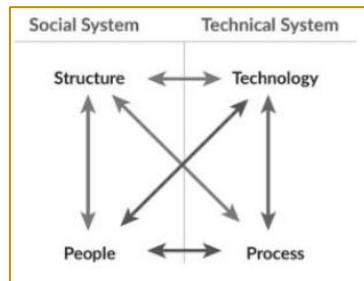


INFORMATION SYSTEMS

0) DEFINITIONS

- **ORGANIZATION** → group of people that accomplish a set of **goals** as:
 - o managing **resources**
 - o implementing **business processes**
 - o working for **profit**
 - **BUSINESS PROCESS** → set of **activities**:
 - o executed in **order** (parallel or sequential)
 - o performed by an **organization**
 - o deliver a **service/product**
 - o has specific **inputs & outputs**
 - **ACTIVITY** → time spent by people doing a **task of a business process**
 - **BUSINESS FUNCTION** → group of **people/resources** performing **similar activities** in an organization
 - **APPLICATION** → **software** that supports an **activity/process**
 - **SOFTWARE FUNCTION** → **function** offered by an **application** to support an **activity**
- ⚠ There is a N-N (many-to-many) relationship between business processes and functions.
- **APPLICATION PORTFOLIO** → set of **applications** used by an **organization**
 - **LEGACY** → older software too difficult/expensive to replace (and we need to deal with it)
 - **INFORMATION SYSTEM (IS)** → formal, sociotechnical, organizational system designed to collect, process, store and distribute information; **4 COMPONENTS INTERDEPENDENT = STRUCTURE, TECHNOLOGY, PEOPLE AND PROCESS:**

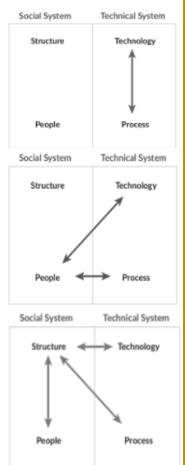


- ⚠ Considering only the technology can cause lack of understanding of systemic relationship!
- ⚠ **formal** = made and managed with a goal for the organization; **sociotechnical** = interaction between structure + **PEOPLE** (individuals involved in the IS, divided in **END USERS, MANAGERS & IT PROFESSIONALS**) and **TECHNOLOGY** (**COMPUTERS, NETWORKS & APPLICATIONS**) + process

- **STRUCTURE** → rules of the relationships between the **people** involved in the IS:
 - o **Hierarchy**
 - o **Communication** lines (hidden/missing communication lines often causes IS failure)
 - o **Reward** mechanisms
 - o **Functions**, divisions
- **IS SUCCESS** → IS supports the organization goals
- **IS FAILURE** → IS never used or abandoned or work against the organization goals
- **IS OUTCOMES** → empowering employees and future opportunities (positive) (vs) deskilling, loss of responsibility and monotonous working environment (negative)

To adapt, there are **3 organizational changes**:

- **FIRST-ORDER** = **AUTOMATE** → only affect the **technical system** through an IT innovation

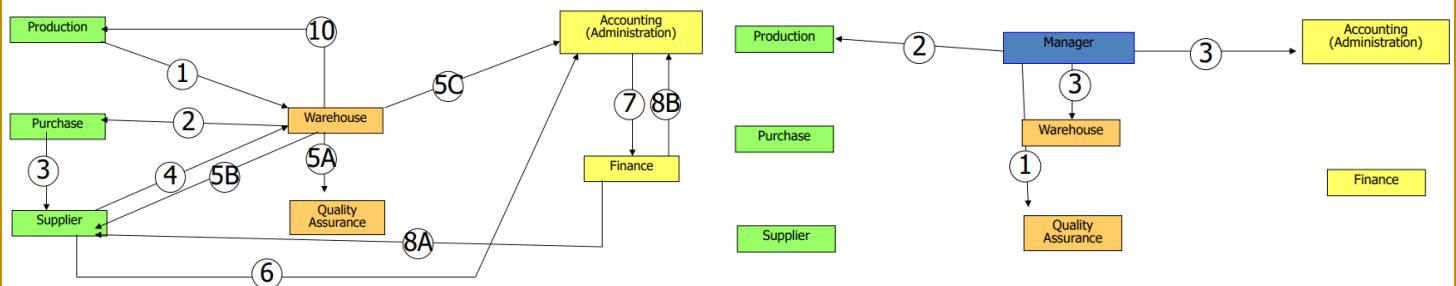


- **SECOND-ORDER** = **INFORMATE** → affect the **people**, modifying the way individuals perform processes and the interaction between people and technology; the organization need to provide training to overcome the human tendency to resist change
- **THIRD-ORDER** = **TRANSFORM** → affect the **structure**, changing all technology, people and process, requiring managerial and executive involvement

The **TECHNICAL SYSTEM** is made of several applications that read/write on several databases that contains **MASTER** data (list of entities: products, customers...) and **TRANSACTIONAL** data (sales, invoices...). These interconnections generate the **INTEGRATION PROBLEM** related to cooperation of data/applications.

The 5th dimension of the IS is **TIME**; technology innovations have a cost and a learning curve. There are different issues when dealing with time: **application portfolio** (difficult to make a census of present applications in big organizations), **integration of data and applications** and **legacy software** (when it's too old, it can happen that the documentation and the source code are unavailable).

EXAMPLE OF A BUSINESS PROCESS (FACTORY & WAREHOUSE):



An IS is needed to:

- **transfer information** (present)
- **document** (past and present) [all the steps must be recorded and it's needed the documentation of the flow]
- **monitor** (past and present) [summary data for the management control loop]

When we create an IS, **the technology must be decided after analyzing the process** (composed by **FLOW** [list of activities to perform when something happens], **DATA** [entities and events that we need to record in the IS] and **BUSINESS RULES**); we can use a different application for each piece of structure or use 1 database with a single application that has all the functions.

The **IT DIMENSION** has 2 parts:

- **APPLICATION MODEL** → describes **software**:
 - **Presentation Layer**: IS communicates with the user through GUI (graphical user interface) and inputs
 - **Business Rules Layer**: represent the logic driving the processing of data entered in Presentation Layer; changes if the process changes
 - **Data Layer** (database)
- **TECHNOLOGICAL MODEL** → describes **hardware** (usually a **3-tiers** and **client-server** architecture)

1) HIGH LEVEL MODELS

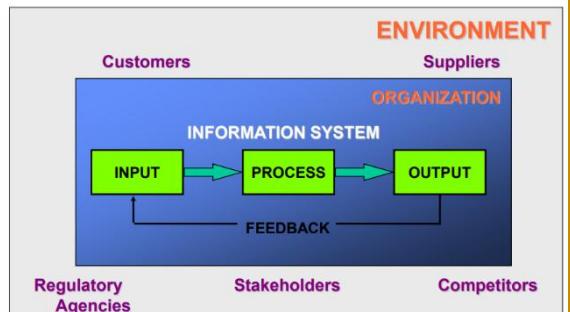
HIGH LEVEL MODELS have as scope **families of organizations** and as goal to understand what is common to all the organizations. Let's see all these models:

- **CONTROL LOOP model** → has 4 parts:

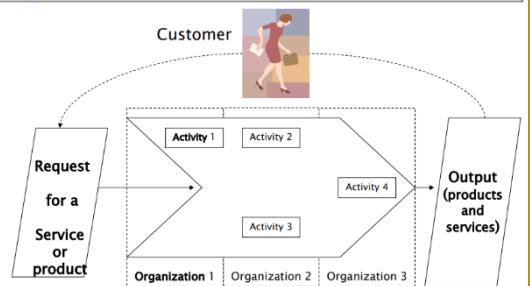
- o **Input** = capture or collection of raw data from within the organization and its external environment for processing in an IS
- o **Output** = distribution of processed information to the people and the activities that will use it
- o **Process** = conversion, manipulation and analysis of raw input into a useful form
- o **Feedback** = output used to evaluate and correct the input

This model gives a view of the context and the environment; organizations (and there is) are influenced by:

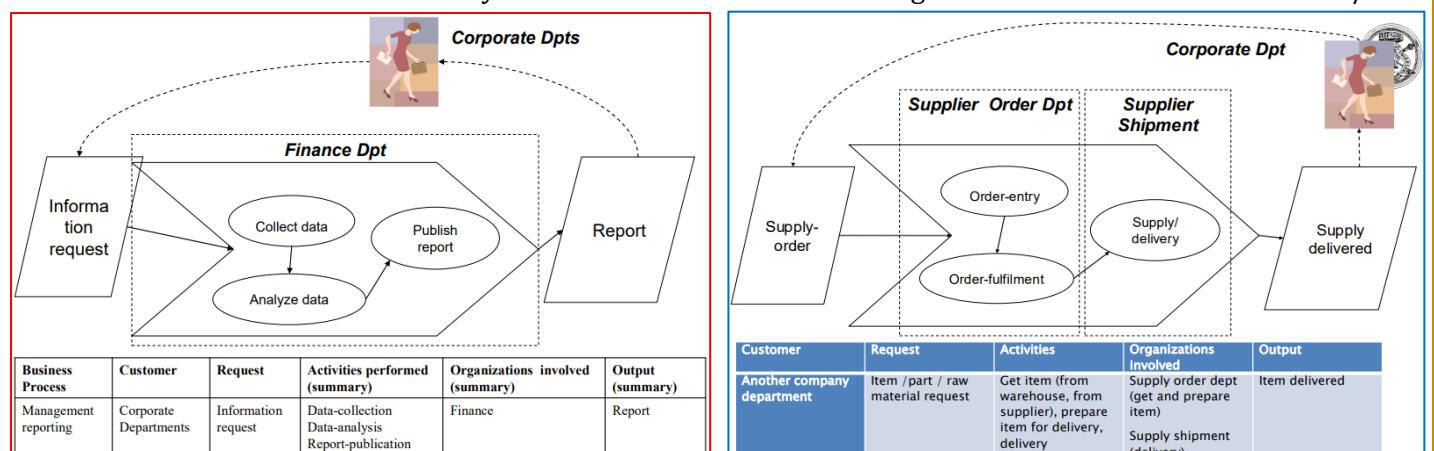
- Customers
- Suppliers
- Stakeholder
- Competitors
- Regulatory agencies (including law system)



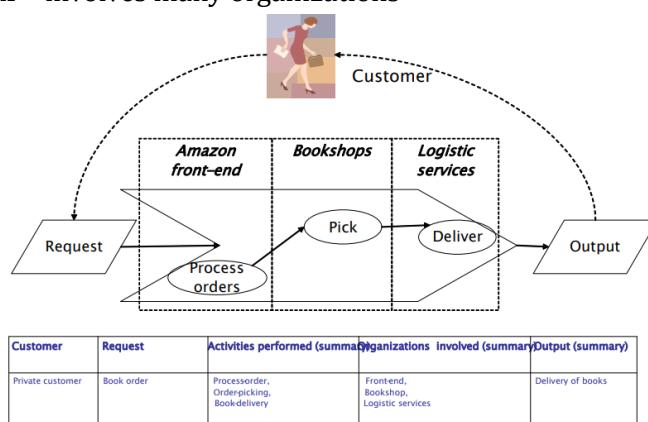
- **CRASO model** (Customer Request Activity organISation Output) → shows the **activities**, the **actors** doing activities and the **assets** ("objects") treated by them. The **customer** is always the start and the end of the loop. CRASO model can be:



