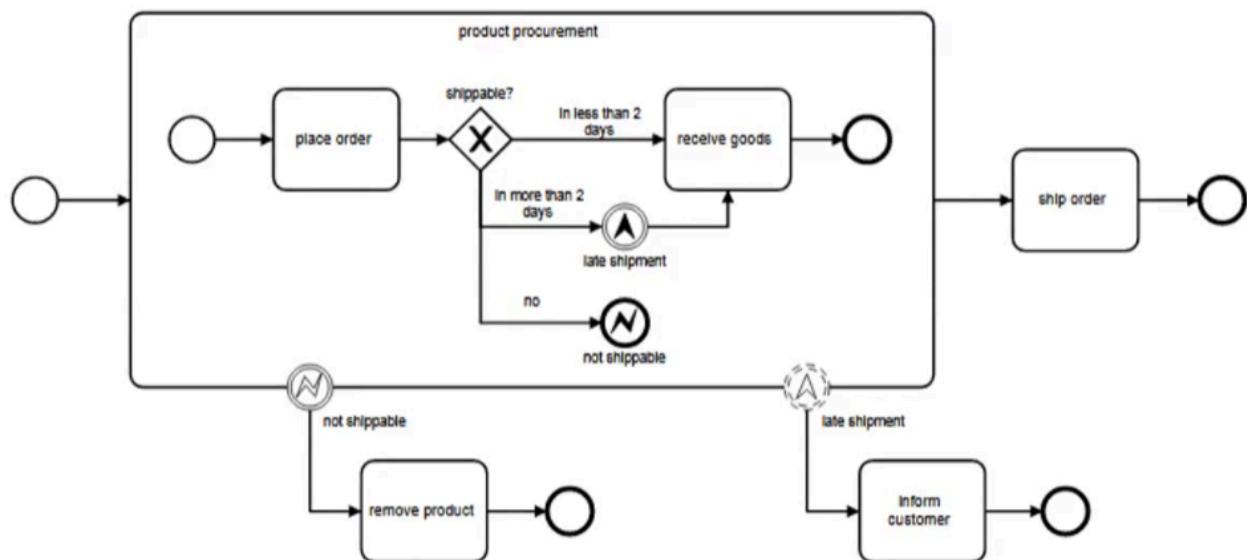


Exception handling - Activity Timeout

- When an activity times out means the activity took too long to complete .
- To model the activity to complete within a time frame, attach an intermediate time event to the boundary of that activity.
- The timer will activate when the enclosing activity starts and if it fires before the activity is completed, that means it took too long to complete this activity and it provokes the activity's interruption

Escalation event

- It is a non interrupting event and it is used to communicate from a subprocess to an upper process
- Unlike an error, an escalation is non critical and execution continues at the location of throwing

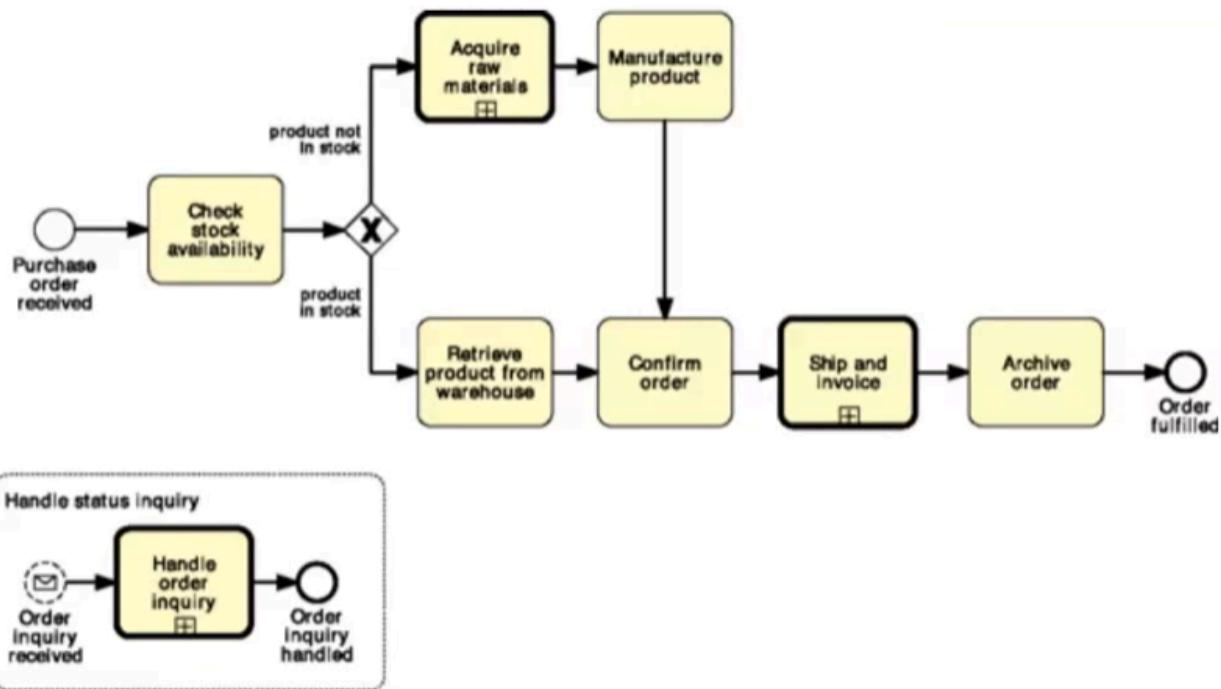


Signal event

- It is used for sending or receiving signal
- Mainly used when communication to a broad audience is needed.
- It is for general communication within and across process levels, pools and between business process diagrams
- There is a source of the signal, but no specific intended target
- A single is defined by the event's label and can be caught by catching signal events bearing the same label
- One source and multiple targets

Event sub-process

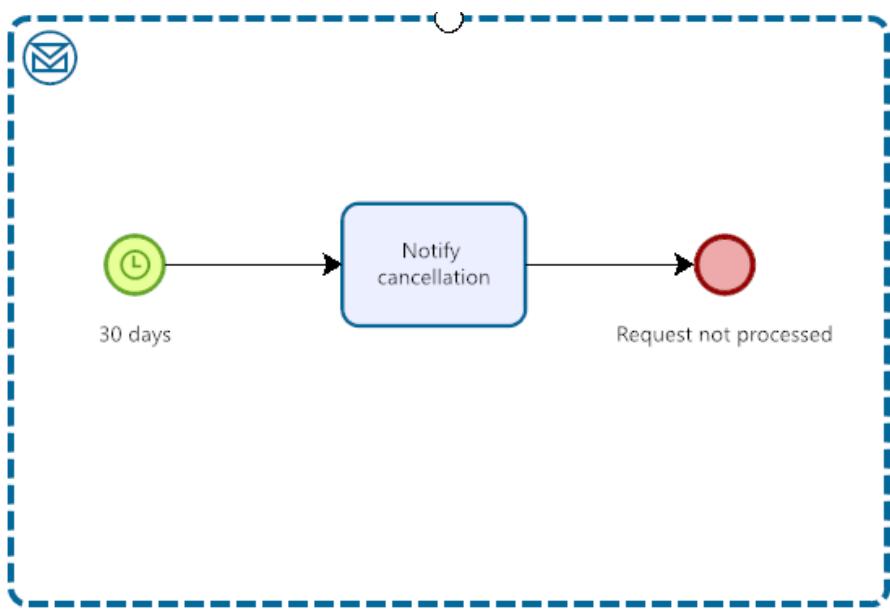
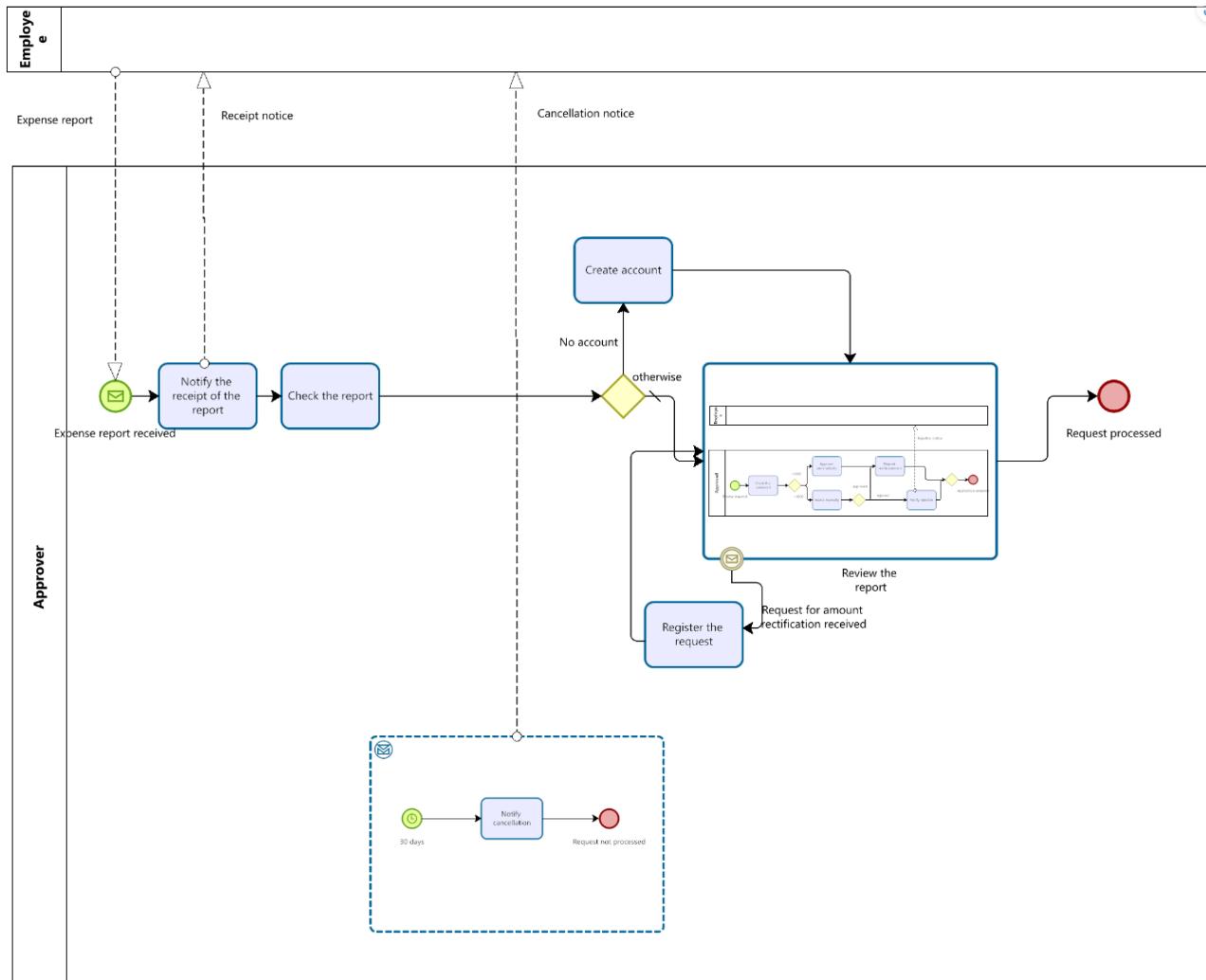
- An alternative notation to boundary events
- It is started by the event which would be attached to the boundary of an activity, encloses the procedure that would be triggered by the boundary event, and must conclude with an end event
- It does not need to refer to a specific activity, but can model an event that occurs during the execution of the whole process
- When a boundary event is needed for the entire process, use event sub process
- The event subprocess is depicted within a dotted rectangle with rounded corners which is placed into an expanded sub-process or into the top-level process
- The start of an event sub-process can be either interrupting or non interrupting
- All synthetic rules (eg. it has start and end event, it is self contained, etc.) apply to the event sub process except boundary events
- It cannot be connected to the main process as well.

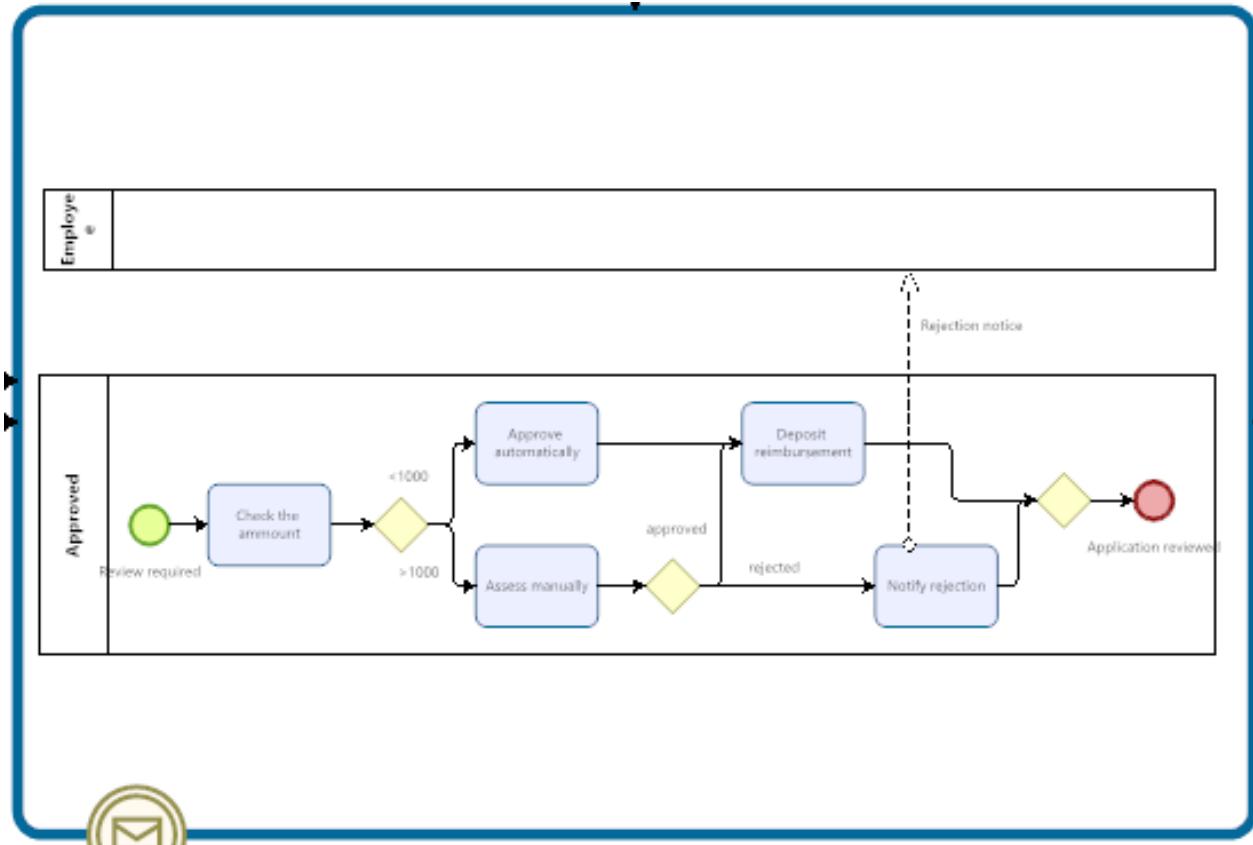


Exercise 3.9

Model the following process.

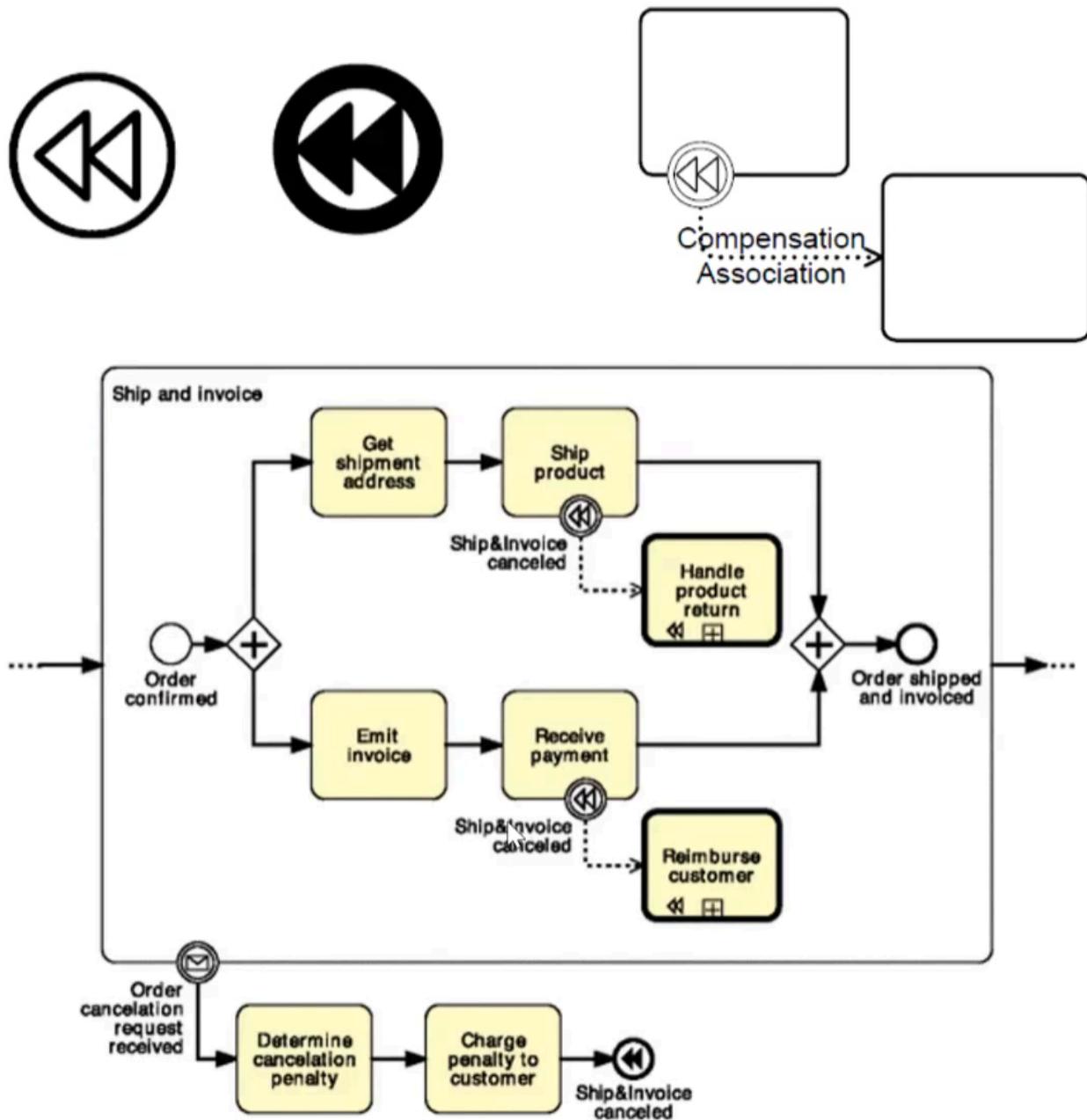
After an Expense report is received from an employee, the employee is notified of the receipt of the report. Next, a new account must be created if the employee does not already have one. The report is then reviewed for automatic approval. Amounts under €1,000 are automatically approved while amounts equal to or over €1,000 require manual approval. In case of rejection, the employee must receive a Rejection notice by email. In case of approval, the reimbursement is deposited directly to the employee's bank account. At any time during the review, the employee can send a Request for amount rectification. In that case the rectification is registered and the report needs to be reviewed again. Moreover, if the report is not handled within 30 days, the process is stopped and the employee receives a Cancelation notice email so that he can re-submit the expense report from scratch.