- **Mono-Organizational** = involves 1 organization; 2 types:
 - o **Mono-Functional** (or **Intra-Functional**): 1 business function (exceptional case)
 - o **Inter-Functional**: many business functions in the same organization that can have different IS/DB

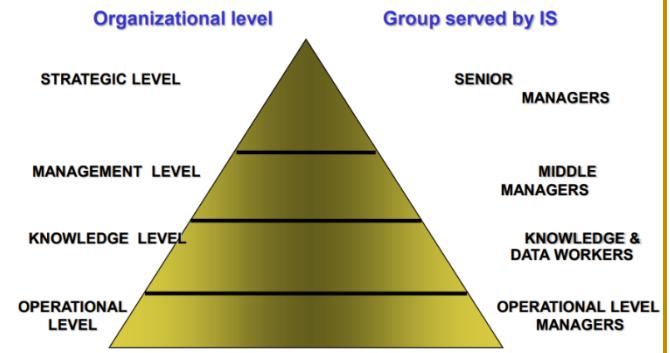


- **Inter-Organizational** = involves many organizations



- **ANTHONY'S model (PYRAMID model)** → mixes the hierarchical levels into the organization and the business functions putting them into a pyramid, where, at each intersection, different IS functions are needed. The **ORGANIZATIONAL LEVEL** is represented by horizontal strips (in the image, example for a retail company):

- **Operational level** = composed by the employees with repetitive activities (day-by-day)
- **Knowledge level** = composed by knowledge and data workers that design new products/services on the present/future time frame (present only in organizations that need designing)
- **Management level** = composed by middle managers that control and plan the activities of the operational level, working on the near future time frame
- **Strategic level** = composed by seniors and high managers that takes key decisions on future



The necessity and importance of an IS depends on each level:

- o **Operational level:**

- **Information intensity of product (IO)** = level of information needed to describe the product (es. a computer has a higher IO than a bottle of water)
- **Information intensity of process (IP)** = level of information needed to describe the process (es. how to build a computer? And how to build a bottle)

⚠ Higher are IO and IP for the organization, more useful is the implementation of an IS.

Information intensity of product		Information intensity of process
High	Low	Low
		Traditional editorial industries
		University & schools Medical labs Banks & Insurance Telephone companies PA Engineering companies
High	Low	Tobacco industry Traditional manufacturing industries
		Gas, electricity companies Distribution

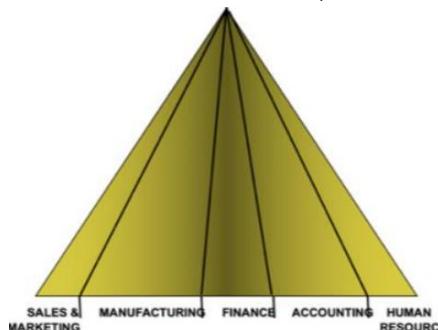
- o **Management level:** the IS supports the management control loop (**MCL**) and, with it, the goal definition, the analysis of results and the corrective actions [for the goal definition, budget goals are often used, but there are also goals related to item produced and item quality]
- o **Strategic level:** the IS is needed to analyze customers ("profiling"), products ("dependability") and performance ("dashboard")

⚠ While in the **operational level the IS has a contiguous use and simple, current, huge information, in the **management** level the IS has a periodic use, but it needs aggregated and historical information.**

For each level are defined the kind of **APPLICATIONS NEEDED**:

- o Strategic level → **ESS** (executive support system) + **DSS** (decision support system)
- o Management level → **MIM** (management information system)
- o Knowledge level → **KWS** (knowledge work system)
- o Operational level → **OAS** (office automation system) + **TPS** (transaction processing systems)

BUSINESS FUNCTIONS are represented as vertical sections; in our example:



- o **Sales & Marketing:**

- **Marketing:**
 - o Identify the customers (and their needs)
 - o Plan + develop products/services to meet their needs
 - o Advertise and promote these products/services
- **Sales:**
 - o Contact customers
 - o Sell products/services
 - o Take orders

System	Description	Level
Order processing	Enter, process and track orders	Operational
Market analysis	Identify customers using demographics, markets, trends	Knowledge
Pricing analysis	Determine price for product or service	Management
Sales trend forecasting	Prepare 5-year sales forecast	Strategic

- o **Manufacturing & Production:**
 - o Plan, develop and maintain production facilities
 - o Establish production goals
 - o Acquire and store materials
 - o Schedule equipment, materials and labor required

System	Description	Level
Machine control	Control action of machines	Operational
Computer-aided design	Design new product	Knowledge
Production planning	Decide when and how many	Management
Facilities location	Decide where to locate new facilities	Strategic

- o **Finance & Accounting:**
 - Finance:
 - o Manage financial assets (cash, stocks, investments)
 - o Borrow money with the best conditions
 - Accounting:
 - o Maintain and manage the financial records/receipts; 3 types:
 - Sectional = towards customers and suppliers (incomes and expenses)
 - Institutional = towards stakeholders and law (taxes and balance)
 - Management = towards internal structure (cost of production)

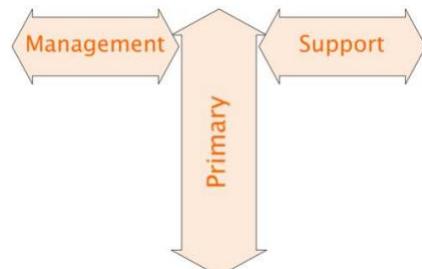
System	Description	Level
Account receivable	Track money	Operational
Portfolio analysis	Design portfolio of investments	Knowledge
Budgeting	Prepare short-term budgets	Management
Profit planning	Plan long-term profits	Strategic

- o **Human resources:**
 - o Understand what skills are needed
 - o Manage employees (identify, maintain, develop)
 - o Compute salaries (+ evaluation and compensation)
 - o Outplacement

System	Description	Level
Training and development	Track employees training, skills and estimate performance	Operational
Career pathing	Design career paths for employees	Knowledge
Compensation analysis	Monitor fairness in employees wages and benefits	Management
HR planning	Plan long-term labor needs	Strategic

- **T MODEL** → has an horizontal part common for every kind of organization and a vertical part specific for the business sector. 3 types of **PROCESSES**:

- o **Support** = IT, HR, accounting, finance and firm (not visible for the customer); provide services to the organization and comply with law obligations
- o **Managerial** = strategic planning, BI and management control loop; lead the organization
- o **Primary** = produce and provide products/services; serve the customers

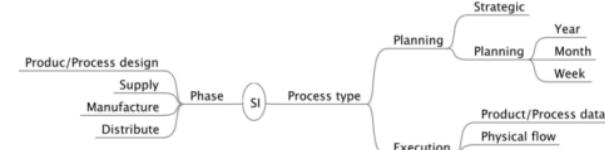


Primary processes for each business domain:

- **Manufacturing:** companies designing and producing individual items in large quantities; models used:
 - o **Value chain** = value is what a customer wants to pay for a product, so organization has to follow a chain of activities to produce this value [dx]
 - o **Planning/execution** = describes vertical phases (logistics + operations):
 - Planning = time planning and strategic analysis
 - Execution = process & product data, order and material management, physical operations



We can **put together process types and phases**; the product/process data can be modeled using:



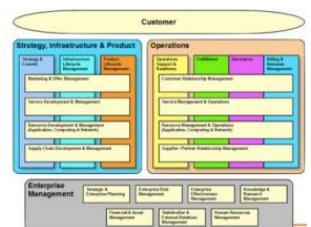
- **PLM tools** (product lifecycle management, store and process designs)
- Bill of Materials (**BoM**, list of components for each product)

⚠ Common acronyms and functions:

- **CAD CAD systems** = product design
- **Planning** (manufacturing resource planning) = from product data and customer orders to orders for the suppliers
- **Execution** (CIM, Computer Integrated Manufacturing) = control manufacturing
- **SCM** (Supply Chain Management)
- **CRM** (Customer Relationship Management)

- **Process industries:** organizations related to process materials (production + maintenance of plants):
 - o **Inbound logistics** = raw material and maintenance material supply

- **Operations** = plant supervision, process control and machinery maintenance
 - **Outbound logistics** = product distribution and sale
 -
 - **Telecom operators** (**Telco** organizations with single customers and big organizations): **eTom** framework is a scheme of process for Telco organizations:
 - **Operations** (3 primary processes):
 - Network
 - Services
 - Workforce
 - **Marketing & sales:**
 - Marketing and sales per customer type (website, call center and shops)
 - Billing (connected with backend that activates SIMs)
 - **After sales service** (technical support)
 - **Utilities**: organizations that produce **natural resources/energy** (produce, extract and trade resources). These have 3 processes: service, network and workforce management. There is little innovation of product and little customer turnover, but some innovation of process. The **value chain** is similar to Telco:
 - **Operations** (service, network and workforce)
 - **Marketing & sales** (per customer type and billing)
 - **After sales service** (complaints and technical support)
 - **Banks & insurances**: the main process is service management:
 - **Banks** = account and investment management, loans; the main issues are customer segmentation, products and data replication
 - **Insurance** = vehicles, life, pension and health; the main issues are IS for local agency and for main site, and data replication
- The **value chain** is:
- **Inbound logistics** (managing cash flow from the customers)
 - **Operations** = activation and delivery of services
 - **Marketing & sales** (per customer type)
 - **After sales service**
- **Retail**: 2 main processes = procurement-inbound logistics + stores management; the main issues are large number of stores, suppliers and customers (less QoS), and perishable goods (es. food) [simple process, big volumes, small margins]. The **value chain** is:
 - **Inbound logistics** (products supply)
 - **Operations** = stores management, control
 - **Marketing & sales** (billing, campaign management, advertising)
 - **Health**:
 - **Patient** = manage and share medical data among all the actors (Electronic Patient Record...)
 - **Private and public care centers** (hospitals, labs):
 - Logistics: patients, drugs, doctors, nurses and medical equipment
 - Administration: payments, reimbursements, communications and maintenance
 - Medical data
 - **Private and public entities paying services**
 - **Medical devices**
 - **Public Administration**: entities interacting with citizens and companies; the main issues are management process often absent, support processes more automated, services to citizens and companies, and basic horizontal services (SPID, PagoPA ...)
 - **Transport** (public infrastructure management, registry of vehicles and driving licenses)
 - **Land & estates** (cadaster, building and monitoring)
 - **Tax**
 - **Health** (*see above*)
 - **Security**
 - **Agriculture, rivers, forests**



The **SEGMENTATION** is separating the software (that an organization is selling) in different software modules, dividing them by business function and domain. 2 types:

- **Segmentation by vendor** → made by organizations who produces the software (es. Oracle)
- **Segmentation by integrator** → made by organizations who merge different softwares (private)

The **PICK CHART** is a graphic that divides the process improvements in 4 categories:

- Possible = easy improvements with low payoff
- Implement = easy improvements with high payoff (quick-win), first to implements
- Challenge = big and difficult improvements with high payoff
- Kill = difficult improvements with low payoff (better to discard)



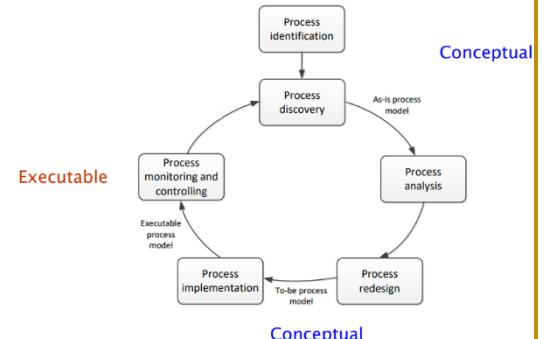
2) LOW LEVEL MODELS

2.1) Process

The easiest way of representing business processes is by using **free text**, but is difficult to have a distinction between the processes. Another way is by using a **table** with 4 columns: process name, input, output of the process and description; each process is a row (but could be overlapping between them).

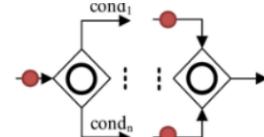
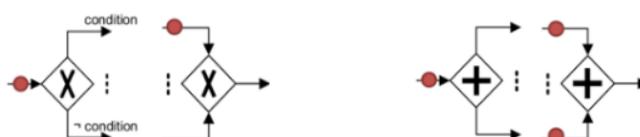
The **BUSINESS PROCESS LIFECYCLE** is composed by:

- **Identification & Discovery** (modeled using text, tables, CRASO, Anthony and T Model)
- **Analysis & Redesign** (modeled using BPMN and other high-level models)
- **Implementation & monitoring/controlling** (made using BPMN, low level models and programming languages)



The **BPMN** (Business Process Modeling Notation) is a graphical representation for specifying business processes that we can use as a model, but more as an enactment of the process that can be executed by a **process engine**. A BPMN has **4 types of core elements**:

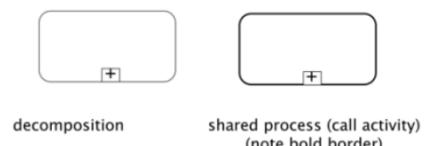
- **Activity (Task)** → a task to be performed
- **Sequence** → order of the tasks
- **Event:**
 - **Start event** = triggers a new process instance by generating a token that traverses the sequence flow
 - **End event** = signals that a process instance has completed and consumes a token
- **Gateway** (every gateway should have a closing [join]):
 - **XOR** = acts as a condition, the token can take only 1 way
 - **AND** = create parallel flows for every branch, cloning the token
 - **OR** = create different parallel flows depending on different conditions



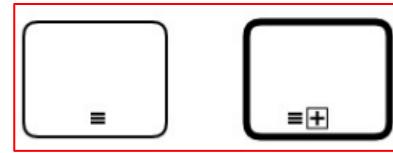
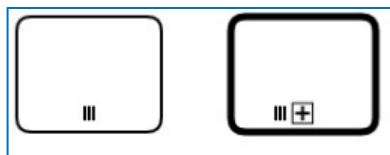
There are different **naming conventions** for BPMN:

- Every event and activity (task) must have a name
- Tasks → a verb followed by business object name and possibly a complement (es. Renew License via Agency)
- Message events → item followed by past participle (es. Invoice received)
- Avoid generic verbs (as handle and record)
- Label each XOR-split with a condition

An activity can invoke a **subprocess** and this is optimal in 2 cases: decompose a large model and reuse a shared process.



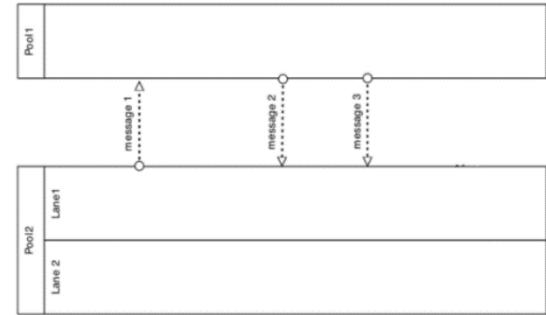
An activity (task) or a subprocess can be **repeated**; this repetition can be made in **parallel** and in **sequence**.



There are different **type of tasks** (activities):

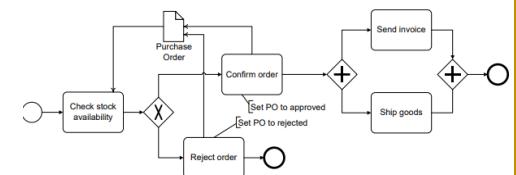
- **Manual** (executed by person, no software tools) [👉]
- **User** (by person, with software tools) [👤]
- **Service** (automated) [⚙️]
- **Message send/receive task**

A **POOL** contains a single complete process. The flow can't cross a pool, but can communicate with other pools using asynchronous messages; a pool contains different **lanes** (units of the same organizational entity that share a common system to communicate).



⚠ The other organizations are considered as a “black box” and are represented by an empty pool because is not a relevant information for us.

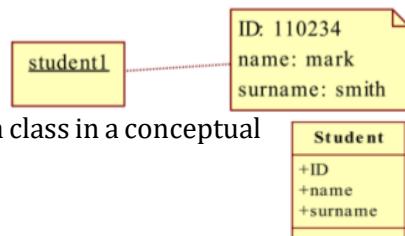
An **ARTIFACT** is a way to connect the BPMN with the Data Model because an artifact represent data required or produced by any activity. But using artifacts make the diagram messy, so instead of using them, we connect the BPMN to the Data Model associating the name of the classes in the UML to the name of the events/tasks in BPMN.



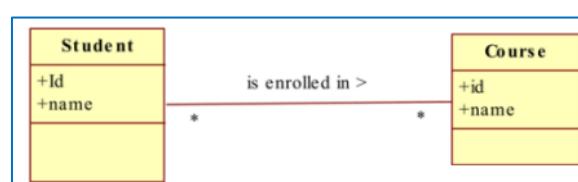
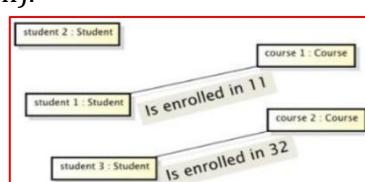
2.2) Data

The Unified Modeling Language (UML) capture the main concepts of the IS and the relationships between them. The purpose of this model is to represent the concept (not things like the system or software classes)

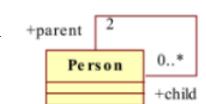
- **OBJECT** = model of an item characterized by attributes, can perform operations and receive messages
- **CLASS** = description of a set of objects that have common properties. Usually, a class in a conceptual model can be:
 - o **Physical entity** (es. person, car...)
 - o **Role** (es. employee, doctor...)
 - o **Social/legal/organizational entity** (es. university, company...)
 - o **Event** (es. sale, order...)
 - o **Time interval** (es. car rental, booking...)
 - o **Geographical entity** (es. city, road...)
 - o **Report [Summary]** (es. weather report, bank...)
- **ATTRIBUTE** = property of classes, associate to each object a certain value



A **LINK** is a relationship **between 2 objects**, used when a property can't be represented on 1 object only. An **ASSOCIATION** represents a set of links and is a relationship **between 2 classes** (same relation of object-class is between link-association).

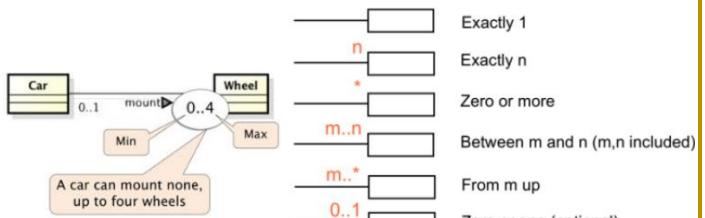


We can associate a label to an extremity of the association and this label is called **ROLE** (very useful in **recursive associations** [from a class to itself]).

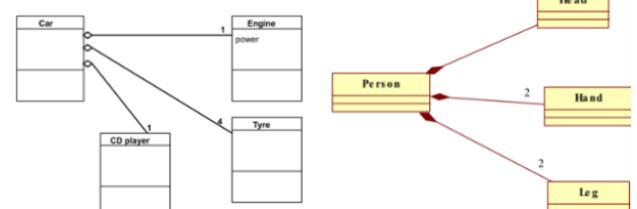


⚠ Style suggestions: **singular noun** for class names; **verb** for associations.

The **MULTIPLICITY** is the **max and min number of links** in which an object of a class can participate and should be specified for each class participating in an association.



An **AGGREGATION** is an association where 1 object B is part of another object A, but B can exist also alone (a **COMPOSITION** instead specify that B can't exist without A).



An **ASSOCIATION CLASS** allows to attach attributes to an association.

⚠ Alternatively, we could use a new class with its own attributes and 2 relationships towards the other 2 classes.

B is a **SPECIALIZATION** of A if the objects described by B have the same properties of the objects described by A, but also other attributes (and A is a **GENERALIZATION** of B).

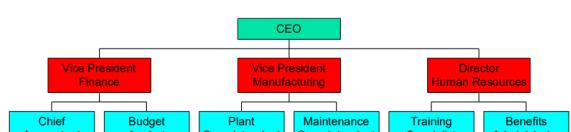
⚠ Don't use:

- Plural nouns for classes
- Forget multiplicity
- Forget roles/association classes (when needed)
- Use class as an attribute
- Use attributes that represent many objects
- Use transient relationships to represent events not interesting (es. "Student exits the class" or "enters the class physically")
- Specify the ID related to an associated class
- Use loops in relationships

2.3) Organization

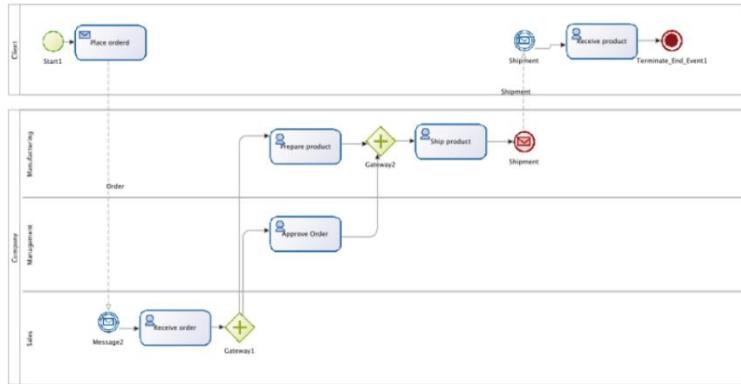
An organization is divided in different parts called **Organizational Unit (OU)** and we can use 2 kinds of models:

- **Inter-organizational:**
 - o List the organizations involved
 - o CRASO model
- **Intra-organizational:**
 - o **Organizational chart** = each node corresponds to a different **OU** and a line represent that the lower node is part of the upper one; this can be used also to represent **roles** in an organization where the top nodes control the down nodes (we can also mix OU and roles in the same chart)
 - o **Linear Responsibility Chart (LRC)** = processes are the rows, OU are the columns; each cell is the degree of involvement of the OU in the process → **P** (if the OU is a main actor in the process), **C** (if the OU just receives something from the process, but doesn't perform any action), **nothing** (if the OU is not involved in the process) [if a process implies too many OU, process has something wrong]



Processes (samples)	Organization's Structures							External Actors	
	Purchase	Design	Production	Sales	Adm.	Human Resources	Information Systems	Supplier	Customer
Management Report Production	C	C	C	C	P	C	C		
Customer Order Processing			P	P					C
Procurement	P		P					P	

- o **BPMN Poll & Lanes** (we can model an organization by a pool where each OU is a lane)



⚠️ BPMN and LRC are cross models between processes and OUs.