Activity compensation

- Compensation is to undo one or more activities that have been completed
- A compensation handler throws a compensation event the event is then caught by a catching intermediate compensation event and the compensation activity is then triggered
- Used for things like return goods or refund
- It is attached to the boundary of the sub process and will activate the compensation association. It also does not use any end or termination event.



Multiple events

- Multiple event indicates that there are multiple triggers assigned to the event
- Eg. if event A or event B or event C happens, then this trigger is done
- When attached to the boundary of an activity, the event can only “catch” the trigger. In this case, only one of the assigned triggers is required
- Can be interrupting or non-interrupting



Parallel multiple event

- There are multiple trigger assigned to the event
- Eg. if event A and event B and event C happens, then this trigger is done
- When attached to the boundary of an activity, the event can only “catch” the trigger
- All of the assigned triggers are required for the event to be triggered
- Can be interrupting or non-interrupting



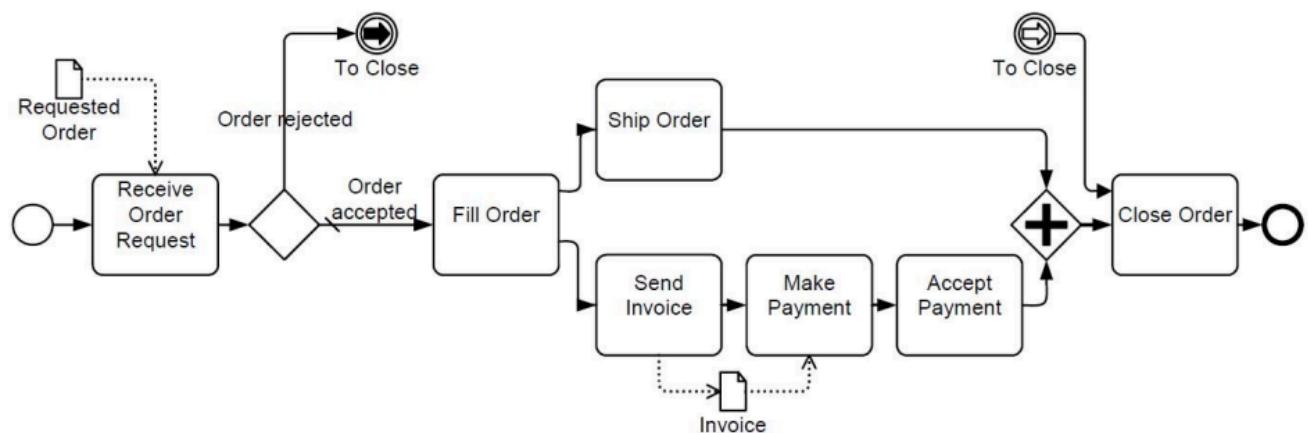
Cancel event

- An attached intermediate catching cancel event on the boundary of a transaction subprocess, or for short, a cancel boundary event and is triggered when a transaction is cancelled
- When it is triggered, it first interrupts all active execution in the current scope. It then starts compensation of all active compensation boundary events in the scope of the transaction.



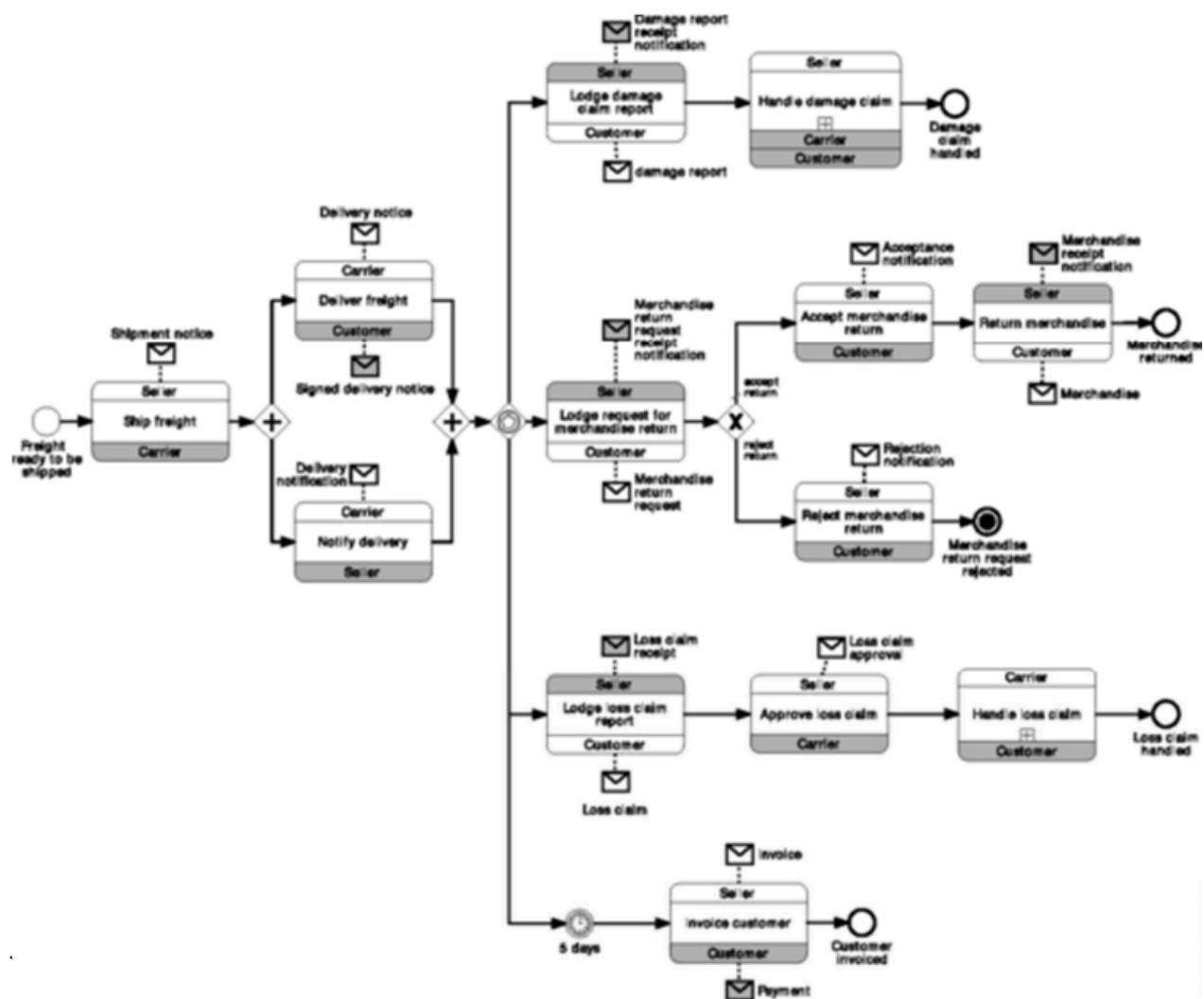
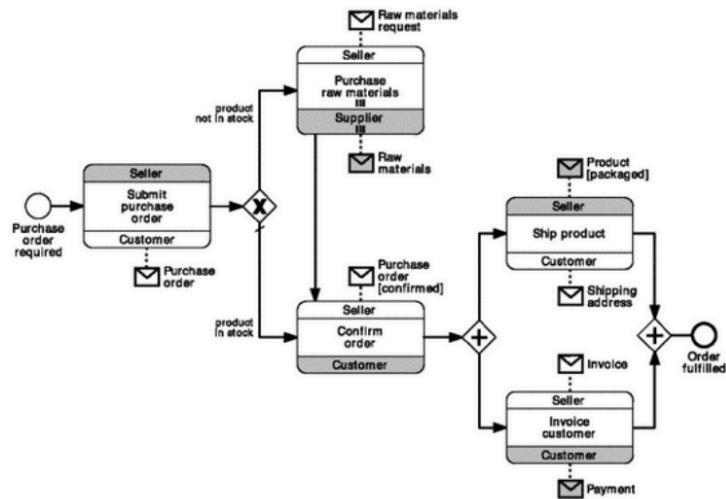
Link event

- A link event has no special execution semantics but serves as a “GoTo” to another point in the same process model. It also be used “Off-Page Connectors” for printing a process across multiple pages
- There can be multiple source link events, but there can only be one target link event.
- It can be used to create looping situations or to avoid long sequence flow lines.
- They cannot link a parent process with a sub process



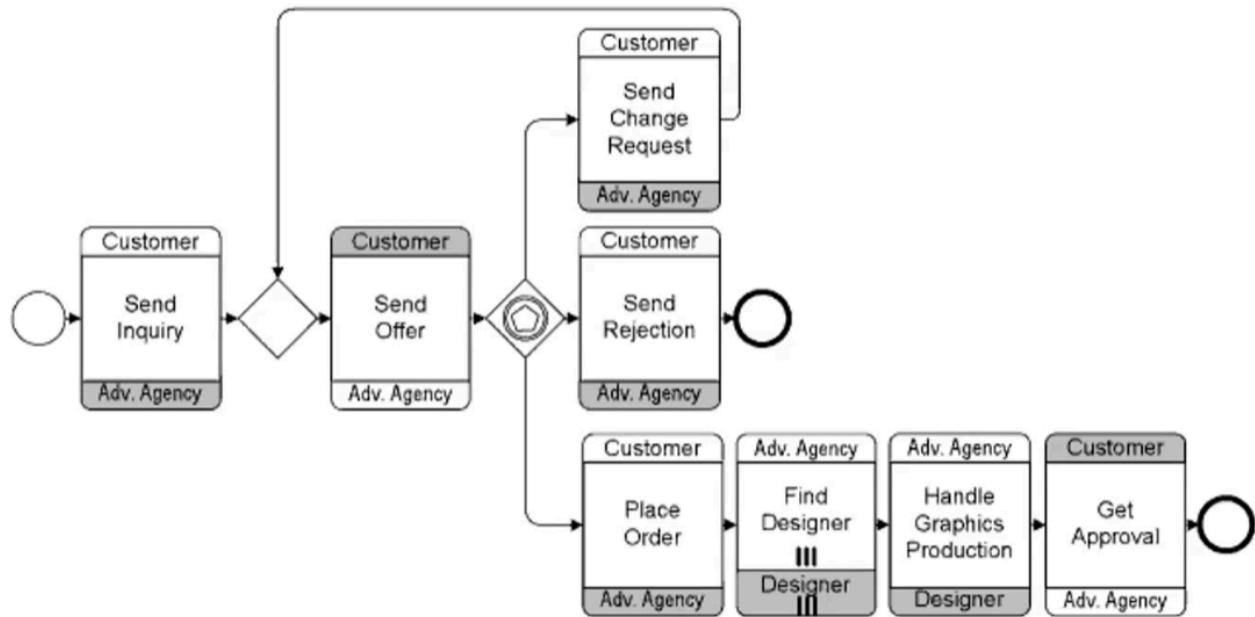
Process Choreography

- When modelling business collaborations, we need to first focus on interactions that have to occur among all involved parties, and on the order in which these interactions can take place
- A process choreography diagram is the process model is a process model of the interactions occurring between two or more parties
- It needs a start and an end event
- It is represented by an interaction which can be either one way or two way
- Each interaction has an initiator and a recipient which are represented as two bands (light band for initiator and darkened band for recipient), one at the top and one at the bottom
- An envelope attached to a band represents a message. It is darkened if it is a return message of a two way interaction
- A precedence relation between two interactions can only be established if the initiator of the second interaction is involved in the preceding interaction. This is because only when the initiator of the second interaction is involved in the first interaction, he or she will then know that the first interaction has completed. Otherwise the initiator of the second interaction would not know that the first interaction has completed.
- First interaction can be initiated by any party in the process
- If there are no other dependencies then it has to end
- An XOR split models the outcomes of an internal decision that is taken by one party
- All interactions immediately following the split must be initiated by the party who took the decision
- The event based XOR split is used when the data to make a choice are not exposed through an interaction before the split. (The interactions following an event-based split must either have the same sender or the same receiver)
- Complex interactions involving more than one business party are modelled via a sub-choreography activity
- This activity is represented with the plus symbol and many have multiple bands representing all roles involved
- Artefacts cannot be explicitly expressed (eg. data store)
- Pools, resources, artefacts are not included. Just the gateway and decision points



Example

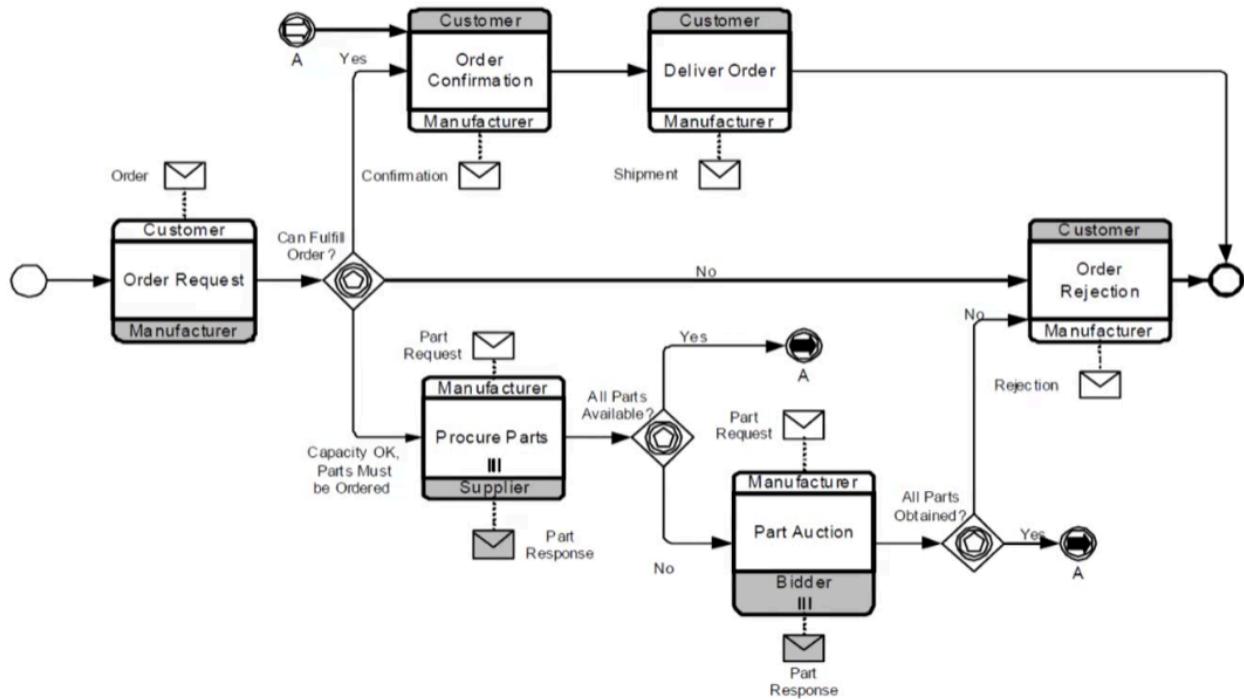
Use plain english to describe how the interactions take place in this process? (Past exam question)



When the process starts, the customer will send an inquiry to the agency. The agency will then send an offer to the customer. Based on the customer response, there are 3 possible outcomes. If the customer sends a change request, the agency will send another offer to the customer. If the customer rejects, the process will end. Lastly when the customer places an order, the agency will find a designer from a list and a designer will accept the request. The agency will pass the specification the customer needs to the designer and the designer will send back the final product. The agency will then show the customer the final product and seek approval. The process ends when the customer approves.

Example

Use plain english to describe how the interactions take place in this process? (Past exam question)



The process starts when a customer sends an order request. The manufacturer then decides whether they can fulfil this order. If yes, the order will be confirmed by the manufacturer and a confirmation message will be sent to the customer. The order will then be shipped by the manufacturer to the customer and the process ends. If no, the manufacturer will reject the order and send a rejection letter to the customer. If there is capacity to manufacture the product but not enough parts, the manufacturer will send requests for parts from multiple suppliers. There are 2 possible outcomes. If the parts are available, the order will be fulfilled. Followed by shipping the product to the customer. If the parts are not available, the manufacturer will send the part requests to multiple bidders. If parts are obtained, the order will be fulfilled. Otherwise, the order will be rejected.