2.4) Business rules

A **BUSINESS RULE** is a statement that contains some aspect of the business, apply to business processes and can only be true or false. Every business has business rules that are **automated** and **formalized** (formalized = implemented in the same way by everyone). A business is **encoded** with a computer language into the application layer. A **policy** is a general direction and will be implemented using different business rules. A business rule should be **declarative, precise, atomic, consistent, expressible, distinct** and **business-oriented**.

During the execution of a process, when the **process engine** encounters a condition/decision, it calls the rule engine which, after accessing the rule, gives the result. The **BRMS** (Business Rules Management System) is a software system used for the business rules (the Business Rule Engine is part of it) [es. Oracle BR engine].

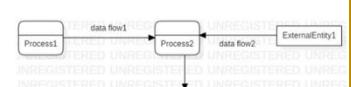
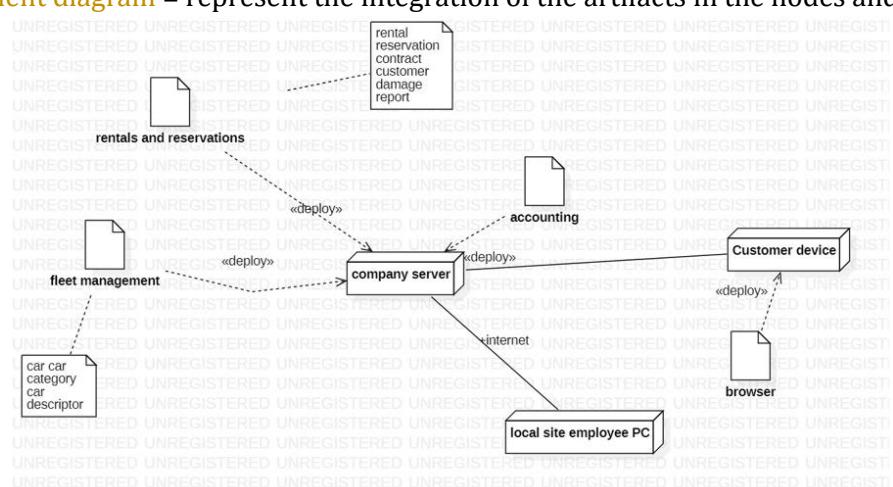
A **Drools rule** has 2 parts: when the condition is verified, the action is carried out. Another possibility is to use Decision Tables (compact way of representing conditional logic) [spreadsheets or CSV] [img dx]

Decision Name & Id		Hit Policy	Input Expression	Input Type Definition	Output Name	Output Type Definition	Annotation
Dish	Decision	U	Input	How many guests	Output +	Dish	
1 "Fall"	<= 8	"Separate"					
2 "Winter"	<= 8	"Winehead"					
3 "Spring"	<= 4				12 Day Aged Gourmet	Steak	
4 "Summer"	[5..8]				"Steak"	Save money	
5 "Fall", "Winter", "Spring"	> 8				"Light Salad ad rice"	Less effort	
6 "Summer"					"Steak"	Hey, why not?	
Input Entry (Condition)		Rule		Output Entry (Conclusion)			

2.5) Technology

There are different notations to describe the **technological implementation** of the IS:

- **Application portfolio:** list of applications
- **Data flow diagram:** describes the processes and what data they exchange →
- **UML deployment diagram:** describe the applications in the context where they are executed:
 - o **node** = a physical or software entity capable of do processing (they can be nested)
 - o **association** = link between nodes
 - o **artifact** = software part that is interesting for the business process (es. source file, library, database)
 - o **deployment diagram** = represent the integration of the artifacts in the nodes and the technology



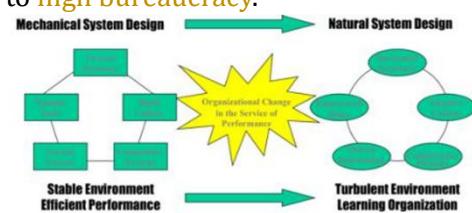
3) ORGANIZATIONS

An **ORGANIZATION** have characteristics related to the **organizational variables** (defined with **organizational design**) [the **changing** of an organization is related to a change of their organizational variables (organizations' **lifespan** is shorting)]. There are different **organizational variables**:

- **Size:**
 - o **Number of employees** (different kinds of employees: full time, part time and collaborators)
 - o **Turnovers**
 - o **Number of sites**
- ⚠ **SMEs** (Small Medium Enterprise) are the majority of companies.
- **Goal type:**
 - o **Coercive** (es. Prison)
 - o **Utilitarian** (es. Profit)
 - o **Normative** (es. University)
- **Culture:** a unifying factor that restraint change; define what is encouraged/discouraged/accepted/rejected
- **Politics:** activities related to making decisions in groups related to the allocation of resources and status (in a company, conflict is normal and can be resolved with brute force or discussion [better])
- **Environment:** resources, governments, regulatory agencies, competitors, financial institutions, knowledge
- **Structure:** describe the role of the people
- **Formalization:** level of description of an activity; if an activity has a complete formalization, it becomes an algorithm called **SOP** (Standard Operating Procedures)
- **Centralization:** where to allocate decision power in the hierarchical levels (**centralized organization** = decision power only at higher levels; **decentralized organization** = power also at lower levels); **high centralization** = more homogeneity and slower responses, & **less centralization** = less homogeneity and better response times
- **Specialization:** level of **detail** of activities and of **specificity** of employees (specific activities are often assigned to specialized roles). More specialization is linked with more formalization, efficiency and precision, but less flexible

⚠ A high level of formalization, centralization and specialization is related to **high bureaucracy**.

The **organization design** spans from a **mechanical/hierarchical system design** (**vertical** structure, rigid culture, stable/efficient environment) to a **natural system design** (**horizontal** structure, adaptive culture, shared information and empowered roles).



There are different **organizational types**:

- **Entrepreneurial** = startup business with total flexibility
- **Machine** bureaucracy = mid-sized manufacturing firm
- **Divisionalized** bureaucracy = biggest organizations that manage sort of independent companies
- **Professional** bureaucracy = law firms and hospitals, where a part of activities is efficient/repetitive, and the other is custom/difficult
- **Adhocracy** = consulting firm where each project is different ("ad hoc")

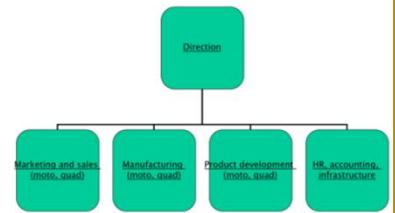
The **organizational structures** are represented in **graphs** with node and links where each node is an OU and a link represent a formal dependency. Given the same size of an organization, a lower depth of the hierarchical levels (horizontal organization) gives **faster reaction** (command chain is close), but increases the **workload** on the upper levels. The **links** can be:

- **Vertical** = control and communication, lower-level employees must perform activities set by the higher level.
Denote the **HIERARCHY**; can be implemented with plans, rules/procedures, command chain and vertical IS
- **Horizontal** = communication, employees in different units must share information and coordinate; can be implemented with IS (DB of shared information), direct contact, full time integrator role, task force and team

The **STRUCTURE** of an organization can be:

- **Functional:** employees are grouped according to similar functions/skills (functions aren't repeated)

- o **Pro** → allow economies of scale (if a unit does more, it costs less), enable skill development and enable organization to accomplish functional goals
- o **Contro** → slow response time to changes, hierarchy overload (poor horizontal coordination), less innovation



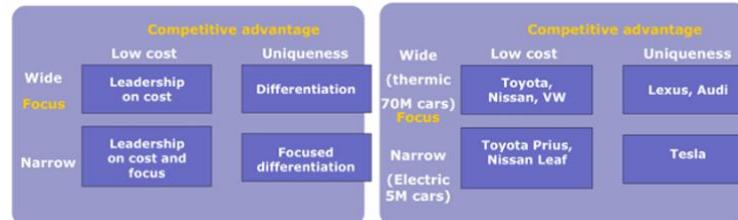
- **Divisional**: employees are grouped by product (functions are repeated for each division)
 - o **Pro** → fast change, client satisfaction, high coordination across functions, adaptation, decentralized decisions (is best in large organizations)
 - o **Contro** → eliminates economies of scale in functional departments, poor coordination, eliminates technical specialization and makes standardization difficult
- **Geographic**: functions repeated for each geographical area
- **Matrix/multi-focused**: grouping by more than 1 criterion
- **Process/vertical**: employees grouped by process

4) STRATEGY

The **STRATEGY** is the **definition of goals** and an **action plan to achieve them**; the **aims** can be profit levels, profit destination (no-profit or public company), interaction with social environment and with environment. The **Nace taxonomy** list the possible business sectors [a company can change its business sector and his strategy].

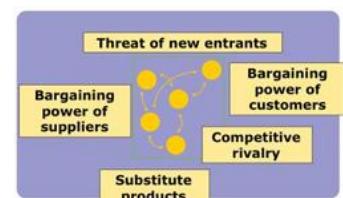
The **Porter's model** describes the strategy of a company considering:

- **Competitive advantage** = the product is unique & costly (luxury) or common & low-cost
- **Market focus** = the product is for the mass market or for specific niches



Porter also defined the **5 forces model** that identifies and analyzes 5 competitive forces that **shape every industry** and helps determine an **industry's weaknesses and strengths**:

- **Substitute products** = new products that substitutes and kill the one you are selling
- **Bargaining power of customers** = have few customers with large volumes lead to dependence to them
- **Bargaining power of suppliers** = higher costs for the supplier's products cause your prices to increase
- **New entrants** = the ease with which a competitor can enter the company's market
- **Intensity of rivalry** = how many competitors there are



The amount of available knowledge is increasing exponentially (shown in the **Knowledge Doubling Curve**), but companies' lifespan is decreasing because of technology boost.