(don't need to say message)

Quality Assurance

Quality of a BPMN model is approached from 3 different perspective

Semantic quality - Validation

- Compare the model with the real world domain of a particular business process and ensure that the model reflects the process in a real world business process correctly and include every statement of the processes.
- Can only be assessed by talking to domain experts
- Ensure the model makes true statements about the considered domain
 - Validity: all statements are correct and relevant to the problem
 - Completeness: the model contains all relevant statements on a process
- Interaction between the domain expert and the process analyst

Pragmatic quality - Certification

- Depends if the model have good usability
- Understandability: how easy is it to read a process model?
- Maintainability: how easy it is to apply a change to a process model?
- Learning: how good a process model reveals how a business process works in reality?
- Many factors will contribute to pragmatic quality
- Pay attention to the size, structural complexity, and graphical layout. The cosmetic aspect of the model makes a big difference

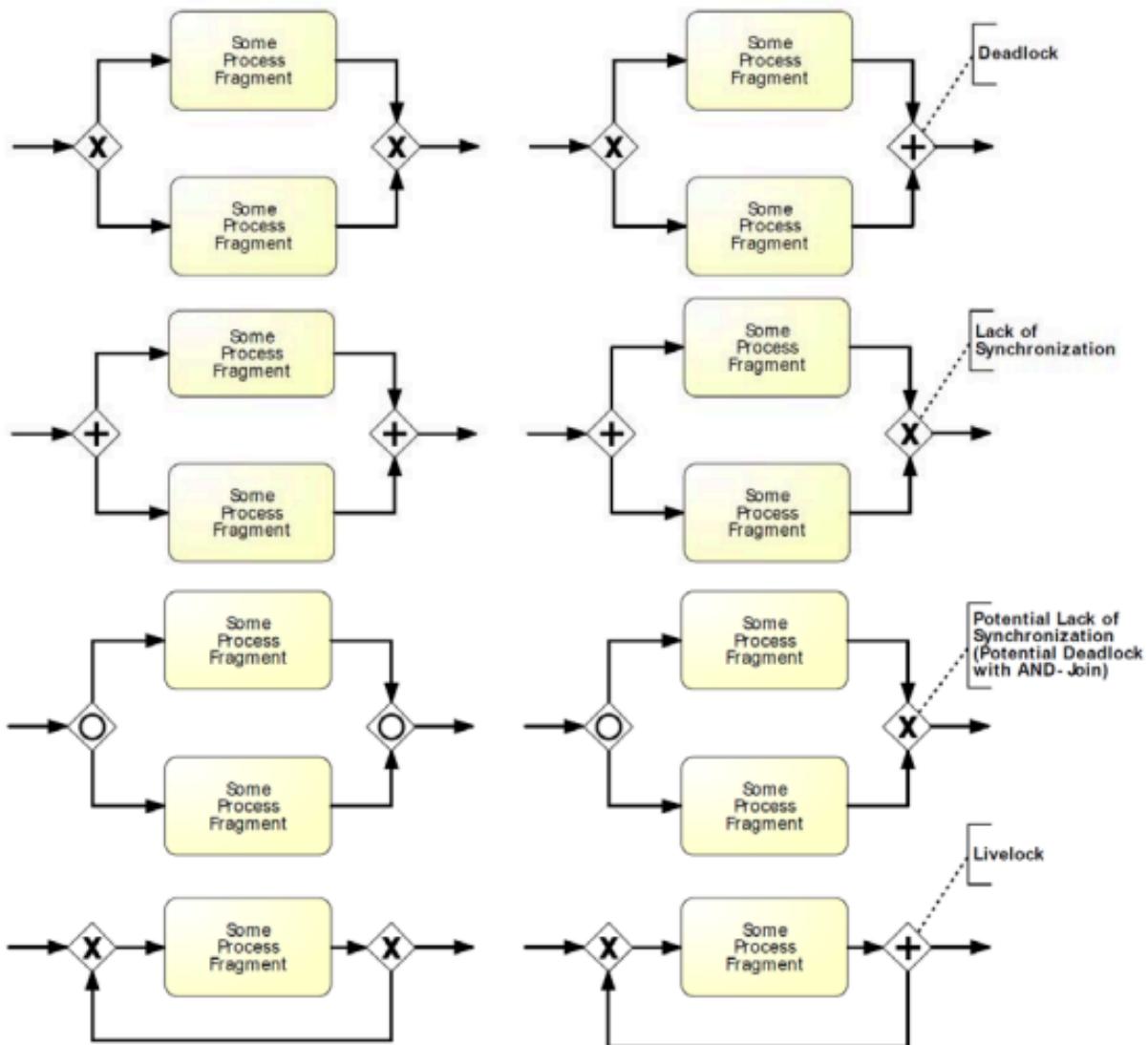
Seven process modelling guidelines

- G1: Use as few elements in the model as possible
- G2: Minimise the routing paths per element
- G3: Use only one start and end event (not always possible)
- G4: Model as structured as possible (Left side of the diagram at the bottom)
- G5: Avoid OR routing elements (OR refers to inclusive or)
- G6: Use verb-object activity labels
- G7: Decompose a model with more than 30 elements

Syntactic quality - Verification

- Address the properties of the model that can be checked without knowing what the real world process is. So anyone can check the quality of the model without knowing what it is.
- Model should start with one or more start events and end with one or more end events, every element must be on the path from start to end event, sequence flow cannot cross the boundary of the pool and subprocesses etc.
- Structural correctness which relates to the types of elements that are used and how they are connected
- Behavioural correctness which relates to potential sequences of execution as defined by the process model should not lead to abnormal behaviours (deadlocks and livelocks)
- Label activities, events and condition adequately
 - Activities as Verb-Object
 - Event as Object -Passive-Participle
 - Condition with reference to object

Deadlock, Livelock, Synchronisation Models



Lecture 5

Process Analysis

To understand the problems with the current model. The causes, impact, solution, priorities, etc., of the problems.

Output:

- Weakness of the process and their impact. The insights will naturally lead to remedies that can be designed in the process redesign phase to address the issues

Qualitative Process Analysis

Value-added analysis

- Idea comes from lean technology originated from Toyota to make the process leaner
- Value classification
 - Classifying different steps in a process into different categories in terms of what value they contribute to the process if any
 - A step could be smaller than a task or a task if it is simple.
 - If a task is composite, it can be decomposed into several steps. It could be a handover (Means when 1 task is completed, the work is handed to the next one that involves the manual handover or internal mail) between two tasks.
 - Identify the customer and know what are the positive outcomes. Customer is the one that pays for the process and will be the most dissatisfied if the process ends in a negative outcome
 - Understanding the customer and their positive outcomes is most important before analysing the value of each step
- Waste elimination

Value classification

- Steps that directly contribute to positive outcomes (Value-adding steps (VA))
- Steps that do not directly add value to the customer but they are necessary for the business (Business value-adding steps (BVA))
- Steps that do not fall into the above categories (Non-value adding steps (NVA))

Exercise 5.1

BuildIT is a construction company specialised in public works (roads, bridges, pipelines, tunnels, railroads, etc.). Within BuildIT, it often happens that engineers working at a construction site (called site engineers) need a piece of equipment, such as a truck, an excavator, a bulldozer, a water pump, etc. BuildIT owns very little equipment and instead it rents most of its equipment from specialised suppliers. The existing business process for renting equipment goes as follows. When site engineers need to rent a piece of equipment, they fill in a form called "Equipment Rental Request" and send this request by email to one of the clerks at the company's depot. The clerk at the depot receives the request and, after consulting the catalogues of the equipment suppliers, selects the most cost-effective equipment that complies with the request. Next, the clerk checks the availability of the selected equipment with the supplier via phone or email. Sometimes the selected option is not available and the clerk has to select an alternative piece of equipment and check its availability with the corresponding supplier.

Once the clerk has found a suitable piece of equipment available for rental, the clerk adds the details of the selected equipment to the rental request. Every rental request has to be approved by a works engineer, who also works at the depot. In some cases, the work engineer rejects the equipment rental request. Some rejections lead to the cancellation of the request (no equipment is rented at all). Other rejections are resolved by replacing the selected equipment with another equipment—such as a cheaper piece of equipment or a more appropriate piece of equipment for the job. In the latter case, the clerk needs to perform another availability enquiry. When a works engineer approves a rental request, the clerk sends a confirmation to the supplier. This confirmation includes a Purchase Order (PO) for renting the equipment. The PO is produced by BuildIT's financial information system using information entered by the clerk. The clerk also records the engagement of the equipment in a spreadsheet that is maintained for the purpose of tracking all equipment rentals.

In the meantime, the site engineer may decide that the equipment is no longer needed. In this case, the engineer asks the clerk to cancel the request for renting the equipment. In due time, the supplier delivers the rented equipment to the construction site, the site engineer then inspects the equipment. If everything is in order, the engineer accepts the engagement and the equipment is put into use, in some cases, the equipment is sent back because it does not comply with the requirements of the site engineer. In this case, the site engineer has to start the rental process all over again.

When the rental period expires, the supplier comes to pick up the equipment. Sometimes, the site engineer asks for an extension of the rental period by contacting the supplier via email or phone 1- 2 days before pick-up. The supplier may accept or reject this request. A few days after the equipment is picked up, the equipment's supplier sends an invoice to the clerk by email. At this point, the clerk asks the site engineer to confirm that the equipment was indeed rented for the period indicated in the invoice. The clerk also checks if the rental prices indicated in the invoice are in accordance with those in the PO. After these checks, the clerk forwards the invoice to the financial department and the finance department eventually pays the invoice.

Consider the process for equipment rental

- What steps are value adding?
- What steps are business value adding?
- What steps are non value adding?

Step	Performer	Classification
Fill request	Site Engineer	VA
Send request to clerk	Site Engineer	NVA
Open and read request	Clerk	NVA
Select suitable equipment	Clerk	VA
Check equipment availability	Clerk	VA
Record recommended equipment and supplier	Clerk	BVA
Forward request to works engineer	Clerk	NVA
Open and examine request	Works Engineer	BVA
Communicate issues	Works Engineer	BVA
Forward request back to clerk	Works Engineer	NVA
Produce PO	Clerk	BVA
Send PO to supplier	Clerk	BVA

Waste Elimination

Minimise or eliminate NVA steps

- Using automation
- Radically redesigning the process

Before eliminating BVA

- Check what is the minimum amount of work required to perform the process to the satisfaction of the customer, while fulfilling the goals and requirements associated with BVA steps in the process?
- Does it compromise the achievement of the business goals? Does it compromise the achievement of business requirements? Does that compromise the compliance with any legal requirements or financial requirements? Etc.
- Find balance and a trade off. Map the BVA to business goals and requirements and see which are the important ones and which can be targeted for elimination.

Exercise 5.3

Consider the process for equipment rental described above

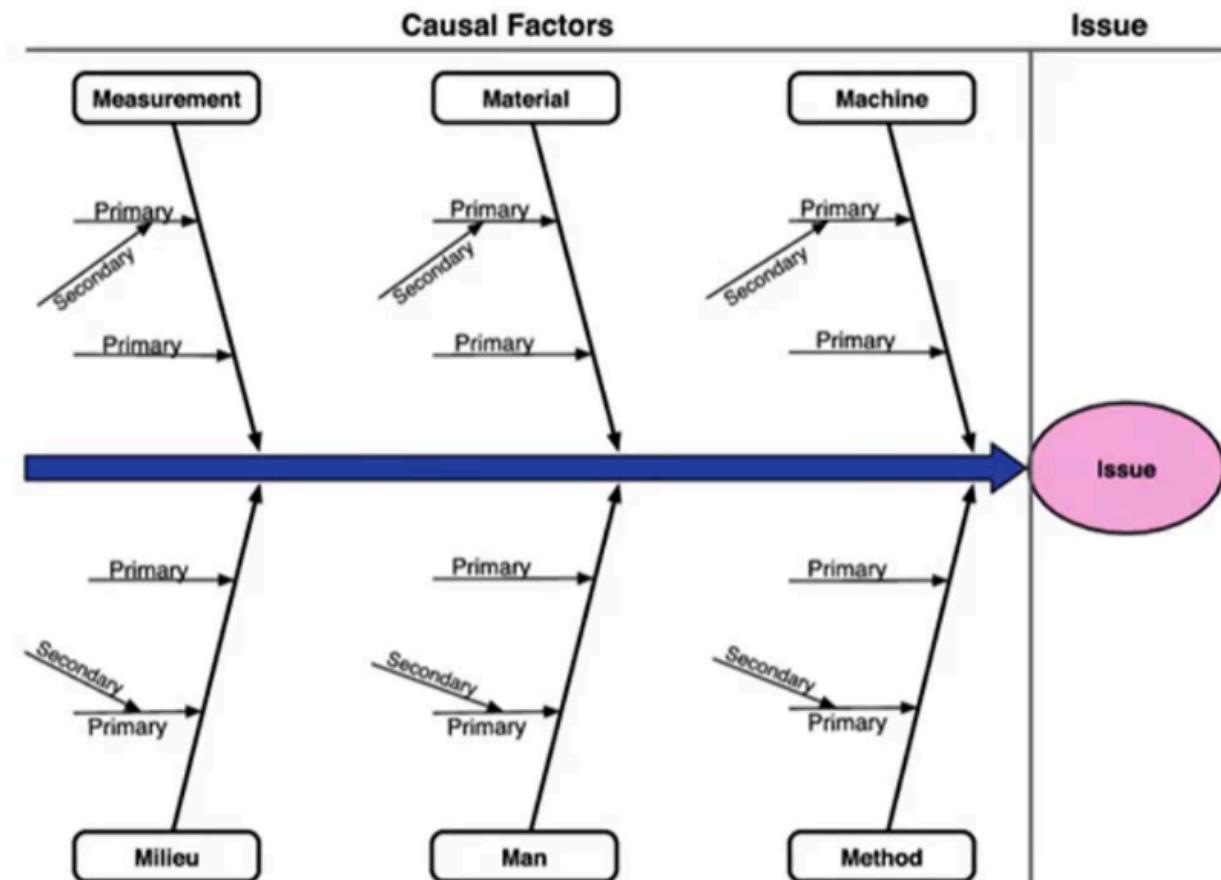
- What steps can be eliminated in your view?

We can let the site engineer view the catalogue and select suitable equipment without the help of a clerk.

We can automatically approve decisions of renting equipment if they are below a certain cost and only bigger equipments need approval from works engineer

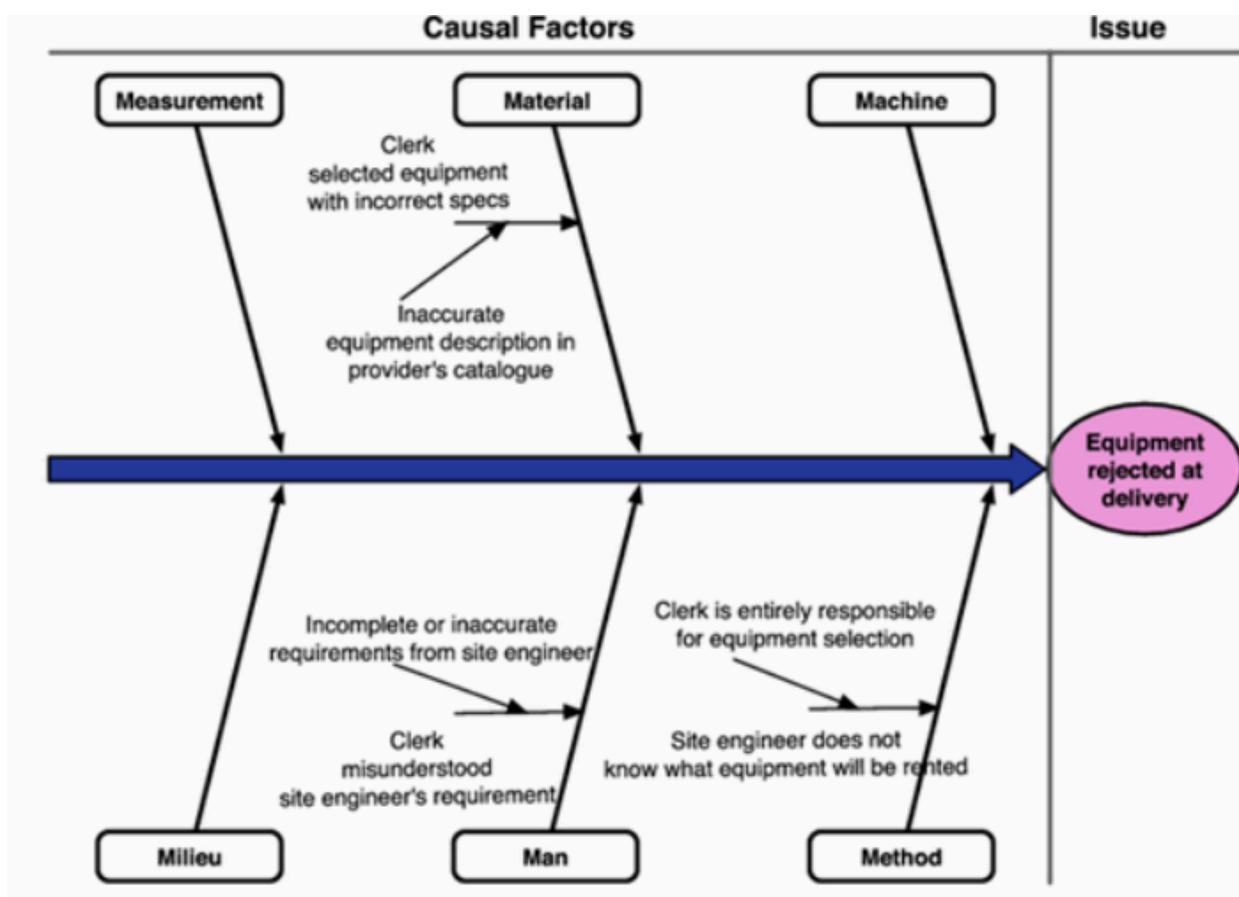
Root cause analysis

- Identify and analyse the weak parts of the process and as well as the root cause.
- Many factors contributing to the (negative) effect
 - Causal factors (If the factors are eliminated, the issue will not happen again)
 - Contributing factors (Increases the chance of a given problem occurring and if addressed, it will not be completely removed)
- **Cause-effect diagrams**
 - Finds the relationship between a given negative effect and its causes.
 - Factors that are grouped into categories - 6M
 - Machine (All factors that are related to technology. Eg. software failure, network failure, system crash, application lack functionality, poor UI, etc.)
 - Method (All factors related to the way the process is designed, understood or performed. Eg. If every small little decision needs to be made by the manager, there is a lack of empowerment of the participant and wastes a lot of time in seeking for permission)
 - Material (All factors related to the input. Eg. raw material, import data. If incorrect, inconsistent, inaccurate, not updated, not timely, etc.)
 - Man (All factors related to human resource. Eg. not enough manpower, not enough training)
 - Measurement (All factors that are related to the calculation measurements within the process. Eg. any measurements that are not perfect.)
 - Milieu (All factors that are related to the environment and is out of our control)
 - Categories are meant as guidelines for brainstorming during root cause analysis
 - The cause effect diagram/fishbone diagram below is used
 - The primary factors are the factors that have a direct impact on the issue
 - The secondary factors are the factors that have impact on the primary factors



Exercise 5.4

Consider the process for equipment rental described above. During an audit of this process, several issues were identified. One site engineer finds that the equipment delivered at the construction site is often not suitable. Hence it has to be rejected. One clerk claims that the site engineers generally do not specify their requirements in sufficient detail. Other clerks blame the suppliers for giving inaccurate information in their catalogues. On the other hand, site engineers complain that they are not consulted when there are doubts regarding the choice of equipment. Draw a cause-effect diagram to identify causes for the issue.