The **Business Model Canvas (BMC)** is a tool to express all the essential strategic decisions in an organization:

- **Value proposition** = list of all products and services, how they produce benefits and gains for the customer (**Gain Creators**), how they alleviate problems and reduce negative emotions (**Pain Relievers**) [newness, performance, customization, price, social status, design, cost reduction, risk reduction, accessibility, usability]
- **Customer segments** = **groups of customers the organization aim to serve** (and not to serve) [mass market, niche market, segmented, diversified, multisided]



- **Channels** = the physical or non-physical way of **reaching the customer segments**:
 - o raise awareness about organization
 - o explain the value proposition
 - o purchase + deliver the product/service
 - o provide post purchase support
- **Customer relationship** = type of **relationship between organization and customer segment**:
 - o Personal assistance [call center] (or dedicated personal assistance [financial advisor])
 - o Self-service [website]
 - o Automated service (customized self-service, [google search])
 - o User community (share suggestions + support between customers)
 - o Co-creation [YouTube]
- **Key resources**:
 - o Physical [facilities, vehicles, stores, platforms, networks...]
 - o Intellectual [brands, trademarks...]
 - o Human [workers, salesforce...]
 - o Financial [cash, stock options]
- **Key activities** (are not outsourced):
 - o Design, production
 - o Problem solving
 - o Platform management
- **Key partnerships** = **relationships with other organizations**:
 - o Alliances between non competitors
 - o Coopetition (alliances between competitors on specific product/service)
 - o Buyer-Supplier relationships
 - o Outsourcing relationships
- **Cost structure** = **cost related to key resources, activities, relationships**; cost driven (Ryanair) or value driven (luxury); must be considered fixed and variable costs. **Economy of Scale** (produce 1 product to increase the volume of production) vs **Economy of Scope** (produce many products to increase the set of products)
- **Revenue streams** = **how much customer segments pay for the product/service**:
 - o Asset sale (1 time payment)
 - o Usage fee (proportional to usage)
 - o Subscription fee (for amount of time)
 - o Renting/lending/leasing (exclusive use for a defined amount of time)
 - o Licensing (right of using a copy)
 - o Brokerage fees (fee for intermediation service [es. Booking.com])
 - o Advertising

Price can be:

- **Fixed** = based on static variables (list price, number of features dependent, customer segmentation dependent, volume dependent)
- **Dynamic** = the price changes depending on market conditions (negotiation, yield management, real time market, auctions)

There are different kinds of **Business Model (BM) Patterns**:

- **Unbundling** = dividing the activities in 3 macro-categories:
 - o Product innovation
 - o Infrastructure management
 - o Customer relationships
- **Long tail** = selling small quantities of many items (while in the traditional way the aim is sell large quantities of few items) [content industry]; it's possible because of democratization of production, democratization of distribution and better link supply-demand
- **Multisided** = selling to 2 different (but interdependent) group of customers
- **Free** (revenue from advertisers)
- **Freemium** = the basic service is free, the premium requires a fee
- **Bait and hook** = upfront there is a free or very cheap offer, but later there are fees to pay

⚠ The Mission Model Canvas is an adaptation of the BMC for non-profit organizations

5) KPI – CSF – BSC (MANAGEMENT)

The **managers** of an organization need to have control of what is happening and they do it by using metrics and measures (the entire cycle is the **Management Cycle**). An **indicator** is an high level aim of the company that implies measures.

A **measurement** is the empirical objective assignment of numbers to entities, in order to characterize a specific attribute. A **MEASURE** is an attribute of an entity; **typical entities** are:

- Resources (employee → measures: age, salary, machine, web server)
- Activities (design → measures: duration, cost, production)
- Product/services (car → measures: cost, book, insurance)

The possible measures are grouped in **dimensions**:

- Time window
- Hierarchical nodes/Geographical
- Product/Product category
- Customer/Customer category
- Activity in process
- Project

The **MEASUREMENT PROCESS** has different phases:

- **Define/modify** indicators and measures (using Management accounting, CSF, KPI)
- **Verify** indicators and measures (meaningfulness, cost, coverage, frequency/obsolescence)
- **Collect** and store the measure (data collection & storage, measure computation & presentation)
- **Present** the results (to the managers) and use them day by day
- **Check** if they are used and useful

There are different **APPROACHES** to define indicators:

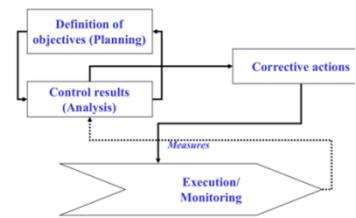
- **Management accounting** → set indicators on costs, revenues, cash flow, investment, capital, return of investment. There are 2 aspects to consider:
 - o **Financial accounting** = public data, standards and laws, historical perspective
 - o **Management accounting** = private data, fit for the use of company

There are different **indicators and measures**:

- **Expenses** = costs for the organization (fixed + variable)
- **Revenue** = income for the organization
- **Accounts receivable** = invoices issued to customers
- **Accounts payable** = invoices received by suppliers (*)
- **Liquidity** = money available for the organization at a certain time
- **Net income** = total revenues – total expenses
- **Asset** = what is owned: current (converted in cash within a year) + fixed (provide benefits in more than a year)
- **Liability** = what is due: current (payable within a year*) + long-term (payable in more than 1 year [mortgage])
- **Equity** = assets – liability
- **Cash flow** = sum of cost – sum of revenues, over a certain period [can be positive or negative]
- **Operating profit** = sum of invoices issued – sum of invoices received, over a period
- **Profitability** = net profit margin (net income / revenues), operation profit margin ((net incomes – taxes – interests) / revenues) and EBITDA (earnings before interest taxes depreciation amortization)
- **Balance sheet** = summary of assets, liabilities and equity at a certain time

The **cost accounting** is an important part and includes budget and cost of operations, departments, processes, products; it's needed to analyze the **variances** and the **profitability** to compute the **unit cost** of products and services. We divide:

- **Direct** cost = traceable to a product/service sold to the customer
- **Indirect** cost = related to the horizontal functions (not directly traceable and difficult to compute); can be allocated in 2 ways:

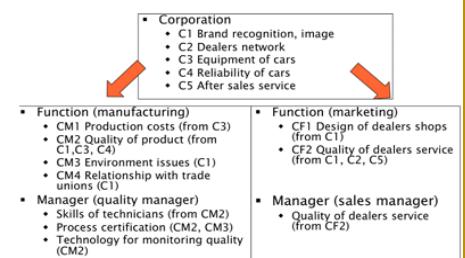


Entity	Attribute	Measure
Person	Age	Year of last birthday
Person	Age	Months since birth
Car	Cost	Euros, Dollars
Car	Weight	Kilograms
Car	Reliability	Number of defects per year
Car production process	Duration	Time in hours from start to finish
Car production process	Quality	Average number of defects found per car

- proportional to number of products manufactured
 - activity based costing (split the cost on different activities)
 - **Fixed** cost = doesn't depend on the number of units produced
 - **Variable** cost = depend on quantities produced
- ⚠ To allocate costs related to **personnel**, we need to consider salary (direct cost) + overheads (indirect cost); the **FTE** is the virtual number of employees working full time on a process [are also used tools like timesheets]
- **CSF (Critical Success Factors)** → only a few factors are important in an organization and should be monitored. CSF exists at different levels in the organization structure (corporation, function, single role) and can come from different areas:
 - **Business domain** = key areas for all companies in same business domain [es. cost for manufacturers, ...]
 - **Competitive factors** = factors that differentiate company from others [es. low cost, QoS...]
 - **Environmental factors** = norms, rules, standards [es. pollution, ...]
 - **Contingency factors** = temporary constraint

A CSF is composed by:

- **Name** (brand recognition)
- **Description** (how brand is known or associated to a product)
- **Type** (business domain, competitive factor...)
- **Level** (corporation, function...)



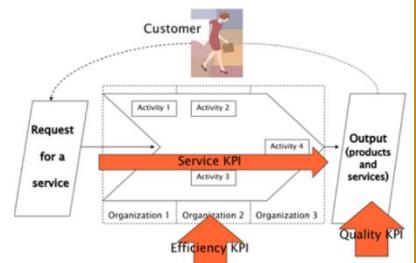
⚠ CSF can be linked with compensation for the group of employees that achieve a certain goal.

- **KPI (Key Process Indicators)** → while CSF focuses on the different areas of the company, the KPI focuses on measuring certain indicators on the processes. The **KPI descriptor** is composed by:

- **Name**
- **Definition** (how the KPI is computed)
- **Type**
- **Segmentation**

There are 4 types of KPI:

- **General**
 - **Input volume** (how many times the process starts)
 - **Output volume** (how many times the process ends)
 - **Input volume/Output volume** (ratio of completed operations)
 - **Human resources**
 - **Non-human resources** (plants, facilities...)
 - **Inventory**
 - **Other resources** (website, IS...)
- **Efficiency**
 - **Cost per unit** (total/volume)
 - **Productivity of resources** (volume/resource)
 - **Utilization of resources** (used resources/available resources)
- **Quality**
 - **Conformity** (non-conform items/total items)
 - **Reliability** (probability that the product satisfies its functions after time T)
 - **Customer satisfaction** (1 to 5 votes)
- **Service**
 - **Lead time** (time to satisfy an order)
 - **Response time** (lead time + queue = total time needed)
 - **Punctuality** (actual lead time - nominal lead time)
 - **Perfect orders** (on time and within specifications)
 - **Flexibility** (modified orders/total orders)



- **BSC** (Balance ScoreCards) → focuses on 4 key perspectives of the organization that must be balanced:
 - o **Financial** (cash flow, return of investment, profitability, return on equity)
 - o **Customer** (satisfaction, returning customers, market share, quality)
 - o **Internal Process** (number of activities, success rate, accident ratios, manufacturing indicators)
 - o **Innovation and learning** (investment rate, promotions, employee turnover, gender ratios)

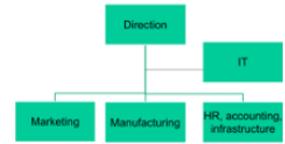
All the information of the BSC is visualized by the **Dashboard BSC** [dx].

- ⚠ There are **statistics** applicable to a measure [Central tendency (mode, median, mean), Frequency distribution, Variance]

Financial perspective -turnover -ROI	Customer perspective
Internal processes	Innovation and learning

6) IT

The **IT area** is the organizational entity that supports/offers IT services to an organization; only companies above a certain size threshold can sustain an IT area. Before there was a **Decentralized IT** (IT for every department), now the IT works directly for the direction as a “staff” function (**Centralized IT**) [for this the scheme has IT over]



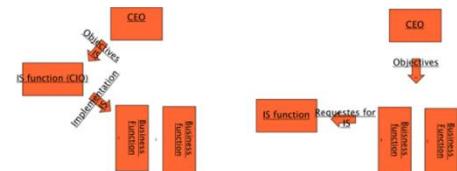
The **centralized approach** has:

- ✓ Economy of scale
- ✓ Standardization
- ✓ Data sharing
- ✓ Governance (control of IT budgets, enforcement of IT strategy)
- ✓ Consistency of data
- ✗ Less reactivity to requests from other business functions
- ✗ Less specialization

⚠ If there is no control, the centralized approach will become decentralized because of entropy (**Conway's Law**).