Through analysing the causes and factors that contributed to the negative outcome, analysts can have a good understanding about why the equipment is rejected. The next step is to understand the impact of these different issues. Out of 100 rejections, how many are caused by material, or by man etc. So the idea of the impact is needed before the redesigning part

- **Why-why diagrams**

- Recursively asking “why” questions to pin down the root cause
- Also known as 5 whys, because in most cases, the root cause can be found after asking why 5 times

Exercise 5.5

Consider the process for equipment rental described above

Use the why-why diagrams to identify the causes for the following issues

- Site engineers sometimes reject delivered equipment, why?
 - Wrong equipment is delivered, why?
 - Miscommunication between site engineer and clerk, why?
 - Site engineer only provides brief/inaccurate descriptions of what they want
 - Site engineer does not (always) see the supplier catalogues when making a request and does not communicate with the supplier, why?
 - Site engineer does not have internet connectivity
 - Site engineer does not check the choice of equipment made by the clerk
 - Equipment descriptions in supplier's catalogue not accurate
 - Site engineers keep equipment longer than needed via deadline extensions, why?
 - Time between request and delivery is too long, why?
 - Excessive time spent in finding a suitable equipment and approving the request
 - Time spent by clerk contacting possibly multiple suppliers sequentially
 - Time spent waiting for work engineer to check the request
 - Build IT often has to pay late payment fees to suppliers, why?
 - Time between the invoice received by the clerk and confirmation is too long, why?
 - Clerk needs confirmation from the site engineer, why?
 - Clerk cannot assert when the equipment was delivered and picked up, why?
 - Delivery and pickup of equipments are not recorded in a shared information system
 - Site engineer can extend the equipment rental period without informing the clerk
 - Site engineer takes too long to confirm the invoice, why?
 - Confirming invoices is not the priority of the site engineers

Issue documentation and Impact assessment

- Analysing the impact of the issues that is identified in order to prioritise the redesigned efforts
- A process may suffer from many issues but it is not possible to address all of them.
- 2080 philosophy, 20% of the causes will cost 80% of the impact. This is used to try identify the most important issues to prioritise more important issues
- Issues register
- Pareto analysis and PICK charts

Issue register

How and to what extent each issue is impacting on the performance of the process. Helps to understand the impact of the issues and analyst can focus on the issues that matter most to the organisation

- Quantitative impact such as time loss, money loss
- Qualitative impact such as nuisance to the customer

Can contain a combination of issues and factors

- Name
- Priority
- Description
- Assumption
- Qualitative Impact (Impact caused but cannot be measured by money)
- Quantitative Impact (Impact caused and can be measured by money)
- Possible resolution
- Caused by
- Is cause of

Table 6.2 Issue register of equipment rental process

Issue 1: Equipment kept longer than needed
Priority: 1
Description: Site engineers keep the equipment longer than needed by means of deadline extensions
Assumptions: BuildIT rents 3000 pieces of equipment per year. In 10 % of cases, site engineers keep the equipment two days longer than needed to avoid disruptions due to delays in equipment rentals. On average, rented equipment costs € 100 per day
Qualitative impact: Not applicable
Quantitative impact: $0.1 \times 3000 \times 2 \times € 100 = € 60,000$ in additional rental expenses per year
Issue 2: Rejected equipment
Priority: 2
Description: Site engineers sometimes reject the delivered equipment due to non-conformance to their specifications
Assumptions: BuildIT rents 3000 pieces of equipment per year. Each time an equipment is rejected due to a mistake on BuildIT's side, BuildIT is billed the cost of one day of rental, that is € 100. 5 % of them are rejected due to an internal mistake within BuildIT (as opposed to a supplier mistake)
Qualitative impact: These events disrupt the construction schedules and create frustration and internal conflicts
Quantitative impact: $3000 \times 0.05 \times € 100 = € 15,000$ per year

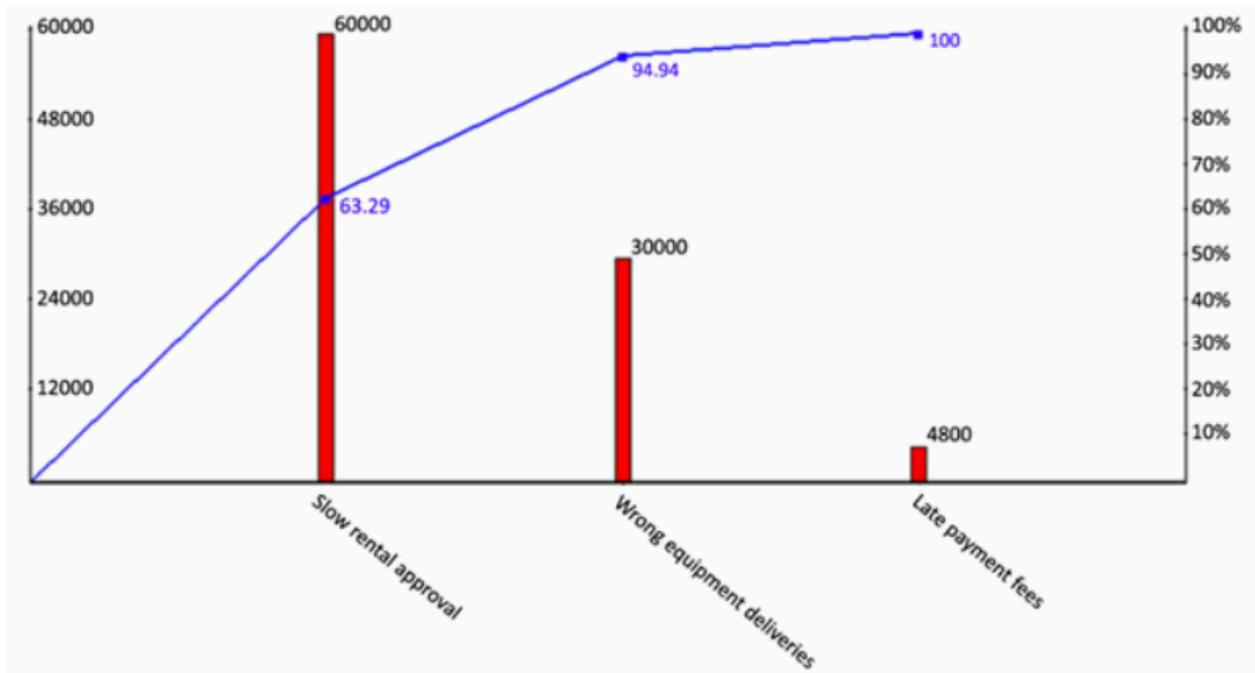
Pareto analysis

Uses the assumptions in issue register, to compile and create a graphical representation for easier understanding.

A small number of factors are responsible for the largest share of a given effect

A Pareto chart consists of

- A bar chart where each bar corresponds to an issue
- A curve that plots the cumulative percentage impact



PICK charts

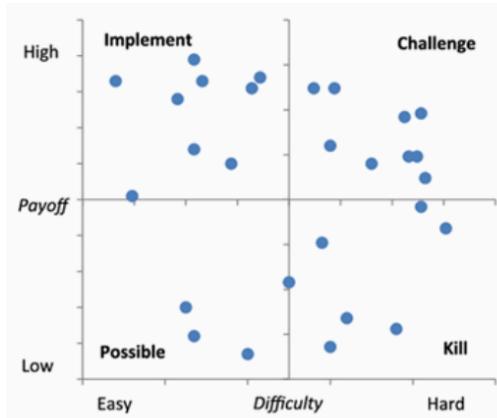
Need to consider both payoff and levels of difficult when deciding which issues should be given higher priority

A PICK chart is a four quadrant chart where each issue appears as a point.

- X axis: difficulty level
- Y axis: payoff

Trade offs

- Possible: if there are sufficient resources
- Implement: definitely implemented
- Challenge: Should be addressed but challenging
- Kill: not worth addressing



Quantitative analysis

- More detailed and more precise analysis based on performance measures
- Analyse the business process quantitatively in terms of the performance measures such as cycle time of the process
- Measure the cycle time of the current process as well as the cycle time of the redesigned option to see how much the cycle time will improve
 - Flow analysis
 - Queueing analysis

Process performance dimensions

- Time - Cycle time (Make it faster)
 - Time that it takes to handle one case from start to end
 - One can focus on average cycle time, maximal cycle time, cycle time variation, etc.
 - Processing Time: The time that resources spend on actually handling the case
 - Waiting Time: The time that a case spends in idle mode
 - Queueing time: waiting time due to the fact that no resources available to handle the case or synchronisation problem where the case had been complete but cannot move on as there are certain activities not completed yet
- Cost - Operational cost (Make it cheaper)
 - Cost is the financial nature of the business process including turnover, yield, or revenue
 - Fixed costs (such as use of infrastructure, maintenance of information etc.) are overhead that are not affected by the intensity of processing
 - Variable costs are correlated with some variable quantity, such as the level of sales, the number of new hires, etc.
 - Operational costs that include labour costs are directly related to the output of the business process. Labour cost is often the focus.
 - Fixed cost and variable cost
- Quality (Make it better)
 - External quality
 - Measured by the client's satisfaction with either the product or the process
 - In terms of product, to what extent does the customer feel that the specification or expectations are met by the delivered product.
 - In terms of process, to what extent does the customer's expectations are met in terms of how the process is executed. As a customer, what do you want the business to do in their process? Eg. get more information about the order after it is placed, like the order status, time, the accuracy of information.
 - Depends on the variation of work that is performed to the level of experience
 - Internal quality

- Relates to the process participants' viewpoint (not discussed in detail)
- **Flexibility**
 - The ability of resources to execute different tasks within a business process setting. Eg. More generalist means the participant can do many types of work and the process is more flexible than to have specialist that is only able to do certain tasks which makes it inflexible
 - If there are too many generalists, assign them the same work so that they can practise and grow to be specialists. If there are too many specialists, consider training them to have more skill sets so that they can become generalists.
 - The ability of a business process as a whole to handle various cases and changing workloads
 - The ability of the management in charge to change the used structure and allocation rules
 - The organisation's ability to change the structure and responsiveness of the business process to wishes of the market and business partner
 - Flexibility is often the balance of the ratio or the trade off between generalist and specialist

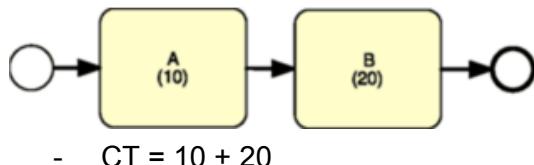
Flow Analysis

- A family of techniques that allow us to estimate the overall performance of a process given some knowledge about the performance of its activity
- Typically used to calculate the average cycle time of a process given the knowledge about the average cycle time of activities which means on average how long will it take for activity to be performed. Then calculate the average time it takes to perform the process.
- Calculation of average cost of a process knowing the cost per execution or the error rate given the error rate per activity is possible,
- Cycle time is focused in this module

Calculating cycle time

Sequential Fragment

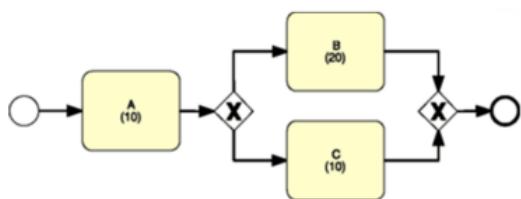
- Sum of activities in the process



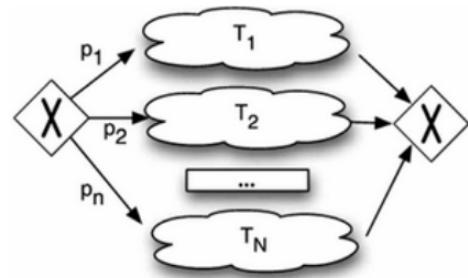
- $CT = 10 + 20$

XOR-Split and XOR-Join Fragment

- Weighted average of the cycle time of the branches in between

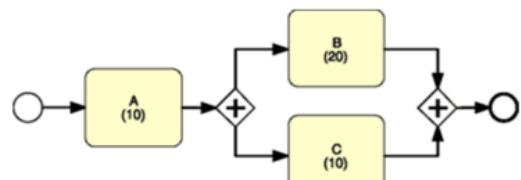


$$- CT = 10 + (P_b \times 20) + (P_c \times 10)$$



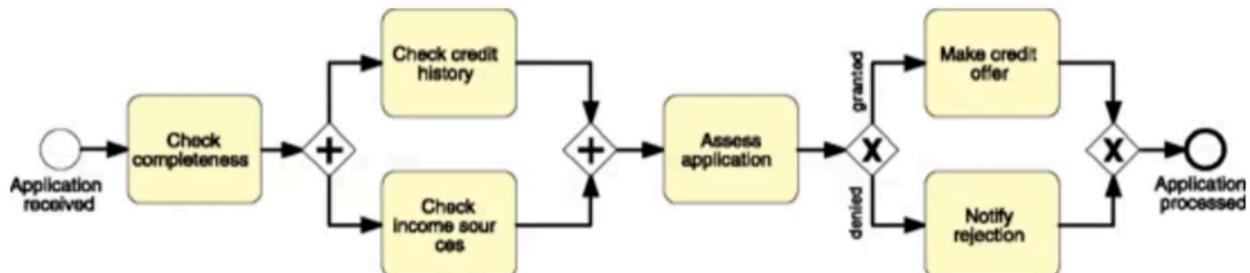
AND-Split and AND-Join Fragment

- Cycle time of the slowest branch in the process



$$- CT = 10 + 20$$

Exercise 5.5



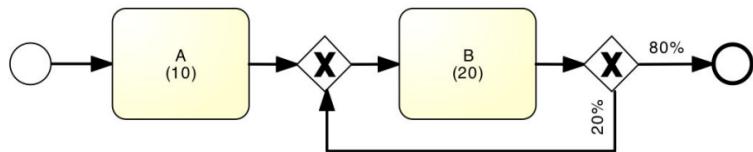
What is the average cycle time if the credit is granted to 60% of the cases.

Activity	Cycle Time
Check Completeness	1 Day
Check Credit History	1 Day
Check Income Sources	3 Days
Assess Application	3 Days
Make Credit Offer	1 Day
Notify Rejection	2 Days

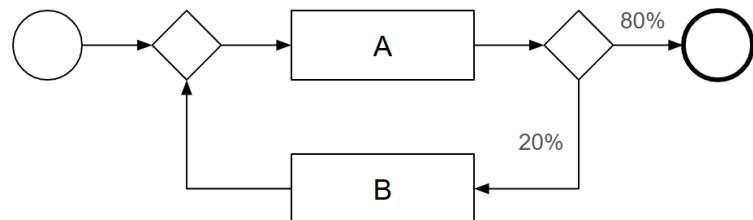
$$CT = 1 + 3 + 3 + (0.6 \times 1) + (0.4 \times 2)$$

Repetition Fragment

- Cycle time of fragment that might be repeated multiple times
- $CT = T/(1-r)$
- T is the cycle time of activity in the repeated process (B in the diagram below) and r is the probability where it will repeat again.

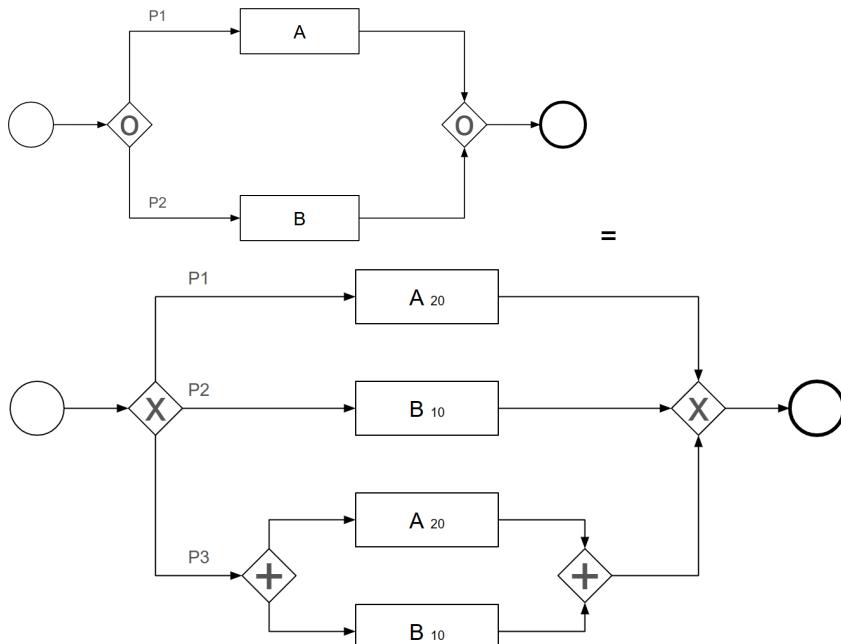


$$- CT = 10 + 20/(1 - 0.2)$$



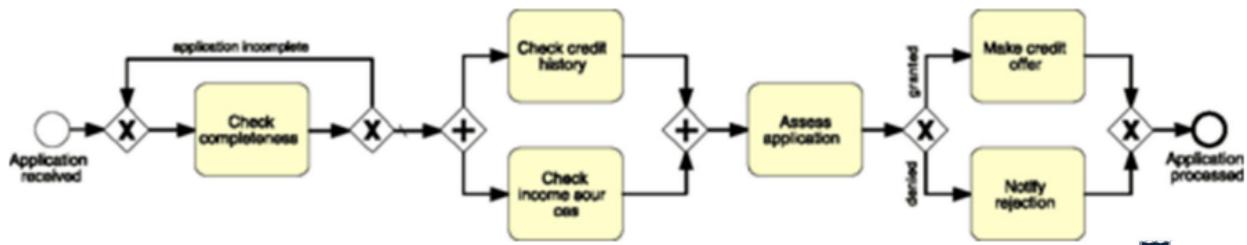
$$\begin{aligned} - CT &= (T_b + T_a) / (1 - r) - T_b \\ &= (T_b + T_a) / (1 - 20) - T_b \end{aligned}$$

Inclusive OR



$$- CT = (P1 \times 20) + (P2 \times 10) + (P3 \times 20)$$

Exercise 5.6



Let us also assume that in 20 % of the cases, the application is incomplete and in 60 % of cases the credit is granted.