There are 2 different methodologies to coordinate the different division with the IS:

- **Push** = the CEO gives the strategy to the CIO that implements the IS for the different business functions
- **Pull** = the CEO gives objectives to the business functions and the business functions request the IS to the IT area



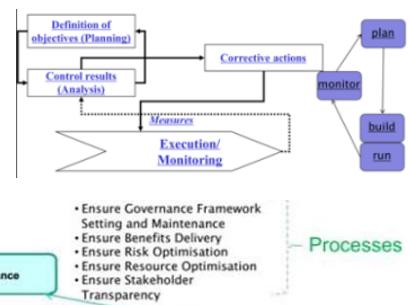
There are **different roles inside IT area**:

- **Manager** → in charge of a team:
 - o **General manager** = in charge of an entire organization
 - o **Functional manager** = in charge of a functional area/team
- **End user** → they use the software applications
- **Executives:**
 - o **CEO** (Chief Executive Officer)
 - o **CIO** (Chief Information Officer)
 - o **CDO** (Chief Data Officer)
 - o **CDO** (Chief Digital Officer)
 - o **CISO** (Chief Information Security Officer)
- **Technical staff:**
 - o **Architect** = develops framework for the development of a system
 - o **Developer** = builds the software using the framework provided by the architect
 - o **Administrator**
- **Analysts and Managerial staff:**
 - o **Analyst**
 - o **Project Manager** = responsible for delivering the IS on time, within budget and scope
 - o **IS Manager** (under the CIO)
- **Data science and analytics:**
 - o **Data scientist** = in charge of analytics on data
 - o **Data engineer** = does data access and preparation

- o **Subject matter expert** = individual with a deep understanding of business and the functional domain of analysis
- **IT Consultant** → moves assuming roles like the ones described previously

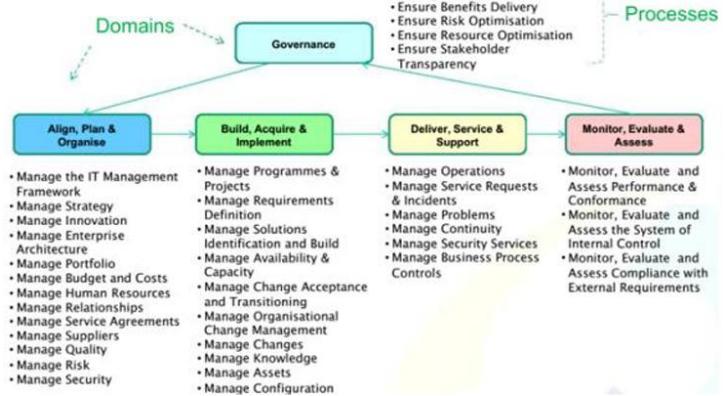
The **COBIT** is a reference document that aims at aligning Business and IT Strategy meant for managers and auditors. It implements the **management control loop** using a different notation:

- Definition of objectives becomes **plan**
- Corrective actions become **build**
- Execution becomes **run**
- Control results become **monitor**



Each process for governance and management is **decomposed** in activities and practices (with input and output for each).

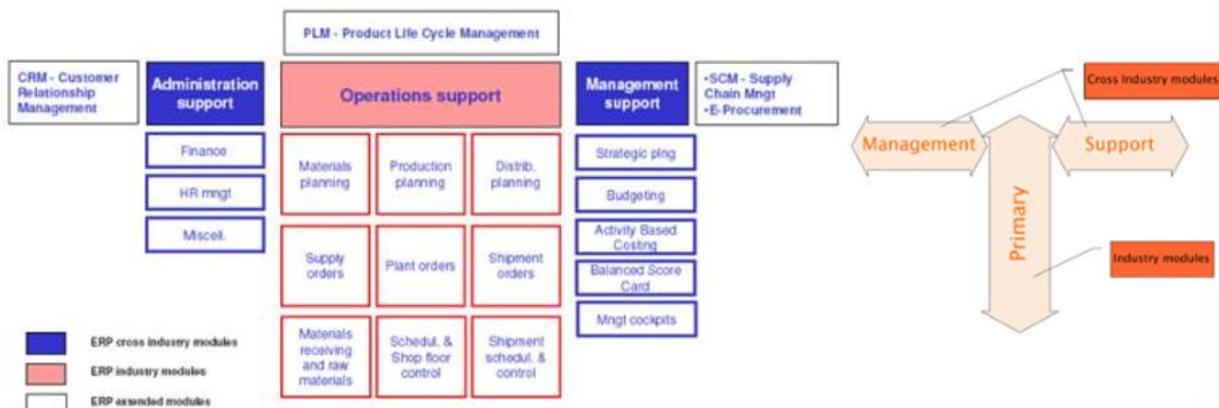
⚠ Usually Delivery, Service & Support (**Run**) takes 60-70% of the IS budget while Build, Acquire & Implement (**Build**) takes 20-30% (or 0% if nothing changes).



7) ES: ERP+CRM+SCM

ERP (Enterprise Resource Planning), **CRM** (Customer Relationship Management) and **SCM** (Supply Chain Management) are software applications that help managing the business; **ENTERPRISE SYSTEM** (ES) is **ERP + CRM + SCM**.

An **ERP** is composed of different modules, where we can recognize the **T Model**: the **vertical** line is related to modules specific for the business, while on the **horizontal** line there are cross-industry modules.



The **ES** is organized in **3 levels**:

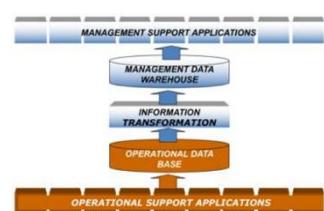
- **Software functions** = supports single operation and activities
- **Module** = a software application that has different functions
- **Suite** = a set of software application that can share the same database

The **ES** model has **3 principles**:

- **Data sharing** = all the software applications share the same data; in case of data sharing, there are:

- o **Horizontal integrity**: all applications share the same data
- o **Vertical integrity**: same data from operational level to management level

The management support applications aggregate data and show KPIs.



- **Modularity** = companies that produce software sell different modules that fit different business functions
- **Prescriptivity** = the ERP sold is the same for every customer, but there is a limited capability of customization

⚠ Before buying/building an ERP, a company needs to do a **gap analysis** (help to decide if it's convenient or not using a software to do a certain activity and if the software should be bought or produced). The **transition to an ERP** has different **costs** (license + personalization, delay [time for doing the transition], changes to business processes, loose flexibility on some operations...); the cost depends also on the **size of the companies** (large corporations [turnover > \$50M] have constraints like multi-currency, multi-language, etc...; SME [turnover < \$50M] has less constraints).

⚠ There are different **ERP vendors** (**major players** [SAP, Oracle ERP cloud, Microsoft Dynamics NAV], **local producers** and **open-source** products); there are also different **vending options** (installation [cloud or on-premise] or payment [per license or per user-per-month]).

A **CRM** implements an integrated and structured process to **interact with customers**, building a long-term **relationship** with the customer (increasing their satisfaction); the **customer becomes a core aspect of the commercial strategy**:

- **easy access** to products/services
- **customized offers**
- **complete access** (from pre-sale to post-sale)
- the company collects **complaints and suggestions**

The CRM has **3 principles**:

- **Multichannel** = the customer can access the company through any channel
- **Uniqueness of data and services** = the access is consistent through all channels, the data provided is the same and doesn't depend on channel
- **End to end service chain** = evolution of Porter's value chain where company is a chain of services connected:
 - o Reservations (DB with availability of product/service + frontend)
 - o E-commerce (when the delivery is included)
 - o Customer care (complex service chain that assists the customer after the sale)

⚠ In the 80's the CRM tool was **SFA** (Sales Force Automation) for B2B (few buyers buy many items and negotiate the price) and B2C (many buyers buy 1 item at a fixed price and pay immediately)

⚠ Not all **business domains** need a **CRM**; it depends on intensity of relationship with the customers, size of the customer pool, loyalty of customer and multichannel or not.

The **key functions** of a CRM are **commercial logistics**, **support for multichannel interaction**, **after sale support** and **analysis of customers**. A CRM can have **different modules**:

- **Sales Force Automation (SFA)** [see above] = find new customers and interact with them for the sale (offer creation) ["Salesperson"]
- **Internet channel**:
 - o General information, catalogue of products
 - o Purchase (product suggestion, shopping cart, checkout)
 - o Transactions of the customer + log of all customer actions
 - o After sale (complaints and suggestions)
- **Call center channel** = with a CTI (Computer Telephone Integration); has different functions:
 - o Information on company and products + telemarketing
 - o Purchase + status of purchases
 - o Complaints
 - o History of interactions
- **CRM Analytics** = using data from the DW:
 - o Segmentation indexes
 - o Data mining to compute predictive indexes
 - o Reports on customers, production of dashboards
 - o Definition of segments and customers per segment



- **Campaign management** = planning and execution of campaigns:
 - Selection of customer lists using the CRM Analytics
 - Design and plan campaign
 - Transfer data from CRM Analytics to operational IS

⚠ There are different **CRM vendors** (full liners [sell CRM with ERP and BI], Analytic CRM/BI and Telephone technology vendors])

8) IT ECONOMICS

The processes (inside COBIT) that **manage the economics of the IT area** are:

- **Governance** = ensure benefits delivery and resource optimization
- **APO** = manage strategy, budget and costs
- **MEA** = monitor performances and costs

The **cost of unit** is calculated as $\frac{\text{fixed cost}}{\# \text{units produced}} + \text{variable cost}$.

As we said in chapter 4) Strategy, we call:

- **Economy of scale** = maximize #units_produced to minimize the cost of unit to make the most out of *fixed cost*
- **Economy of scope** = use the same infrastructure to produce different units to divide the cost of infrastructure among different products

When considering **informational units**, the variable cost is negligible, while the fixed costs refer to the entire IS.
Network effect = value of a service increases with the number of users.

The **TCO (Total Cost of Ownership)** is the financial estimate of all costs of a product/service considering the entire lifecycle, divided in 4 phases:

- **Construction** (make)/**Selection** (buy)
- **Deployment**
- **Operation + Maintenance**
- **Dismissal**

⚠ It's better to consider a solution with a lower TCO instead of a solution with lower "label" cost

⚠ The **downside** of the TCO is that you need to make assumptions on the future; the best way of computing the TCO is computing the best and worst case

⚠ Today, when buying with "as a service" payment mode, the estimation of the TCO is easier and less uncertain

The **ROI (Return On Investment)** represents the gain % related to a certain cost and is $\frac{\text{Benefit} - \text{Cost}}{\text{Cost}}$ or $\frac{\text{Profit}}{\text{Cost}}$; the problem with the ROI is that it doesn't consider the time:

the **NPV** [Next Present Value] fixes it or we can use the **ROI on several time periods**.

The **break-even-point** is the point where costs and revenues are balanced.