Activity	Cycle Time
Check Completeness	1 Day
Check Credit History	1 Day
Check Income Sources	3 Days
Assess Application	3 Days
Make Credit Offer	1 Day
Notify Rejection	2 Days

$$CT = 1/(1-0.2) + 3 + 3 + (0.6 \times 1) + (0.4 \times 2)$$

Cycle time efficiency

- CTE = TCT / CT
- Theoretical processing time divided by the overall cycle time
- If it is close to 1 indicates that there is little room for improving the cycle time
- If it is close to 0 indicates that there is significant amount of room for improvement
- Theoretical processing time is calculated by using the processing time of each activity and the overall cycle time is the processing time + waiting time.
- Using the example above, checking completeness takes 1 day but the processing time might be 10 minutes. So the efficiency is 10 mins / 1 day.

Work-In-Progress

- The arrival rate (λ) is the average number of new instances of the process that are created per time unit
- Eg. A restaurant receives 200 orders per day, 200 is the arrival rate
- WIP is the average number of instances of a process that are active at a given point in time which means that the instance is not completed yet.
- $WIP = \lambda \times CT$
- WIP increases if the arrival rate or cycle time increases. If arrival rate increase (more customer and we would like to keep WIP the same, we have to decrease the cycle time

Exercise 5.6

A fast-food restaurant receives on average 1200 customers per day (between 10:00 and 22:00). During peak times (12:00- 15:00 and 18:00-21:00), the restaurant receives around 900 customers in total, and 90 customers can be found in the restaurant (on average) at a given point in time. At non-peak times, the restaurant receives 300 customers in total, and 30 customers can be found in the restaurant (on average) at a given point in time.

1. What is the average time that a customer spends in the restaurant during peak times?

$$900 / 6 = 150$$

$$90 = 150 \times CT$$

$$CT = 90/150$$

$$= \frac{1}{6} \text{ hrs}$$

2. What is the average time that a customer spends in the restaurant during non-peak times?

$$300 / 6 = 50$$

$$30 = 50 \times CT$$

$$CT = 30 / 50$$

$$= \frac{3}{50} \text{ hrs}$$

3. The restaurant plans to launch a marketing campaign to attract more customers. However, the restaurant's capacity is limited and becomes too full during peak times. What can the restaurant do to address this issue without investing in extending its building?
Attracting more customers means increasing lambda. By not investing in extending the building, WIP needs to remain the same. That means CT needs to decrease

Calculating cost, or error rate instead of cycle time is the same except for AND Split and join. For that, all the sum needs to be added up

Limitations of flow analysis

- Cannot be used to calculate the cycle time of an unstructured process model
- More complex Math equations are available but often require tool support
- Need to know the average cycle time of each activity
- Does not take into account the fact that a process behaves differently depending on the load (If the load increases but the number of resources remains constant, the waiting time will be longer. It does not take load variation into consideration. It is due to a phenomenon known as resource contention, different jobs, different case, different customers will contend for the limited resources)

Queueing theory

It addresses the problems listed above.

Mathematical technique to analyse systems that have resource contention.

Eg. In networking, a router has limited processing capacity, memory and so on. Packets will be transferred to the router and compete with the computing resource and will result in a queue. By

using queue analysis to understand, regulate, estimate the behaviours of the router to support the traffic

A queueing system consists of

- One or more queues
- A service
- One or more servers

Provides a very broad set of techniques, but we will only present two models

- M/M/1
- M/M/c

Poisson processes

- E.g, Customers arrive at a given mean arrival rate λ . The mean inter arrival time is $1/\lambda$; but, customers arrive independently so the time between the arrival of the first customer and arrival of the second customer is random. The time between the arrival of the second customer and the third customer is also random.
- If a restaurant has 60 customers per hour, that means that the mean arrival time between two customers is $1/60$, which is one minute
- The distribution of arrivals between two consecutive customers follows an exponential distribution (a.k.a a negative exponential distribution) with a mean of $1/\lambda$
- In practice, the Poisson process and exponential distribution describe a large class of arrival processes

M/M/1 and M/M/c

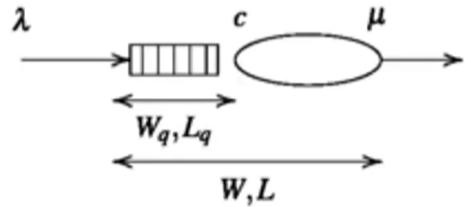
- M: Inter-arrival times of customers follow an exponential distribution
- M: Processing times follow an exponential distribution. Eg the average processing time is T. However there is a probability it will take longer than T and this probability will decrease in exponential manner when T increases. (The doctor spends 10 mins on average to see a patient. On complex cases he might take 30 mins. He might take an hour, or he might even take the whole day. But the probability of it taking longer exponentially decreases as the time he takes increases)
- 1: There is a single server
- c: There are c servers
- M stands for "Markovian"
- λ : The mean customer arrival rate per time unit (How many customer arrive per hour) (lambda)
- μ : The mean number of customer that can be served per time unit (How many customer can be served per hour) (mu)
- c: Number of servers
- ρ : Occupation rate, $\rho = \lambda / (c \times \mu)$. The system with occupation rate of more than 100% is unstable and will become longer and longer forever because the server cannot cope with the demand (rho) (If c = 1 and λ is greater than μ which means ρ is more than 100%. This means that customer is arriving more than they can be served)

Queueing theory allows the calculation of

- L_q : average number of job in the queue
 - $L_q = \rho^2 / (1 - \rho)$ (For M/M/1)

$$L_q = \frac{(\lambda/\mu)^c \rho}{c!(1-\rho)^2 \left(\frac{(\lambda/\mu)^c}{c!(1-\rho)} + \sum_{n=0}^{c-1} \frac{(\lambda/\mu)^n}{n!} \right)} \quad \text{M/M/c}$$

- W_q : average time one job spends in the queue
 - $W_q = L_q / \lambda$
- W : average time the job spends in the queue (CT)
 - $W = W_q + (1/\mu)$
- L : average number of jobs in the system (WIP)
 - $L = \lambda W$



Exercise 5.7

A company designs customised electronic hardware for a range of customers in the high-tech electronics industry. The company receives orders for designing a new circuit every 20 working days on average. It takes a team of engineers on average 10 working days to design a hardware. How many working days does it take on average for an order to be fulfilled?

$$\lambda: 1/20$$

$$\mu: 1/10$$

$$c: 1$$

$$\rho: (1/20) / (1/10) = 0.5$$

$$L_q: 0.5^2 / (1 - 0.5) = 0.5$$

$$W_q: 0.5 / (1/20) = 10$$

$$W = 10 + (1 / (1 / 10)) = 20$$

Answer = 20 days

Consider now the case where the engineering team in the previous example takes 16 working days to design a hardware. What is then the average amount of time an order takes to be fulfilled?

$$\lambda: 1/20$$

$$\mu: 1/16$$

$$c: 1$$

$$\rho: (1/20) / (1/16) = 0.8$$

$$L_q: 0.8^2 / (1 - 0.8) = 3.2$$

$$W_q: 3.2 / (1/20) = 64$$

$$W = 64 + 16 = 80$$

An insurance company receives 220 calls per day from customers who want to lodge an insurance claim. The call centre is open from 8am to 5pm. The arrival of calls follows a Poisson process. Looking at the intensity of arrival of calls, we can distinguish three periods during the day: the period 8am to 11am, the period 11am to 2pm and the period 2pm to 5pm. During the first period, around 60 calls are received. During the 11am–2pm period, 120 calls are received, and during the 2pm–5pm period, 40 calls are received. A customer survey has shown that customers tend to call between 11am and 2pm because during this time they have a break at work and they take advantage of their break to make their personal calls. Statistical analysis shows that the durations of calls follow an exponential distribution.

According to the company's customer service charter, customers should wait no more than one minute on average for their call to be answered.

Assume that the call centre can handle 70 calls per hour using seven call centre agents. Is this enough to meet the 1- minute constraint set in the customer service charter? Please explain your answer by showing how you calculate the average length of the queue and the average waiting time.

What happens if the call centre's capacity is increased so that it can handle 80 calls per hour (using eight call centre agents)?

The call centre manager has been given a mandate to cut costs by at least 20%. Give at least two ideas to achieve this cut without reducing the salaries of the call centre agents and while keeping an average waiting time below or close to one minute.

$$W_q = 1 \text{ min}$$

$$8-11 = 20 \text{ calls/hr}$$

$$11-2pm=40 \text{ calls/hr}$$

$$2-5 = 13.3 \text{ calls/hr}$$

$$\Lambda = 40$$

$$Mule = 70$$

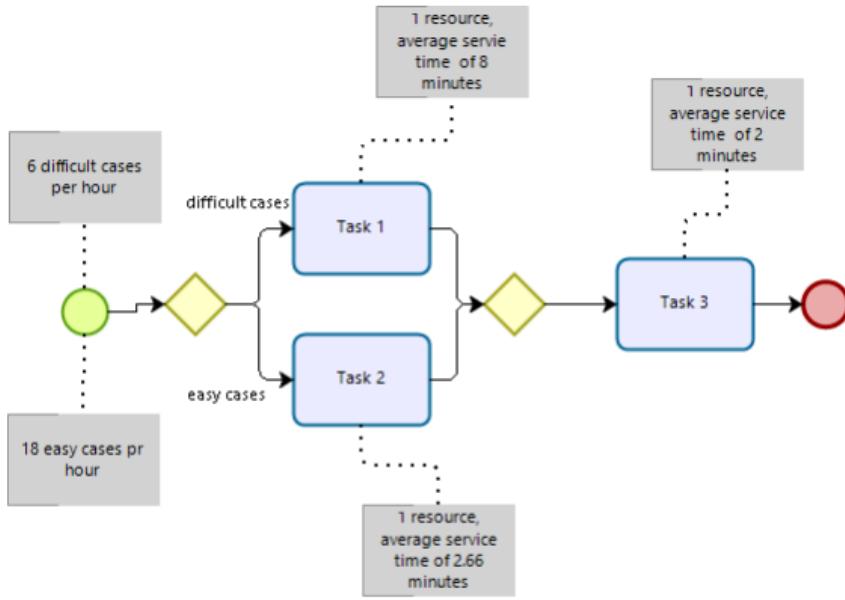
$$\rho = 40/70 = 4/7 \text{ hrs}$$

$$L_q = ((4/7)^2) / (1 - 4/7) = 16/21$$

$$W_q = (16/21)/40 = 1 \text{ min } 14\text{s}$$

Cutting cost by 20% means labour cost needs to be cut. Without reducing salary means less call agents can be used. This means reducing mule. To keep w_q close to 1 minute, the load has to be reduced so lambda needs to be reduced. To reduce lambda, the company can use a responder machine to answer queries of the customers. By doing that, customers with questions that can be answered by standard answers will be filtered out and the call centre agents just need to focus on customers that need answers to questions that are more in depth. The other method is to adjust the work force and put more workers on peak hour shift as during non peak hour shift, the waiting time is very low.

Train call agents so they can work faster and handle more calls per hour



Calculate:

- Occupation rates
- Average waiting time
- Average throughput time
- Avg. number in system

Occupation rate = Rho, Waiting time = W_q, Throughput time = W

Every task can be modelled as a MM1 model

Task1:

$$\Lambda = 6$$

Mule = $60/8$. 8 min for 1 task, in an hour is $60/8 = 7.5$

$$\rho = 6/7.5 = 0.8$$

$$L_q = p^2/1-p = 3.2$$

$$W_q = (3.2/6) = 32 \text{ mins}$$

$$W = 8/15 + 1/7.5 = 40 \text{ mins}$$

Task2:

$$\Lambda = 18$$

$$Mule = 60/2.66 = 3000/133$$

$$\rho = 18/(3000/133) = 399/500 = 0.798$$

$$L_q = 0.798^2 / 1 - 0.798 = 3.152$$

$$W_q = 3.152/18 = 0.175 = 10.5 \text{ mins}$$

$$W = 0.175 + 1/(3000/133) = 133/606 = 13.16 \text{ mins}$$

Task3:

$$\Lambda = 24$$

$$Mule = 60/2 = 30$$

$$\rho = 24/30 = 0.8$$

$$L_q = 0.8^2/1-0.8 = 3.2$$

$$W_q = 3.2/24 = 2/15$$

$$W = 2/15 + 1/30 = \frac{1}{6} \text{ hrs} = 10 \text{ mins}$$

$$\text{Total } W = 25\% \times 40 + 75\% \times 13.16 + 10 \text{ mins}$$

Limitations of basic queueing theory

- Queueing theory is complex. If the inter-arrival times and processing times do not follow an exponential distribution, one needs to use a very different queueing model

Lecture 6

All business process tend to evolve organically over time and the world evolve as well

What is redesign

- Any change to the existing process that is related to the business process concept can be considered as redesign
 - Customers (How the process interacts with the customers)
 - Business Process Operation (What steps are in the process)
 - Business Process Behaviour (In what order these activities will be performed)
 - The organisation and the participants
 - The organisation structure (elements: roles, users, groups, departments, etc.)
 - The organisation population (individual: agents which can have activities assigned for execution and the relationships between them)(who is carrying out the process)
 - The information (How information is being exchanged in the process. Whether it is paper or digital)
 - The technology (technology that is used to support the process)
 - The external environment (Collaborating organisations that work with the process)
- Eg. Print document process, printing with eco friendly paper instead of normal paper does not count as redesign.
- Not each business domain is equally suitable for redesign
 - Manufacturing domain
 - Transform raw materials into tangible products
 - Service domain
 - Process information to deliver a particular service
- Redesigning the manufacturing domain is harder as it has many constraints. For Example, storing products in a warehouse will have limitations but for storing documents then it is possible to store as much as the user likes. Or rearranging the process steps cannot be done as freely as the physical movement of materials, or certain machines need to be executed first.
- There are more degrees of freedom for redesigning business process in the services domain, than is the case in the manufacturing domain

Exercise 6.1

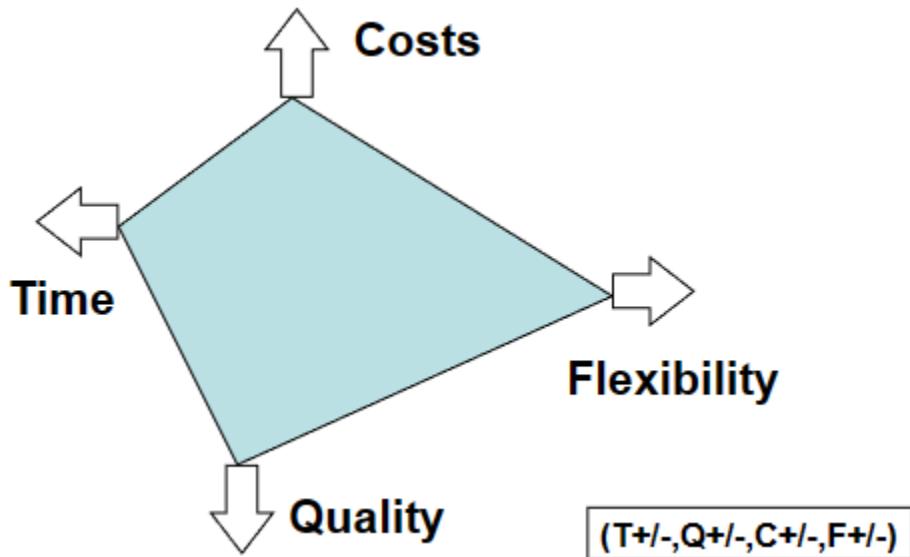
Consider the following processes and decide whether they are suitable for being redesigned

- Dealing with a customer complaint - yes
- Carrying out a cardiovascular surgery - not really
- Production of a wafer stepping machine
- Transporting a package
- Providing financial advice on composing a portfolio - yes
- Designing a train station - not really

First step is to identify the environment of the project to know what are the constraints that exist and how to work with those. Lots of options will become not applicable because of constraints

Devil's quadrangle

Framework that helps to address what to achieve. By improving a process in one dimension, it might have a weakening effect on the other dimensions. Make tradeoffs to maximise performance that matters more than the others



Exercise 6.2

Consider the following redesign acts. Which performance measures are affected by these, either positively or negatively?