Period	0	1	2	Total
Benefit	0	300	500	800
Cost	400	200	100	700

$$\text{ROI} = (800 - 700) / 700 = 14\%$$

Ex: construction of ERP (make)

	0	1	2	3	4	Total
Cost	Construction 100 Deployment 100 Maintenance 70	Operation 100 Maintenance 50	Operation 100 Maintenance 50	Operation 100 Maintenance 50	Operation 100 Maintenance 50	1170
Benefit	0	400	400	400	400	1600
Benefit - cost	-500	-300	-70	180	430	430

- TCO: 1170
- ROI: $(1600 - 1170) / 1170$
- Break even: 3 years

Ex: acquisition of ERP (license)

	0	1	2	3	4	Total
Cost	Selection 100 Service fee 100	Operation Licence 100 Service fee 250	1000			
Benefit	0	350	350	350	350	1400
Benefit - cost	-200	-50	100	250	400	400

- Time frame: 5 years, acquisition from external vendor, on premise operation
- TCO: 1000
- ROI: $(1400 - 1000) / 1000$
- Break even: 2 years

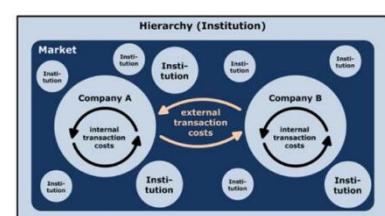
Ex: acquisition of ERP (SaaS)

	0	1	2	3	4	Total
Cost	Selection 100 Service fee 250	Service fee 250 Service fee 250	1100			
Benefit	0	300	300	300	300	1200
Benefit - cost	-100	-50	0	50	100	100

- Time frame: 5 years, acquisition (as a service)
- TCO: 1170
- ROI: $(1200 - 1100) / 1100$
- Break even: 3 years

A **TRANSACTION** is an exchange of products/services between 2 parties; 2 types:

- **Internal transactions** = inside a company between 2 organizational units
- **Market transactions** = happens outside the organization, the 2 parties are independent and there is always an exchange of money > than the nominal cost. Their cost is computed using the TCO; phases before and after the manufacturing are the transaction costs. Types of market transactions:



- **Time and material** = there's a contract on cost of work (+time) and materials
- **Fixed price** = there's a contract on the result and its value

A transaction is described by a **contract** with legal value that should be the **complete description** of what is exchanged and what happens in case of exceptions (it's difficult to describe the product completely [**information asymmetry** that allows opportunistic behavior of 1 of the parts]). In **internal transactions**, the contract isn't needed; in **market transactions**, the information is not controlled and the price is decided by the market; in **firm transactions**, the information is controlled and centralized, there's a hierarchy and the price is imposed.

The **TRANSACTION THEORY** makes some assumptions: actors take decisions rationally to maximize utility and profit, all actors have all information, all products (within a specified category) are equal; the consequences are that the **market** defines the best price and the market is the perfect place to do transactions.

But the reality is worse than theory, so the market is less suitable for complex products and for having full control on process and product quality (so the higher is the unclarity of the item description, the higher the advantage of the firm to produce it internally).

When choosing between internal and external transactions, there are other factors to consider:

- **Efficiency** (lower in market, higher in firm)
- **Cost** (in market defined, in firm undefined)
- **Know how** (in market is external and not available, in firm is internal but can be lower than available)
- **Problem resolution** (in market is performed with the contract, in firm by hierarchy)

Changing the type of a transaction could affect the size of the firm: **vertical disintegration** happens when there is a change from firm transaction to market transaction (the team that is working internally on the product that is going to be outsourced becomes useless, so the company becomes smaller) [**integration** is vice versa]; it depends on the **cost** of internal transactions vs the external transaction, the importance of the "**know how**" and the need of specific product/service. A consequence is the "**network**" company (integrate independent companies each one specialized on components). Other kinds of **collaborations** are:

- **Joint ventures** = independent company owned/shared by more owners
- **Long term contracts and collaborations**

The **AGENCY THEORY** resolves issues in the relationship between business principals and their agents. The firm is made of Principal (owner or shareholders) + Agents (employees and managers) and is based on a web of contracts between principal and agents (contrast between goals of agents and principal causes **agency costs**).

There are 3 types of agency costs (IS decrease the costs):

- **Monitoring costs** (control of the agents by the principal)
- **Bonding costs** (reporting of the agent to the principal on activities done)
- **Residual loss costs** (profits lost by the principal due to the suboptimal behavior of the agents)

Level (Anthony)	Decision type		
	Structured	Semi-structured	Unstructured
Strategic	Plant placement	Fund raising	RD strategy
Managerial	Maintenance budget	Sale budget	Manager hiring
Operational	Stock resupply	Bonds buy / sell	Select cover for magazine

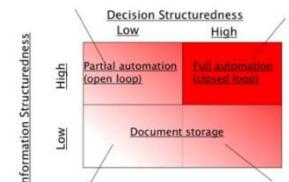
In the **DECISION THEORY** there are 3 **types of decisions**:

- **Structured** = follows an algorithm and is repeatable
- **Semi-structured** = output is defined, inputs & decisions semi-defined
- **Unstructured** = no algorithm, subjective

A decision can also be:

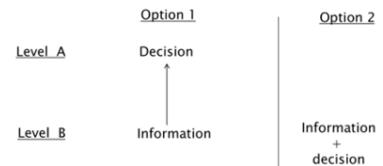
- **Planned**
- **Unplanned**
- Under **certainty** (outcome is known)
- Under **noncertainty**
 - Under **risk** = some knowledge about probability of each outcome
 - Under **uncertainty** = no information on outcomes

The **decision process** has many steps (identify problem & alternatives, evaluate alternatives + select one, implement & evaluate decision). Depending on the **structuredness** of the information and of the decision, the IS can become powerful: when the information is unclear, the IS can only store the textual description; when they are both high, the IS can automate the process.



The decision can be taken at **many levels** of the organization:

- **Option 1** = cost on transferring the information to the upper level and the risk that the information transferred is not completely right
- **Option 2** = no cost but the decision can be suboptimal because it's taken in a lower level (agents)



3 decision issues:

- **Bounded rationality** (not all information is available)
- **Analysis paralysis** (too much information doesn't help)
- **Conflicting goals in decisions** (time vs money)

COGNITIVE BIASES are mental shortcuts that make rational decisions difficult (connected to Heuristics):

- **Confirmation bias** = related to information cherry-picking, use only the information that is convenient
- **Motivated reasoning** = find reason to produce the desired outcomes instead of logical outcomes
- **Survival bias** = consider a dataset containing only the "survivors" to some selection filter
- **Optimistic bias** = tendency to underestimate costs and overestimate benefits
- **Bandwagon effect/social conformity** = doing what others do and groupthinking (uniform thinking in working teams), but successful organizations have people that think in different ways
- **Cognitive dissonance** = beliefs and behaviors are inconsistent, this dissonance can be fixed changing the beliefs or the behavior
- **Dunning Krueger effect** = incompetent people think they are better than they are, while competent people recognize the difficulty of problems and their inability
- **Repetition** = the more a statement is repeated, the more the belief in it strengthens
- **Authority bias** = statement by an authoritative person is more trusted
- **Anchoring** = the first piece of information considered biases the subsequent process
- **Loss aversion** = people prefer to avoid a loss than achieve a gain

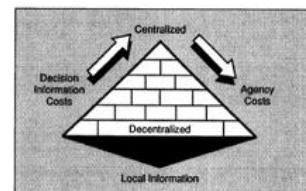
⚠ These biases are used to manipulate decisions and can be also present in algorithms and datasets

Another aspect related to decisions are the **logical fallacies** that are flaws in reasoning or tricks to obfuscate the truth to push a certain decision:

- **Ad hominem** = attack the person to attack the argument
- **Anecdotal** = use a personal experience as an argument
- **Appeal to emotion** = use emotions as an argument (used in most of the commercials)
- **Appeal to authority** = a person with authority is more trusted than scientific method
- **Ambiguity** = use an unclear description to support an argument
- **Burden of proof** = make a claim and let others prove it's false
- **Circular reasoning** = use argument to prove argument

The **ICC (Internal Coordination Costs)** are composed by:

- The **decision (information)** costs appear when decisions aren't taken where the information is produced (centralization):
 - **Communication, documentation (miscommunication)** cost = collection/transmission of data to higher levels
 - **Opportunity cost** = delays in availability of information at higher levels and lost opportunities
 - **Suboptimal decisions** = because of delays, imprecisions or cognitive biases
 - The **agency** costs are related to monitoring, bonding and residual loss (decentralization)
- ⚠ Jensen said that we need to allocate the decision capability in order to minimize internal coordination cost
- ⚠ The overall costs are **ICC + ECC (External/Market Coordination Costs) + Operation**



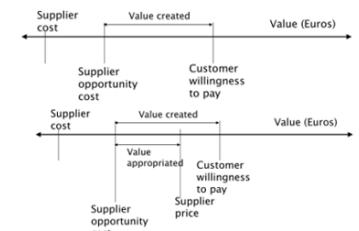
The **cost of the IT** area in an organization can be computed as:

- Cost of **IT area**:
 - **Direct**
 - Fixed = personnel, facilities, HW and SW
 - Variable = services from other companies (outsourcing; es. rental), licenses, rental
 - **Indirect (outside of the IT area, difficult to compute)**
 - Learning cost of non-IT people to learn using IT tools
 - Suboptimal decisions because of IT tools + time lost

- Cost of **IT project** → using the TCO so considering all costs (direct, indirect, internal, external) on all phases:
 - o Construction (BAI domain in COBIT)
 - o Selection (BAI domain in COBIT):
 - Requirement definition
 - Vendor/product identification, evaluation and selection
 - Contract definition
 - o Deployment
 - Install product on machines
 - Training of users
 - Data entry/reformat
 - o Operation (DSS domain in COBIT) [day by day support]
 - o Maintenance (DSS domain in COBIT) [changes]
 - o Dismissal

Let's talk about the **VALUE of IT** in an organization. **Value** can be **intrinsic** (property of an object), **labor** (how much labor/effort is needed), **monetary** (price) and **subjective** (depends on the consumer). The **marginal utility** is the added satisfaction that a consumer gets from having 1 more unit of a product/service (value doesn't depend on the whole usefulness). We define:

- **Value creation** = if Supplier Cost (SC) is 17, Supplier Opportunity Cost (SOC = min cost accepted for selling) is 18, Customer Willingness to Pay (CWP) is 26, value created is 8
- **Value appropriation** = if supplier sells at 24, the customer saves 2, the value appropriated is 6



The **IS** can have an **impact on costs**:

- **Transaction** costs
 - o External:
 - Lower cost for search, evaluation and selection (Internet and market places)
 - Lower cost for communication (Internet, supply chains, integration of IS supplier-purchaser)
 - o Internal:
 - Lower cost for coordination and communication (email, document repository, mobile phone)
- **Agency** costs (the eased collection of information from lower levels)
 - o Reduces bonding, monitoring costs
 - o Avoid needing intermediate management levels reducing the hierarchy
 - o Reduce specializations needs for lower levels, increasing their decision power
- **Decision** costs
 - o Better quantity and quality of information
 - o Better decision making because of powerful tools to support the decision process
 - o Possible information overload

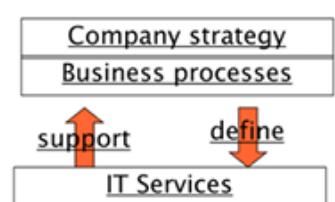


Let's talk about **IT Governance**. Governance processes in **COBIT** are about decisions related to IT in the company:

- Define strategic IT plan
- Define information architecture/technology direction (UML deployment diagram)
- Define IT processes, organization
- Manage IT investment

The **Governance of the organization** decide the importance of IT and its budget. The **IT Governance** choose:

- Buy/make software
- Contractors
- Technologies
- Performance (cost/speed)
- Risks (losing data, services down)
- Resources (people and money involved)



The **Corporate Governance** contains all the processes by which all companies are directed and controlled (the IT Governance is a subset of the Corporate Governance).