- A new computer application is developed that speeds up the calculation of the maximum loan amount that a given client can be offered. Improves time and quality but is more costly and has lesser flexibility
- Whenever a quote is needed from a financial provider, a clerk must use a direct messaging system instead of email. Improves cycle time but has lower quality
- By the end of the year, additional, temporary workers are hired and assigned to picking items for fulfilling Christmas orders (improve cycle time and quality but reduce quality and cost)

Heuristic process redesign

Based on summary off the successful stories in the industry from practices in the past

- A redesign heuristic can be seen as a rule of thumb for deriving a different process
- There are lots of heuristics but not all can be applied. Some heuristic can be combined, some are conflicting. Look at the main goal and choose the superior scenario.
- Start from an existing process to achieve gradual process improvement
 - Initiate: Set up the redesign project
 - Create an understanding of the existing situation (as-is) (what are we going to achieve. Eg if cycle time is too long, redesign goal is supposed to reduce cycle time)
 - Modelling techniques
 - Analysis techniques
 - To set the performance goals for the redesign project
 - Devil's quadrangle
 - Design: Use a list of redesign heuristics to determine potential improvement actions
 - Determine if a heuristic is applicable, if so, what is a desirable action
 - What clusters of applicable and desirable heuristics can be created (Putting compatible heuristics together. Eg automation and empowerment heuristics are conflicting.)
 - Create a set of scenarios, each of which describes which redesign heuristics are applied in this scenario, and how this is done (most likely more than 1 will be created)
 - Evaluate the different redesign scenarios
 - Can be done in a quantitative way or a qualitative way or a combination of both
 - The outcomes may be that none of the scenarios seems attractive so
 - Adjust the performance goals
 - Lower expectations
 - Step back to the design phase
 - Drop the redesign project

Customer heuristics

- Focus on improving the interaction with customers
 - Control relocation: move control towards the customer (Eg. Electrical companies will send a technician every quarterly to check on the customer's meter to see how much electricity they used. Not only was it expensive, customers also complain oftenly about how the readings by technicians are inaccurate. So they changed it such that customers can check it themselves and upload the reading into a portal) (Idea is to engage customers/collaborating partners more in the process to give them satisfaction as well as eliminate errors.)
 - Contact reduction: reduce the number of contacts with customers and third parties (Reduce the customer by compiling the contact. Cost might increase due

- to extra steps taken if a customer is not contacted. Like if did something that does not need to be done if customer submitted a document)
- Integration: consider the integration with a business process of the customer or a supplier (Locking in with a supplier or a partner)

	Time	Cost	Quality	Flexibility
Control relocation	•	-	+	•
Contact reduction	+	-	+	•
Integration	+	+	•	-

Business Processing Operation Heuristics

Focus on the elements of a business process

- Case types: Determine whether activities are related to the same type of case and if necessary, distinguish new processes (Case is what an organisation handles and if a process has more than 1 case types, can consider creating a new process to handle the other case type. Two separate teams for two processes reduces the flexibility)
- Activity elimination: Eliminate unnecessary activities from a business process
- Case-based work: Consider removing batch-processing and periodic activities from a business process (Lose quality when removing control steps)
- Triage: Consider the division of a general activity into two or more alternative activities (Eg for accessing applications, there are low and high risk applications. Instead of having a general accessing application process, split them up. But by doing this there is a need for more specialist which means high cost low flexibility)
- Activity Composition: Combine small activities into composite activities and divide large activities into workable smaller activities (By grouping smaller tasks together, the setup time needed is lesser)

	Time	Cost	Quality	Flexibility
Case Types	+	+	-	-
Activity Elimination	+	+	-	•
Case-Based work	+	-	•	•
Triage	•	-	+	-
Activity Composition	+	+	•	-

Business Processing Behaviour Heuristics

Regulate the logic within the business process

- Resequencing: Move activities to more appropriate places (If the task does not have any dependency and does not need to be done in sequence, it might better to postpone certain activities that does not require to be done immediately to a later part of the process and see if there are similar activities that can be done together to reduce setup time)
- Parallelism: Consider whether activities may be executed in parallel (If the task does not have any dependency and does not need to be done in sequence, can save time by executing it in parallel. But might increase cost if A and B is done parallel but if A is done the task can terminate so B is done for nothing)
- Knock-out: Order knock out in an increasing order of effort and in a decreasing order of termination probability (It is a condition when not met, terminates the program. To order knockouts, put the knockout with the highest probability or the one that takes the least effort to perform should be checked first. Ratio is expected knockout probability vs the expected effort to check the condition. Most favourable ratio should be checked first)
- Exception: Design business processes for typical cases and isolate exceptional cases from normal flow (Create and allocate the normal flow first before separating the exception flows and allocating to either same resource or other resources)

	Time	Cost	Quality	Flexibility
Resequencing	+	+	•	•
Parallelism	+	-	•	-
Knock-out	-	+	•	•
Exception	+	-	+	-

Organisation Heuristics

Related to the structure of the organisation

- Case assignment: Let workers perform as many steps as possible for single cases (To reduce setup time by giving a worker to perform as many steps in the process)
- Flexible assignment: Assign work in such a way that maximal flexibility is preserved for the near future (Eg. There are 2 workers and A has skill 1 and B has skill 1 and 2. If work that requires skill 1 arrives, it should be assigned to worker A so that if a work that requires skill 2 arrives, worker B can work on it)
- Centralisation: Treat geographically dispersed resources as if they are centralised (Availability of resources should not be constrained by their location and task can be assigned to the most suitable resource. Like xray done in hospital A can be accessed from other hospitals)
- Split responsibilities: Avoid shared responsibilities for tasks by people from different functional units (If shared, more likely to be a source of neglect and a source of conflict.)
- Customer teams: Consider to compose work teams of people from different departments that will take care of the complete handling of specific sorts of cases (Like in a law firm there is a team that handles criminal law, business law, immigration law etc)

- Numerical involvement: Minimise the number of departments, groups and persons involved in a business process (Less coordination problems)
- Case manager: Appoint one person to be responsible for the handling of each type of case (Improves external quality of business process because this person will serve as a single point of contact and the business process becomes more transparent)

Related to the organisational population and the resources being involved

- Extra resources: If capacity is insufficient, consider increasing the available number of resources
- Specialist-Generalist: Consider to deepen (specialist) or broaden (generalist) the skills of resources (Specialist high quality work, more expensive, less flexible while generalist is the other way round)
- Empower: Give worker most of the decision-making authority instead of relying on middle management (Allow decision making of workers reduces the middle management which decreases cost, reduces cycle time as they can approve certain decisions. But when bad decision is made, quality is reduced and cost might go up)

	Time	Cost	Quality	Flexibility
Case Assignment	+	•	+	-
Flexible Assignment	+	-	•	+
Centralisation	+	-	•	+
Split Responsibilities	•	•	+	-
Customer Teams	•	•	+	-
Numerical Involvement	+	-	•	-
Case Manager	•	-	+	•
Extra Resources	+	-	•	+
Specialist-Generalist	+	•	+	-
Empower	+	•	-	+

Information Heuristics

Relate to the information the business process uses, creates, may use or may create

- Control addition: Check the completeness and correctness of incoming materials and check the output before it is sent to customers (Additional control means adding more quality check or control step. Contradicts heuristics that removes steps including control steps. Use this if improvement of quality is needed and use the other one if cycle time needs improvement)

Buffering: Instead of requesting information from an external source, buffer it and subscribe to updates (Obtaining information from third party)

	Time	Cost	Quality	Flexibility
Control Addition	-	-	+	•
Buffering	+	-	•	•

Technology Heuristics

Relate to the technology the business process uses or may use.

- Activity Automation: Consider automating activities (Does not work with empower.)
- Integral Technology: Try to elevate physical constraints in a business process by applying new technology (Any new technology depending on the scenario)

	Time	Cost	Quality	Flexibility
Activity Automation	+	-	+	-
Integral Technology	+	-	•	•

External Environment Heuristics

Improve upon the collaboration and communication with the third parties

- Trusted party: Instead of determining information oneself, use the results of a trusted party (Some other parties may have done the assessment and determined the same information in a different context. Eg. When registering in bank A, an information check is done. When registering another account at bank B, bank B can just take the information from bank A since it is trusted and it needs similar information bank A checked. By doing so, it can reduce the time wasted and the cost. Political comes into play as well, in America, they do not really outsource workers due to them wanting to keep the job for Americans)
- Outsourcing: Consider outsourcing a business process completely or parts of it
- Interfacing: consider a standardised interface with customers and partners (reduce the occurrence of mistake)

Redesign Case

The Intake process starts with a notice by telephone at the secretarial office of the healthcare institute. This notice is done by the family doctor of the person who is in need of mental treatment. The secretarial worker inquires after the name and residence of the patient. On the basis of this information, the doctor is put through to the nursing officer responsible for the part of the region that the patient lives in. The nursing officer makes a full inquiry into the mental, health, and social status of the patient in question. This information is recorded on a registration form. After this conversation has ended, this form is handed in at the secretarial office of the institute. Here, the information on the form is stored in the information system and subsequently printed. For new patients, a patient file is created. The registration form as well as the print from the information system are stored in the patient file. Patient files are kept at the secretarial office and may not leave the building. At the secretarial office, two registration cards are produced for, respectively, the future first and second intakers of the patient. The registration card contains a set of basic patient data. The new patient is added to the list of new notices. Halfway during each week, on Wednesday, a staff meeting of the entire medical team takes place. The medical team consists of social-medical workers, physicians, and a psychiatrist. During this meeting, the team leader assigns all new patients on the list of new notices to members of the team. Each patient will be assigned to a social-medical worker, who will act as the first intaker of the patient. One of the physicians will act as the second intaker. In assigning intakers, the team leader takes into account their expertise, the geographical region they are responsible for, earlier contacts they might have had with the patient, and their caseload. The assignments are recorded on an assignment list which is handed to the secretarial office. For each new assignment, it is also determined whether the medical file of the patient is required. This information is added to the assignment list. The secretarial office stores the assignment of each patient of the assignment list in the information system. It passes the produced registration cards to the first and second intaker of each newly assigned patient. An intaker keeps this registration at times when visiting the patient and being at the office. For each patient for which the medical file is required, the secretarial office prepares and sends a letter to the family doctor of the patient, requesting for a copy of the medical file. As soon as this copy is received, the secretarial office will inform the second intaker and add the copy to the patient file. The first intaker plans a meeting with the patient as soon as possible. During the first meeting, the patient is examined using a standard checklist which is filled out. Additional observations are registered in a personal notebook. After a visit, the first intaker puts a copy of these notes in the file of a patient. The standard checklist is also added to the patient's file. The second intaker plans the first meeting only after the medical information of the physician—if required—has been received. Physicians use dictaphones to record their observations made during meetings with patients. The secretarial office types out these tapes, after which the information is added to the patient file. As soon as the meetings of the first and second intaker with the patient have taken place, the secretarial office puts the patient on the list of patients that reach this status. For the staff meeting on Wednesday, they provide the team leader with a list of these patients. For each of these patients, the first and second intaker together with the team leader and the attending psychiatrist formulate a treatment plan. This treatment plan formally ends the intake procedure.

Redesign points

1. Reduce the point of contact, ask family dr to submit the documents at the start
2. Ask doctors to fill in a form instead when requesting that their patients to be admitted
3. When a new patient is added to the list, managing doctor can make a decision and assign it to a most suitable caretaker and use weekly meeting for something more important like discussion of treatments

Lecture 7

Process Execution

Is heavily tool supported and there are specific software tools that are used to support the execution of the process including the writing of the model, instantiating the model, assigning work, coordinating execution, monitoring performance and managing other aspects.

Process Automation

- Process automation refers to the intent to automate any conceivable part of procedural work that is contained within a business process, from simple operations that are part of a single process activity up to the automated coordination of an entire, complex process.
- Automated coordination of the entire complex process is more important than automation of individual activity. From a business process concept view, automation is the automation of coordination because multiple participants get involved and work needs to be routed from one another in accordance with the rules defined in the process model. Without tool support, a worker needs to manually decide how to allocate tasks. With an order management process, it helps to allocate orders to workers and it saves a lot of effort.
- An automated business process, also known as workflow, as a process that is automated in whole or in part by a software system which passes information from one participant to another for action according to the temporal and logical dependencies set in the underlying process model
- Process automation is often supported by the user of IT and IS

Workflow

Works closely related to another technology called workflow. The name is used interchangeably with business process management, workflow management, and business process management.

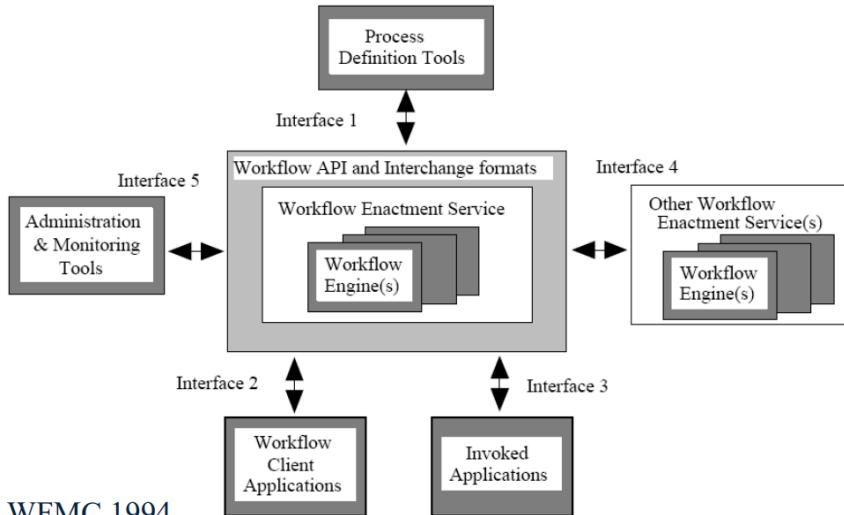
It is the automation of a business process, in whole or part, during which documents, information or tasks are passed from one participant to another for action, according to a set of procedural rules defined in a model.

Lots of effort and many products were created just to manage workflow. To minimise risk of applying workflow and standardise the workflow management effort, the Workflow Management Coalition was formed and it is responsible for publishing standards for workflow management so they published many standards and try to regulate how the workflow management should be done.

Workflow management system

A system that creates and manages the execution of the workflow through the use of software running on one or more workflow engines which is able to interpret the process definition, interact with workflow participants and, where required, invoke the use of IT tools and applications.

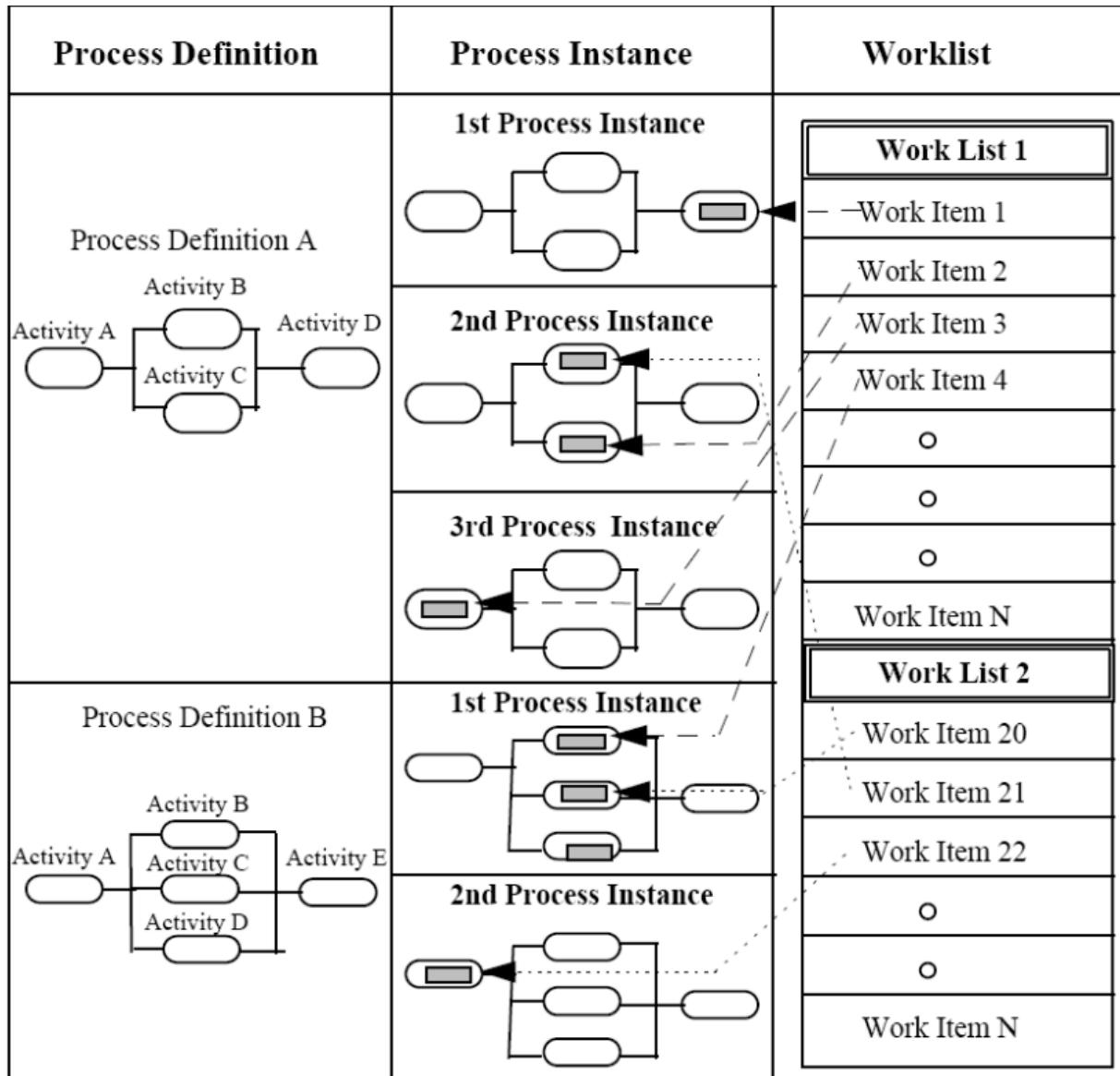
Workflow reference model is created with those standards in mind.



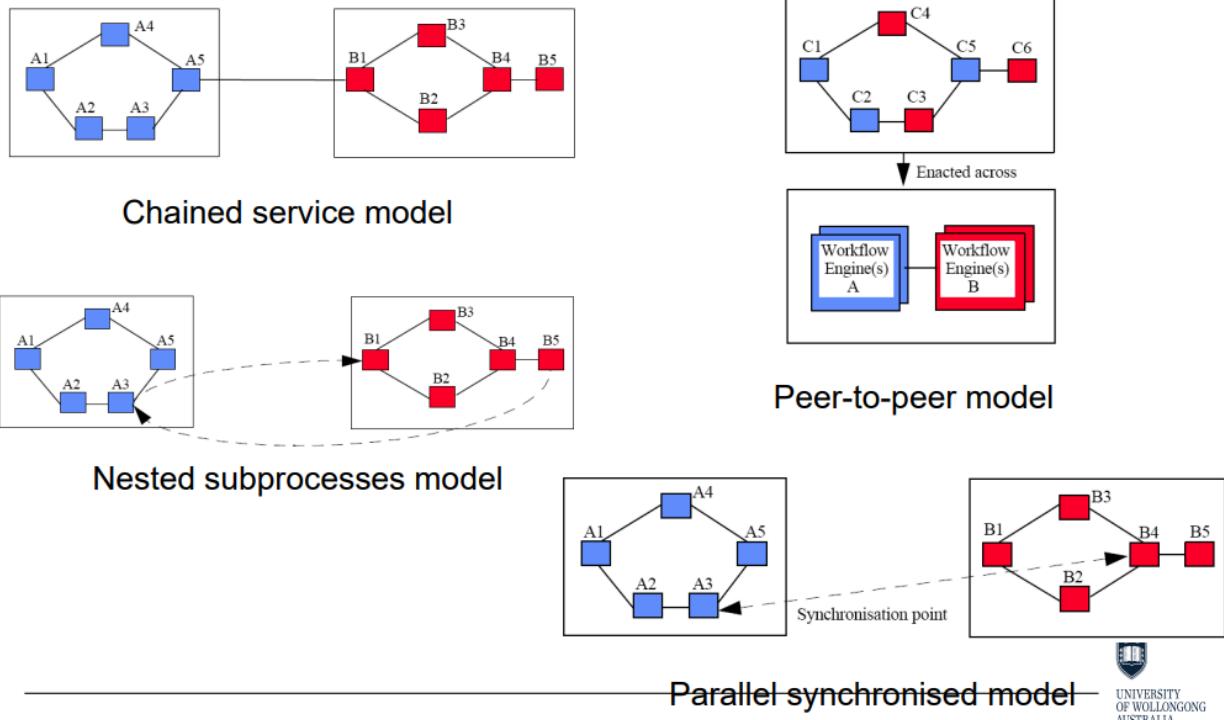
Workflow engine

Responsible for loading the model and creating the instance of the model and retrieving all relevant data information about this instance and then creating the work items and then attach the data and information to each work item to authorise and qualify participants. It will then monitor the execution of these work items and coordinate the work when they need to be passed from one to another. The workflow engine also needs to be able to integrate with other external services. For example any document management service and other third party applications so that they can support the process. Managers need information about the processes so the workflow engine provides data for the dashboard. Lastly it needs to interact with other workflow engines of collaborating partners. It defines different interfaces in order for the developers or users to understand what should be available for each component to work.

"Not discuss much about how it is implemented"



Eg. Microsoft Outlook has an interface that shows all the work that has been assigned to the user. They are known as work items and they are instances of the activities that may belong to a different process. Users then check the state of each work item and users can only work on the work item once it receives the token (preceding task has been completed). When a work item becomes available, meaning it can be done and once completed and submitted, the client will interact with the workflow engine and inform it that the work has been completed. The engine will then inform the rest of the participants about the work that is done and the cycle completes until the process is completed.



Chained service model

- After one process is completed, the other process can start.
- The blue process needs to coordinate with the engine in the red process

Nested Subprocess model

- One of the activity in the blue process is implemented as a process of the other organisation
- The blue engine need to coordinate with the red engine to evoke the sub process

Parallel Synchronised Model

- Both models are generally independent but A3 needs to synchronise with B4 to pass data or access the same resource etc.
- Engines need to coordinate the execution of both process instances to ensure that they are synchronised

Peer to peer model

- Often working very closely with the collaborative organisation which means some activities in one process will be coordinated by one engine and some other activities in the same process will be coordinated by the other engine.

The workflow management interfaces will need to define all the different collaboration types so that the engines can understand them and support them

Business Process Management Software Suite (BPM)

BPM Software Suite is a natural evolution of workflow management system because business managers and software developers realise that a business process management suite as a software should integrate all the existing processes or existing systems in the organisation to serve as a middleware. It makes sure that all work is done in the right time and by the right resource so it will help coordinate different tasks and synchronise data from existing systems because all the data that are needed for the process either as input or output would usually be managed by existing systems so they need to be coordinated by the system. The system also helps coordinate the human process activities, like streamlining tasks, triggers and timelines that are related to a business process and make sure that they will be completed exactly like how they are defined.

The aim of using BPM for BPMS is to achieve a more efficient, compliant, agile and more visible execution of the process

Key BPMS Components

They work together and represent a cohesive set of actions that deliver BPM solutions.

Eg. The Modeling component helps users to model and simulate different work patterns and analysis, monitoring and auditing component helps managers to have visibility about work in progress and make real time decisions to adjust the process to meet the targets. It also provides a rich set of processes of data that can be used for analysis purposes.

Business process:

- Modelling
- Integration
- Execution
- Analysis, monitoring and auditing
- Measurement
- Optimization

Exercise 7.1

Consider the following questions about a BPMS:

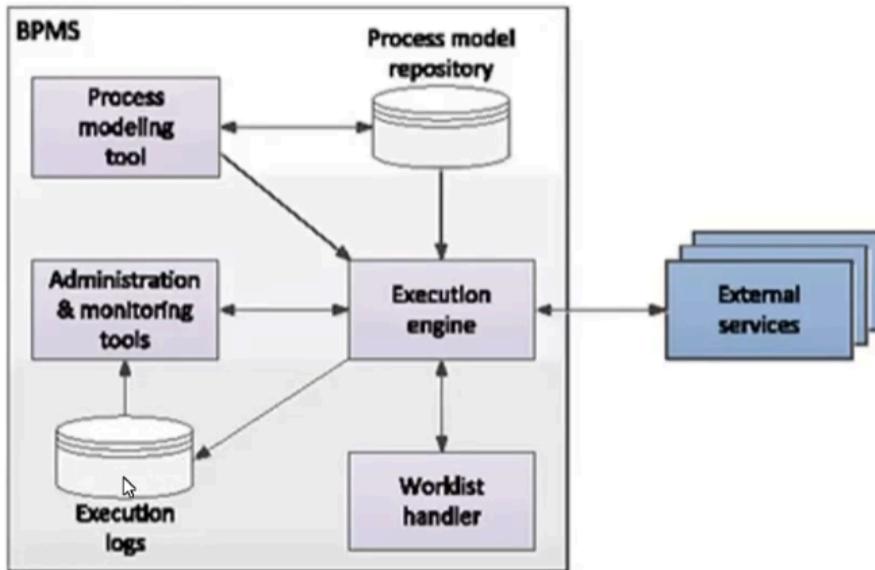
- Why would it not be sufficient to only create a business process model with the modelling tools, without any information on the types of resources that are available?
 - To get substantial benefits, the process needs to be executed, and in order to put it into execution, it needs to be assigned to the right resource for execution at the right time. Hence, understanding the availability of different types of resources is needed.
- In what situation will the execution engine generate multiple work items on the basis of the completion of a single work item?
 - Every work item is actually an instance of activity that needs to be performed. So in a typical and split gateway and then the token is split into multiple and multiple tokens will activate the execution of multiple activities. So in this case, multiple

work items will need to be generated and need to be assigned to the right resource for execution.

- Can you provide examples of external services that may be useful to be invoked when a participant wishes to carry out a work item?
 - Organisations would use the document management system to manage various electronic documents like locate, retrieve, update, store and archive different electronic documents. In the service process domain, a lot of data is needed for the process and in order to execute it, data objects are needed as input. In order to automate it, the external documents should be retrieved by the document management system and make it available for the right resource for the activities to execute
 - Software that does automatic calculation of the maximum amount the applicant can borrow. If this replaces a human resource to calculate the maximum loan that an applicant can have, it needs to be integrated with the BPMS so that it can be invoked automatically when it is needed.
- What would be a minimal requirement to be able to pass on work items between the BPMSs of the insurance company that was provided as an example?
 - The state of every item which is the same as the token in the process instance. What is the token, and where is the token in the process which will determine the state of every activity, every work item in the process and the information about the availability of the data (where is it and the other data available either as result of completing a work item or as a result of being input to the whole process or result of getting data from external services)
- If it is important that a BPMS hands out work items to available resources, can you imagine other, relevant types of information on resources that are useful to be captured by an administration tool?
 - Administration tool is used by the manager in order to finetune and configure the system. Eg. if a worker is sick and takes sick leave, it should be configured and reflected in BPMN so that work will not be allocated to this resource. Or if work is overloaded on one resource, configuration needs to be made to better load balance

Architecture of BPMS

- Similar to workforce management reference framework



- There are some execution loss as compared to workforce management reference
- Workflow management system does not keep a good execution log for further analysis for mining and improvement.
- In BPMS, it is an important function to keep a good log of the execution, performance data past history for future use

Execution Engine

- Create executable process instances
- Distribute work to process participants in order to execute a business process
- Automatically retrieve and store data required for the execution of the process
- Delegate automated activities to software applications across the organisation

Worklist handler

- Lists work items
- Can best be imagined as an inbox
- Check out when start a work item and check in when complete it

Administration and monitoring tools

Shows overview about how the system works. In the view, all the resources and workers available can be seen and that work items have been assigned to them. Colour coded bar graph to show that state of the work items. Bottlenecks can be adjusted through a menu and improve performance easily

Advantages of using BPMS

- Workload reduction
 - Automate part of the work that is traditionally done by people such as transporting work (will no longer be transported by internal mail or participants)
 - Provide better coordination (Helps to determine which activities needs to be performed and in what order)
 - Gather all relevant information to carry out a particular task (Imports have been modelled explicitly and will be loaded by invoking external service to make data and information available to the resource)
- Flexible system integration
 - Split off generic functions from applications (Business process logic can be changed any time without touching the function parts of the program)
 - Provide the means to glue together separate systems
- Execution transparency
 - Operational information which relates to recent, running, future cases
 - Historical information which relates to completed cases (Used by process analysis/quantitative analysis which is kept in the logs)
- Rule enforcement
 - The process is carried out in precisely the way that it has been designed (Rules that needs to be respected will be respected)
 - Eg. In a bank there is a rule called separation of duties, which means the resource that will do transaction registration and the transaction inspection person will be different. BPMS will always allocate the work to 2 different resources while if allocated manually, the rule might be violated.

Exercise 7.2

To which categories would you classify the following incentives to introduce a BPMS in an organisation?

- An auditing agency has found that the written procedures and actual execution of business processes are not aligned. The management of that organisation wishes to enforce the written procedures and decides to introduce a BPMS.
 - Rule enforcement
- The clients of an organisation complain that they can only get very shallow updates on the progress of the orders they make. The IT manager of that organisation looks into the use of a BPMS to capture and provide status information of all these orders.
 - BPMS provides accurate, timely and relevant information when executing processes. It provides execution transparency
- An insurance organisation finds out that there is a high need to quickly adjust the way claims processing is carried out to the offerings that its competitors bring to the market. Using a BPMS is considered to address this demand.
 - Firstly there is a need to understand the difference between both offerings, therefore historical data is needed which is execution transparency
 - Then to execute the process, workload reduction and flexible system integration is needed

Challenges of BPMS

- Technical challenges
 - Many applications have never been developed with the coordinated use in mind (Does not provide any domain specific business functions. Made solely for coordinating work and needs to involve external applications and services. Many applications that have not been developed with coordinator will have problems with integration. Process logic is embedded with business functioning logic which is hard to change. Therefore, some application coordination take place on the interface level which is also known as screen scraping where the user inputs are collected and sent to the applications that cannot be fully integrated and trigger the results which will then be collected off the screen by bpms to track the progress. This is low level integration and is troublesome and not ideal)
 - Screen scraping: low level integration solution
 - Lack of process-awareness of traditional systems
 - Middleware and enterprise application integration: Microsoft biztalk. IBM websphere, web services and service-oriented architecture (Mainframe application replacement)
- Organisational challenges
 - Users have diverging performance objectives (Process change is governed by devil's quadrangle, BPMS is change)
 - Organisations are dynamic entities (Organization might change and new rules are implemented during the implementation phase of BPMS. The rules implemented for BPMS will then be outdated)
 - The fear that the work will take on a mechanic trait (Workers might feel that they are being controlled by the system and the work will take on a mechanical trait that will affect the moral)

Turning process model executable

The software needs to understand more about the process and capture every small detail of a process model so that the software can work autonomously so workers do not need to interrupt the software often.

Steps to turn process model executable

- Identify the automation boundaries (see what can be automated and does not need human involvement. Some tasks need human involvement but can be attached to software.)
- Review manual tasks (tasks that needs to be done manually and are isolated from any system and cannot be supported by the system)
- Complete the process model (needs to be precise specifications for it to be interpreted by the computer. Eg. Data type of objects, as well as all exception handlings)
- Bring the process model to an adequate granularity level (Bring certain activities from the process point of view)
- Specify execution properties

Identify automation boundaries

What parts can be automated and what parts cannot

- Automated tasks: performed by the BPMS itself or external service without involvement of humans
- Manual tasks: performed by process participants without the aid of any software (Like retrieve the product from the warehouse)
- User tasks: performed by process participants with the assistance of the worklist handlers of the BPMS (User performs the Task with the use of a software application)

Manual tasks cannot be automated

BPBMN markers

- Script (script marker), if the task executes some code (the script) internally to the BPMS (automated and will interact the code without human interaction)
- Service (wheel marker), if the task is executed by an external application which exposes its functionality via a service interface (automated)
- Send (filled envelope marker), if the task sends a message to an external service (automated)
- Receive (empty envelope marker, if the task waits for a message from an external service) (automated)
- User task is marked with a human icon and it means that it can be done with the assistance of BPMS
- Manual tasks are marked with a hand icon. It is only applicable when processes have execution. (Assignment dont need)



Exercise 7.3

- What are the likely types of the following tasks
 - Check stock availability (automated or user)
 - Get shipping address (user)
 - Retrieve product from warehouse (manual)
 - Confirm order (user)

Review manual tasks

- Review if manual task can be linked to a BPMS and implement it via a user task or an automated task (can it be converted to an automated or user task)
- Eg. retrieve products from the warehouse. By using warehouse robots that can be linked to bpms, it can retrieve the items from the section and carry the product to the loading dock making it an automated process. Or a user can carry a scanner that scans the barcode of the item and updates bpms that user is retrieving the product and upon reaching the dock, the user can scan again to notify the system that the user has completed the task making it a user task.
- If unable to make it an automated or user task, isolate the task and make the process before and after automated by dividing the process to before and after the manual process

Complete the process model

- Consider all the exceptions that may arise during execution
- Humans can make ad hoc decisions when exceptions happen but computers cannot
- Specify the data objects that are required as input and output by the tasks specified if not computer does not know what data type input is needed

Bring the process model to an adequate granularity level

- Consecutive task assigned to the same resource are candidates for aggregation because there is no handover (combine)
- Consecutive tasks assigned to the same resource may need to be kept separate for the sake of monitoring the progress (split) eg. For a confirmed order task, if the task is performed by one user and the customer calls to ask for order status, the worker can only say that it is being confirmed. But if the process is split, workers can say it is under the process of checking availability or checking the payment.
- If an activity requires more than one resource to be performed, it is too coarse-grained and should be disaggregated

Specify execution properties

- Provide implementation details such as
 - Process variables
 - Task and event variable and their mappings to process variable
 - Service details for service (External service interfaces and how to invoke them etc.)
 - Participant assignment rules (Like separation of duties (Have more than one person on the task))
 - Task, event and sequence flow expressions
 - BPMS-specific properties (Like working hours etc.)

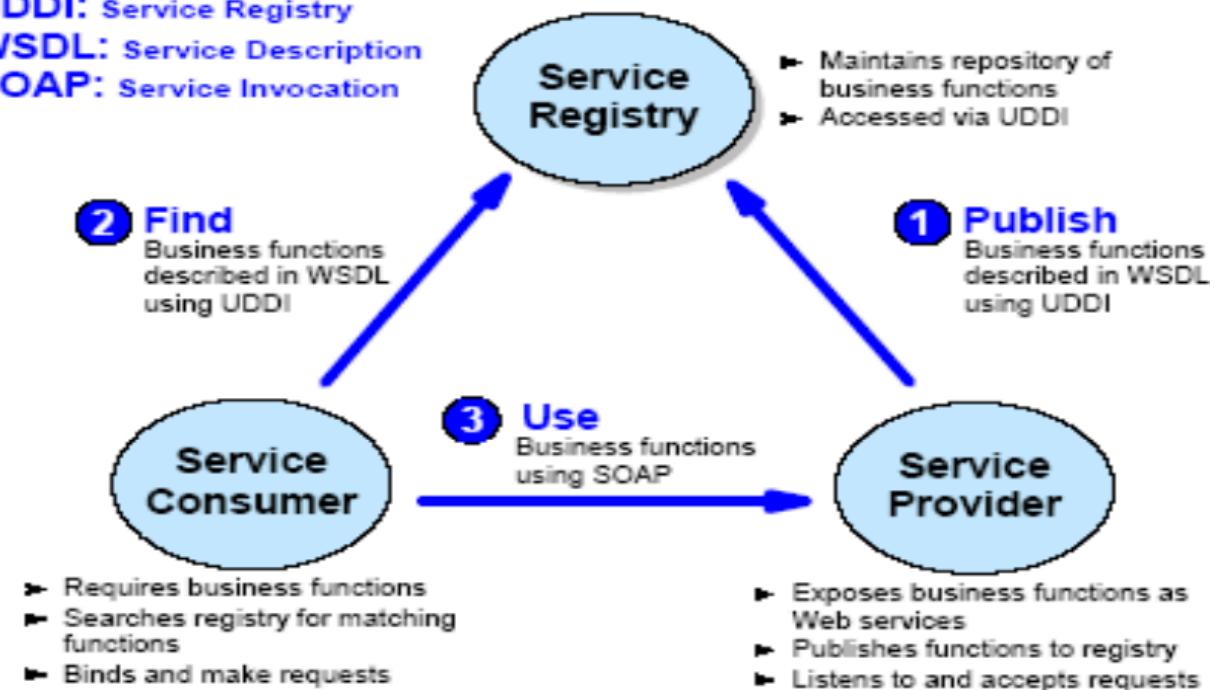
Service Oriented Architecture

BPMN still has a problem during the collaboration process with multiple organisations as they often have diverging goals in collaboration and their systems often do not work together naturally. Additionally BPMS is relatively static and is unable to dynamically compose different systems or services into a new process. Through research they came up with the SOA architecture.