There are 3 key documents:

1. **Strategic plan** = strategy and goals of the company
2. **IS strategic plan** = how IS supports the strategy and is a roadmap for IS development, logic and budget (is linked to and dependent from the strategic plan). Has a time horizon of 3-5 years. It contains:
 - a. **AS IS** (Current situation) [architecture, applications, systems, personnel, organization]
 - b. **Company strategy** with overall IS budget
 - c. **TO BE** (New Situation) [architecture, applications, systems, personnel, organization, new projects]
3. **IS plan** = derived by the IS strategic plan and has a horizon of 1 year. It contains the projects':
 - a. **Schedule**
 - b. **Total budget** for:
 - i. IT functions in the year
 - ii. Staff, infrastructure, licenses, services
 - iii. New projects/investments ranked per priority

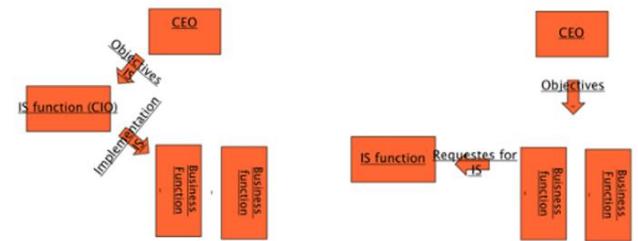


IT Governance **enablers** and **inhibitors** are:

- Senior executives do (not) support IT
- IT (not) involved in strategy development
- IT (not) understand the business
- Strong/Weak Business-IT partnership
- Well/Bad prioritized IT projects
- IT does (not) demonstrates leadership

The **alignment** between Governance and IT Governance:

- **Explicit (push)**
- **Implicit (pull)**



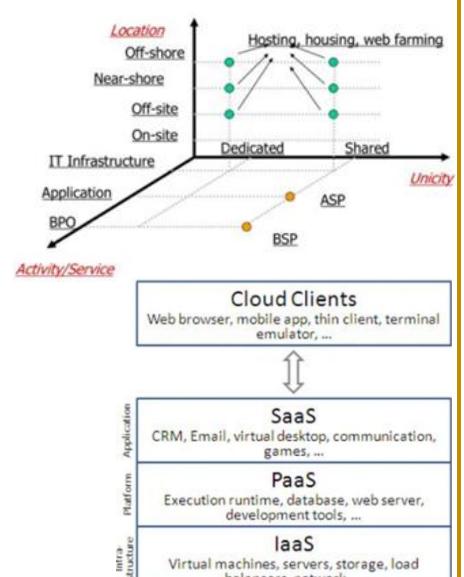
9) OUTSOURCING

Outsourcing is external transaction and vertical **dis-integration** (from internal to external people, facilities are transferred outside). **Insourcing** is internal transaction and vertical **integration** (from external to internal). The decision of outsourcing needs to be analyzed in terms of:

- cost, quality, service
 - strategic efforts
 - know-how and protection of data
- ⚠ In same organization some IT services can be outsourced and others not

To characterize outsourcing we use **outsourcing axes**:

- **Activity/service**
 - o **IT infrastructure** [PaaS, IaaS] (HW, network, call center)
 - o **Application** (development and maintenance)
 - o **Business Process Outsourcing** (complete business process + the people)
- **Unicity**
 - o Solution for **few** customers
 - o Solution for **many** customers
 - o Solution for **mass** market
- **Location**
 - o **On-site** (on-premise) (service in the same facility)
 - o **Off-site** (service in another facility)



- o **Near-shore** (service in another facility, but in the same state or continent)
- o **Off-shore** (service in another facility, in another continent with labor's cost lower and different laws)

The market of **providers** that sells services (es. Amazon AWS, Azure, Aruba, Telecom) has:

- ✓ Costs for infrastructure shared among many (economy of scale)
- ✓ No investment in non-core competence for O
- ✓ Backup, recovery
- ✗ Less control

When we do an outsourcing, we need to define **SLAs** (**Service Level Agreements**) to monitor the transaction; SLAs are **inspired by KPIs** and can be cost, reliability/availability, response time, quality and flexibility.

For the **outsourcing decision** there are **5 questions**:

	Yes	No
Is it strategic for the company?	Discouraged	Possible
The know-how is important?	Discouraged	Possible
Is it commodity (can be fully described)?	Possible	Risky
Is it available at lower price, higher quality than internally?	Possible	Not convenient
Is it subject to law constraints (ex. privacy)?	Discouraged	Possible

The outsourcing decision is **risky** and **long term** because there could be **changes** in organization/IT strategy, service/vendor, technology/environment.

In the **COBIT** the outsourcing decision could be taken by the:

- **Governance** in **evaluate**
- **Management** in **plan** and **monitor** (if the governance is not implied but gives only the general strategy)

The **outsourcing costs** are computed using **TCO** including all cost categories beyond the nominal cost of product:

- Search and evaluate **vendors**
- Write and enforce **contract**
- **Hidden costs (risks)** [lock in, loss of know-how, changes, failure, discontinuity in the service]
- ⚠ **Lock in** = difficulty in changing provider; related to switching costs and risks

The **outsourcing process** has different activities:

➤ PLAN

- o Define the activity/service
- o Find and evaluate vendors (history of vendor and product, users, switching costs, competitors)
 - **Vendor**
 - Size
 - Reputation
 - Time on market
 - Availability of local offices/support
 - Availability of services about the product from other vendors
 - Risks (vendor bankrupt, product discontinued, product changes, vendor acquired)

Vendors are evaluated using an Excel file where each line is a criterion and the columns are the possible vendors; this **Excel** uses the **MCDA** (**Multiple Criteria Decision Aid**) where is possible to give a score to every criterion. To evaluate the final decision an **aggregation (sum or weighted sum)** is needed:

	Option1	Option2		WEIGHT (10)	Option1	Option2
Function1 (0 to 5)	Available 5	Not available 0				
Function2	Not available 0	Available 5				
Size of vendor 5 if > 1000 people 4: 500 to 1000 3: 500 to 50 2: 50 to 5 1: 4 to 1	400 people	40 people	5 if > 1000 people 4: 500 to 1000 3: 500 to 50 2: 50 to 5 1: 4 to 1	7/10	40 people	400 people
Portability 5: windows, unix, 2 only linux 1 only windows	5	2	5: windows, unix, 2 only linux 1 only windows	2	5	
SUM	14	9	WEIGHTED SUM		$4 \cdot 3/10 +$ $5 \cdot 7/10$ $=1,2+3,5$ $=4,7$	$2 \cdot 3/10 +$ $2 \cdot 7/10$ $=0,6+1,4$

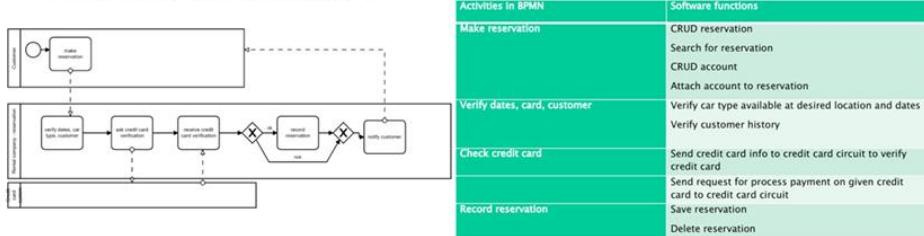
2 rules for choosing criteria are:

- ❖ Sufficiency (all the needed functionalities should be considered)
- ❖ Redundancy (criterion shouldn't be redundant and interdependent)

- **Product**

- **Functions** = described in different **levels** of detail; are related among them, so they are typically organized in a numbered hierarchy. The key activities in the selection are:
 - Starting from the BPMN activities, list the functions **needed** by the processes in the organization
 - Check for each product/vendor if the function is **available**

Example: car rental, reservation process



- Non-functional requirements → ISO 25010:
 - Reliability (failure per period, availability per period)
 - Usability (time to learn, clicks per functions, evaluation by a set of users)
 - Efficiency (response time per function, memory usage per function)
 - Maintainability (time/cost to add or modify function)
 - Portability (time/cost to port to different platforms)
- Context requirement (compatibility, platform, skills available, cost, TCO)
 - **Contract writing** (legal part, technical annex [description of product], SLA & KPI [consider the end-to-end service chain and its effect on the business; it's better to allow thresholds to be changed])

The harder is to describe the activity, the better is to insource it.

The **duration of the contract** is crucial (risk > → duration <) [consider condition to interrupt the contract if there are changes in service description or in technology/context]

The **contract costs** are cost of writing + cost of contract enforcing (writing >, enforcing < & vice versa)

➤ **MONITOR**

- **Contract monitoring** = at regular intervals the SLAs and the issues in the service should be checked (in COBIT, plan & monitor processes remain insourced and require IT competence)

The **CSFs for outsourcing** are:

- Not overlook hidden costs (risks)
- IT skills are needed for monitoring
- Continuous control of contract
- Continuous analysis of risks and changes

10) CHANGE MANAGEMENT (CM)

The **CHANGE MANAGEMENT** is the process from a situation A to a situation B. The 4 important dimensions are structure, people, technology and process.

The **David Gleicher formula** $D * V * F > R$ says that **Dissatisfaction** for current situation, **Vision** (capability to define the future situation) and **First steps** (quantity and quality of actions to support the transition) must overcome **Resistance to change**. The **resistance** is function of the **type of change** (First-order = Automate; Second-order = Inform; Third-order = Transform) and can be **explicit** (immediate) or **implicit** (deferred); resistance can come from:

- **Individuals** (employees, managers, owners):
 - Habit
 - Security (fear of new conditions, ...)
 - Economic factors
 - Fear of the unknown
 - Selective information processing
- **Organization:**
 - Threat to established power relationships

- o Threat to established resource allocation
- o Threat to expertise
- o Group inertia

The **CM process** has 6 key activities: identify potential change, assess changePlan change

- Implement change
- Review change
- Close change

There are 4 **CM styles** that can be adopted:

- **Empirical - rational** = explain why the change should be applied
- **Normative - reductive** = write the rules that should be applied
- **Power - coercive** = we do it or we lay you off
- **Environmental - adaptive** = flexible, change of the context

The **CM plan** describes the key parts of a CM process and can use any **combination of CM tools and models**:

- **CM tools:**
 - o Proper timing
 - o **Education** and communication (vision of change and training to adapt)
 - o Seeking **participation** (in the change)
 - o **Coercion**
 - o **Negotiation**
 - o **Manipulation** and **cooptation** (cooptation = people on the side of the change receive benefits)
 - o **Incentives** and rewards (for accepting the change)
 - o **Champions, leaders, role models**
- **2 CM models:**
 - o **ADKAR** (Jeff Hyatt)
 - **Awareness of need** for change:
 - Management communications
 - Customer input
 - Marketplace changes
 - Access to information
 - **Desire to participate** and support the change:
 - Fear of job loss
 - Discontent with current state
 - Enhanced job security
 - Affiliation and sense of belonging
 - Career advancement or change in social standing (acquisition of power)
 - Incentives or compensation
 - Trust for leadership
 - Hope in the future state
 - **Knowledge on how to** change:
 - Training and education
 - Access to information
 - Role models/champions
 - **Ability to implement** required skills and behaviors:
 - Practice of new skills/tools
 - Coaching
 - **Reinforcement to sustain** the change (Incentives and rewards, Compensation changes, Celebrations, Personal recognition)
 - o **Jonh Kotter** (made by 8 steps)
 - Increase **urgency**
 - Build the **guiding team**
 - Get the **vision** right
 - Communicate and obtain **buy in**
 - **Empower action**

- Create **short term wins**
- **Don't let up**
- **Make change stick**