UDDI: Service Registry

WSDL: Service Description

SOAP: Service Invocation



- Represents a different paradigm to do distributed computing and uses services as the most fundamental units to develop the business processing and develop the distributed applications
- Services in this context is a unit of solution logic (it could be to calculate loan amount, display a map or create a travel plan etc.) Every service represents a solution logic, so each SOA represents the architecture model that aims to enhance the agility as well as the cost effectiveness of the enterprise by reducing the burden of IT on the organisation.
- Most popular implementation of SOA is the web service families and their respective standards and can be represented by the diagram above.
- It shows the entities that come into play in SOA. **The service provider will expose their solution logic as services by wrapping the functions as a service and exposing the business functions as web services.** So regardless of how they implement the business function (what language was used, what platform they use, what is the data type), the standard interface will still be published through a registry. They will then wait for consumers to access their services.
- Service registry is maintained by a repository of available services and interfaces of the services so that the other users can discover the available services and understand their interfaces and eventually invoke the services

- To access a particular service from a provider, follow the interface by invoking it online without the need to invest in infrastructure or database etc.
- Standards that were published to support SOA,
 - WSDL (Web service description language): Is used to describe the service interface
 - UDDI: Used for publishing and for discovering a service
 - SOAP: Used for service invocation

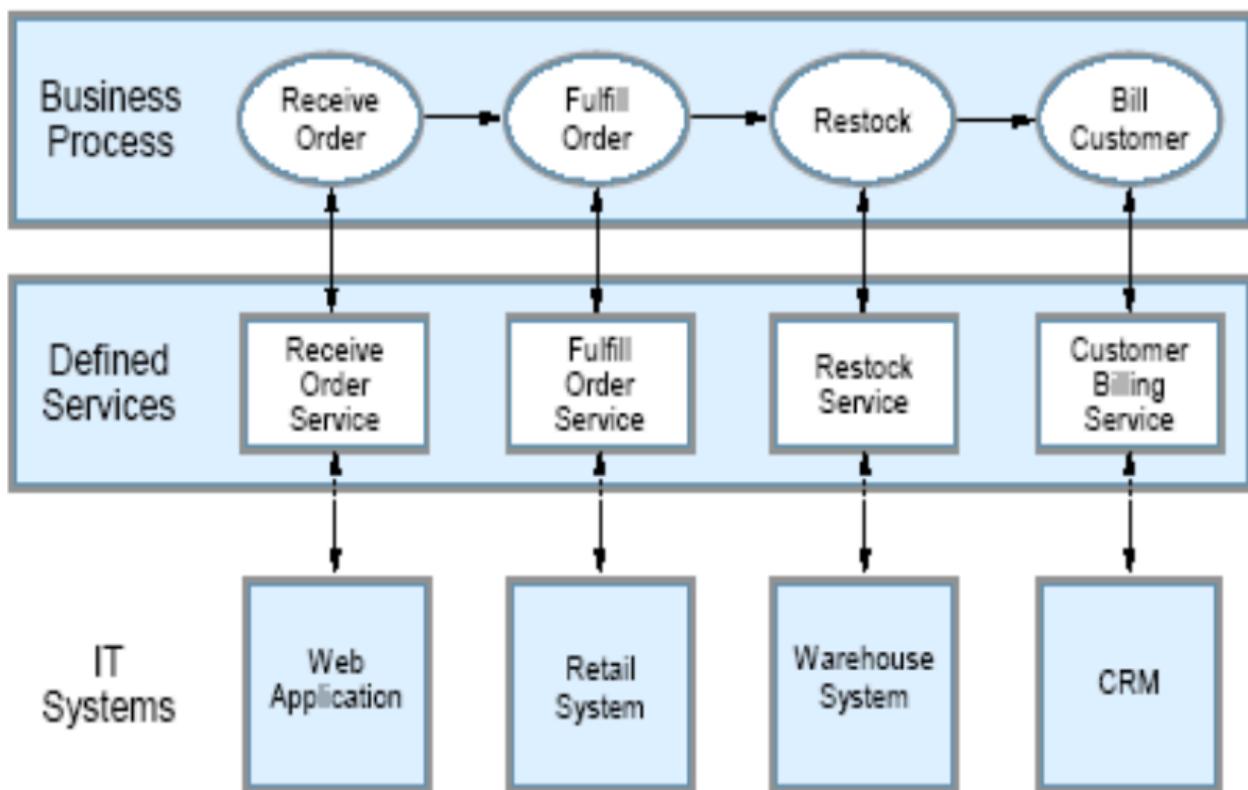
Service

- Defined as any discrete function that can be offered to an external consumer. This can be an individual business function, or a collection of functions that together form a process
 - Services are reusable as multiple consumers can invoke the service online
 - The internal details will be encapsulated and hidden
 - Can be upgraded without affecting the users (As long as the interface remains unchanged, the users can still access the same service, same function with the same user interface)
 - Services are defined by explicit, implementation-independent interfaces
 - Services are invoked through communication protocols that stress location transparency and interoperability

Web services (Skipped)

- Recent set of technology specifications that leverage existing proven open standards such as XML, URL, and HTTP to provide a new system - to - system communication standard
- Based on this communication model, additional higher - level Web services standards have also been defined to address transactions, security business processes and so forth: the higher-order functions that are required to get systems, applications and processes (rather than objects and components) talking to each other
- **Standards**
 - SOAP
 - WSDL
 - UDDI
 - WS-BPEL
 - WS-Reliable Messaging
 - WS-Coordination
 - WS-Transaction

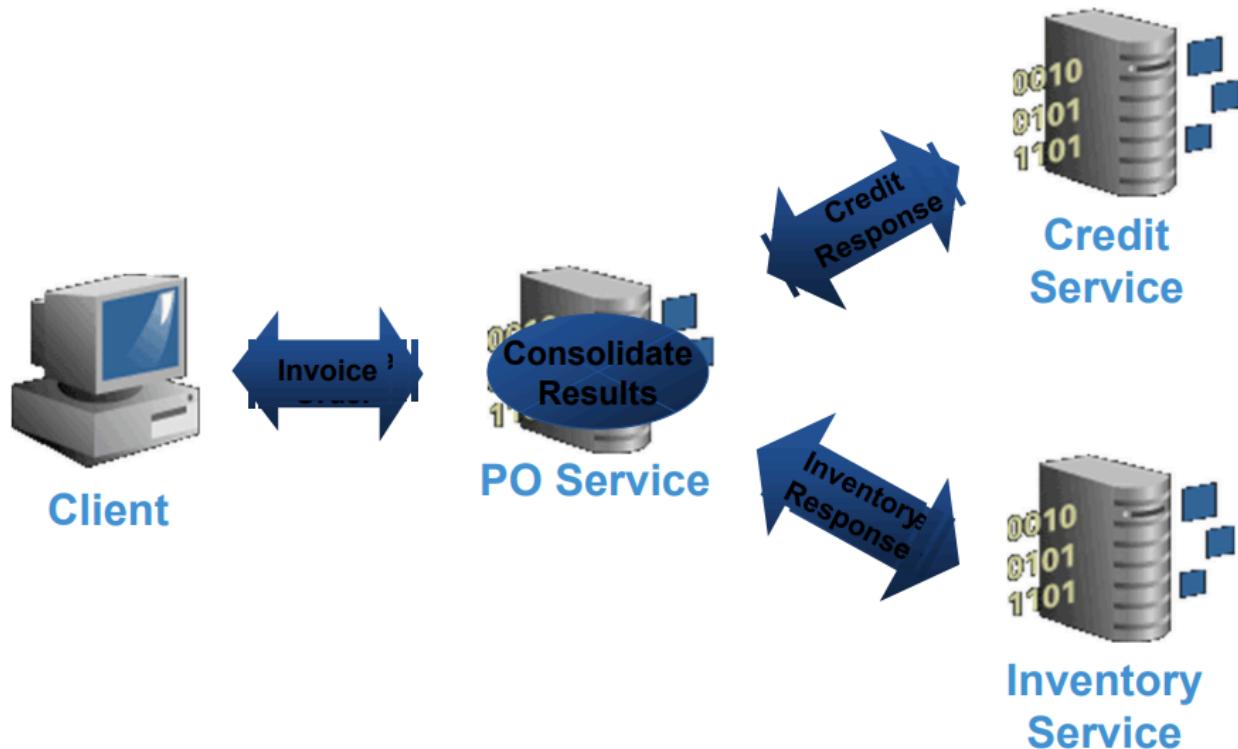
Web services and business process (Focused)



For a business process to work and execute, it will need to invoke many underlying IT systems. BPMS is supposed to coordinate across the existing system. However, each system has a different interface and they use different programming languages, data format, database and platform etc.. In addition, they may be maintained or upgraded by different parts. From a process perspective, it is invoked by adding a middle level between the business process and IT systems. It is known as the services level and every service becomes a fraction of the existing condition becoming an abstraction of the existing business function.

In the example above, the business process has 4 steps, receive orders, fulfil orders, restock and bill customers. In implementation, the business process just needs to invoke the services for each step. In the bottom level, receive order service is implemented as a web application while fulfil order service is implemented as a retail system etc. but it can all be invoked as long as the user interface is understood.

Example



Clients might send a purchase order to a purchase order service and it might be implemented by a real system or just be a process. Assuming it is a process, the PO service will invoke 2 other services (credit and inventory service) in parallel. After both services return their reports, the PO system will consolidate the results and then send the invoice back to the client. Client does not see what happens behind

Business Process Challenges (skipped)

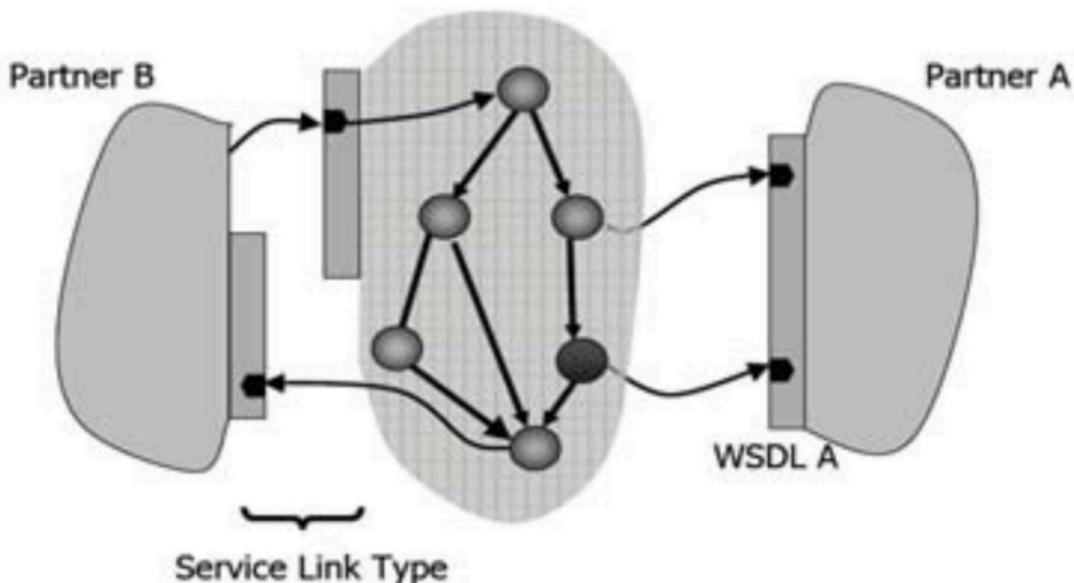
- Coordinate asynchronous communication between services
- Correlate message exchange
- Implement parallel processing of activities
- Manipulate/transform data between partner interactions
- Support for long running business transactions and activities
- Provide consistent exception handling

Value Proposition

- Portable business process
 - Build on top of an interoperable infrastructure of web services
 - Able to make changes
- Industry wide language for business processes
 - Common skill set and language for developers
 - Web service language used to define a business process is known as BPEL
(Secondary goal of BPMN is to provide a way to translate the graphical notation of the model into the XML based language BPEL and vice versa)

- Choice of process engines
 - Standards lead to competitive offerings
 - Most will support BPEL and not understand BPMN

The role of WSDL in BPEL



Circle means steps and arrow means the process flow. Partner A is being invoked twice by npartner B. Partner B starts the process.

Final notes

- BPM and SOA are twin brothers
 - BPM focuses on organisation of business capabilities
 - SOA focuses on organisation or technical capabilities
- SOA augments BPM
 - Organisation's computing assets will be reused by using SOA
 - Process/service independence (Service and implementation can be changed without affecting the process)
- Better together
 - Flexible automation of dynamic processes

Cloud service is also one type of the service and is based on SOA and eg cloud storage can be part of a process.

What is a business process?

Business process is a collection of interrelated activities that is performed by a bunch of actors and resources that produces an outcome that benefits a customer

Related disciplines that supports BPM

Total quality management that improves sustains quality or improve it

Operational management manages the organization and uses analysis techniques to improve efficiency

Lean removes activities that does not add value to the business process

Six sigma improves quality

BPM lifecycle and what is done in every step of the life cycle

Process identification - Identifies all the processes that defines an organization and identify the performance measures for the processes identified

Process discovery - understand the process and create an as is BPMN model

Process analysis - Identify all the issues and their root cause

Process redesign - Create solutions for the issues by eliminating the root cause or reducing the impact and create a to be BPMN model

Process implementation - Identify the changes that needs to be made in the to be BPMN model

Process control - Make modifications to sustain, monitor the process with using the performance measure to ensure that the process is improved and sustain, and see if any other changes needs to be made

what is the trade-off between impact and manageability works out for broad and narrow processes respectively

Broad process has more impact but it is more manageable but narrow process is easier to manage but have lesser impact

what is the relation between processes

Hierarchical and sequential process. A upstream process is the downstream process of another and the outcome of the upstream process impacts the outcome of the downstream process

what is the criteria for evaluation

Impact, dysfunctionality, feasibility

what are the methods to classify types of dimension

Case type and functional type

What is the challenges that an analyst will face from a domain expert

Domain experts will provide fragmented information which means that the information they give are different from each other

They think on instance level which means that they give information on a process based on how they perform it without thinking about the alternatives and exceptions

Most of them also do not possess the knowledge of BPMN modelling

What are the discovery methods strengths and weakness

Documentation discovery method - provides structured information but it might be outdated or not how the process is executed by users.

Observation discovery method - provides context rich information but stakeholders might act differently when being observed, it might disrupt business, and requires manager approval

Interview discovery method - provides detailed information but the process requires a lot of time to ask more unstructured questions.

Automated process discovery method - gathers a lot of information on processes but the quality might not be good as the technology is still new

Workshop discovery method - helps to resolve conflicting information easily but it is hard to coordinate all the stakeholder's time

Why is bpmn used

To create a graphical illustration of a process to help users easily understand it and allows analyst to easily modify it. It is also to be converted into a XML format so that the computer can understand the process flow.

Process choreography, who is sender who is receiver

White sender

Quality assurance of bpmn is approached by?

Semantics which means that the process is fully designed with alternate and exception flows. It is usually checked by the domain expert.

Pragmatic which means that the model is easy to understand, edit.

Synthetic which means that the model is labelled correctly and has start and end events and can be checked by anyone even if they do not know anything about the process.

What to do during qualitative analysis?

Value added analysis, root cause analysis, why why diagrams and cause effect diagrams

What to do during quantitative analysis?

Flow analysis and queueing theory

What is needed in the issue register?

Issue, description, priority, assumption, qualitative analysis and quantitative analysis

What diagrams are there in root cause analysis?

Whywhy diagram and cause effect

What are the factors of cause effect diagram?

Man, milieu, material, method, measurement, machine

what is whywhy diagram?

To ask why on the cause to find out the root cause

How to calculate cycle time efficiency?

CTE = TCT/CT

how to calculate work in progress?

WIP = CT X Lambda

how to calculate rho?

Rho = Lambda/Mule

Lq = Rho squared / 1 - rho

Wq = Lq / Lambda

W = Wq + 1/mule

L = W x Lambda

What is redesign?

Redesign is when changes are made to the business process concept.

What are the design heuristics?

Contact relocation

contact reduction

Integration

Case type

Case based work

Activity elimination

Activity composition

Triage

Parallelism

Resequencing

Exception

Knockout

Case assignment

Flexible assignment

Centralisation

Split responsibility

Customer team

Number of involvement

Case manage

Extra resources

Specialist generalist

Empower

Control addition

Buffering

Automation

Integral technology

Third party
Outsourcing
Interfacing

What is process automation?

What is a workflow engine?

What is a chained service model?

When process a ends, it starts process b

What is a nested subprocess model?

Process a has process b nested as a subprocess

What is a parallel synchronised model?

When both process a and b are running at the same time but they will interact and communicate with each other when the processes reaches an activity that requires the coordination of both processes

What is a peer to peer model?

When a process is closely integrated into another process

What is in the architecture of bpms and what is important in it?

The activity history logs are important. Execution engine, worklist handler and administration and monitoring tool

what are advantages of bpms

Rule enforcement

Workload reduction

Execution transparency

Flexible system integration

what are challenges of bpms

Technical challenges include screen scraping, when softwares are developed, coordinated use was not in mind, lack of process awareness, middleware and enterprise application needs to be integrated.

Organizational challenges include work taking on a mechanistic trait, users have different performance objectives and organization is a dynamic entity

what are the steps to turning process model executable

Identify the automation tasks, recognize the manual tasks, complete the business process model, ensure the process is of adequate granularity level, specify properties for everything

how is webservices and business process linked?

They are linked with BPMS as a middle layer called defined services. When a business process requires a webservice, it will first invoke the process in the defined service layer which will then invoke the webservice. The webservice will send a response to the defined service and then it

will send it to the business process. This is done so that the data format can be standardized throughout the process.

What is SOA and what does it consist of?

Service registry, service consumer and service provider. The service consumer will first browse the service registry for a service they will like to invoke. The list consists of the services that the service provider offer. After the consumer confirmed which service they would like to invoke, they will invoke it and it will be redirected to the service provider immediately and the service provider will respond with no middle man