

# Information Systems

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## 1. Definitions

**Organization:** a group of people that accomplish a set of goals (enterprise, army, church....)

- Managing resources
- Implementing business processes
- Work for profit

**Business process:** set of activities

- Executed in a certain order (parallel or sequential)
- Performed by an organization
- Deliver a service/product
- Has defined inputs and outputs

**Activity:** time spent by people doing a task part of a business process

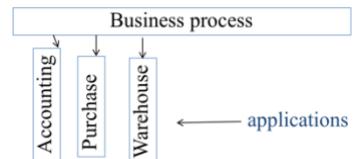
**Business function:** group of people/resources performing similar activities in an organization (sales, marketing, HR ...)

**Application:** software that supports an activity/process

**Software function:** function offered by an application to support an activity or part of it

**Application portfolio:** set of applications used by an organization

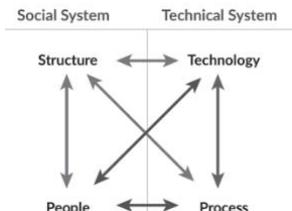
Often a business process can require software functions from many applications, and a function can be required from many business processes. So, it is a many-to-many relationship.



**Legacy:** is an older software that in same way is difficult or expensive to replace and we need to deal with it.

**Information system:** a formal, sociotechnical, organizational system designed to collect, process, store and distribute information.

- **Formal:** built and managed with a goal for the organization
- **Sociotechnical:** involves the social system (structure and people) with the technical system (technology and process) that interact with each other



**Technology:** computers, networks, applications

**People:** individuals involved into the IS:

- **End users**
- **Managers**
- **IT professionals**

An understanding of the people involved is important when designing, implementing, and troubleshooting an IS.

**Structure:** implicit or explicit rules that govern relationships between the people involved in the IS

- Hierarchy
- Communication lines
- Reward mechanisms
- Functions, divisions

Hidden or missing communication lines or user resistance often causes IS failure.

**IS success:** the IS supports the organization goals fulfilling its needs about information processing and supporting efficiency and effectiveness.

**IS failure:** the IS is never completed, is never used, abandoned, or is working against the organization goals.

### IS outcomes:

- On people:
  - Positive: empowering employees and widening the scope of their responsibilities
  - Negative: deskilling, loss of responsibility, and the creation of a monotonous working environment
- On the organization and its future opportunities

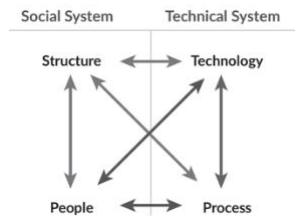
The four components of an IS are **interdependent**, changes in one component may affect other components and, if not properly managed, also its outputs.

Considering only the **technology** dimension can cause lack of understanding of systemic relationship and lack of considering information outside the technology component.

To adapt to the changing environment an organization (and its IS) need to evolve, there are three levels of organizational change:

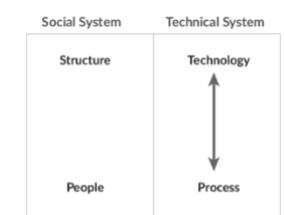
- **First-Order Change: Automate**

A First-Order change only infect the **technical system**, it occurs with the introduction of an **IT innovation** that modifies how an existing process is performed and it's the easiest to envision, justify and manage.



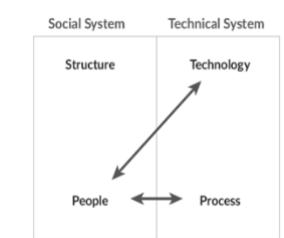
- **Second-Order Change: Informate**

A Second-Order change affect the **people**, it modify the way **individuals** perform **processes** and the manner in which they interact with the technology change.



It occurs when the information intensity of the process being performed changes substantially due to the introduction of new IT.

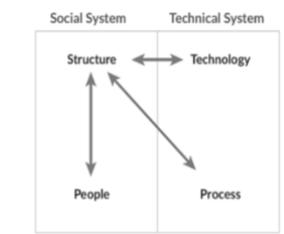
To manage such a change the organization need to provide appropriate **training** and **overcome the human tendency to resist change**.



- **Third-Order Change: Transform**

A Third-Order change affect the **structure**:

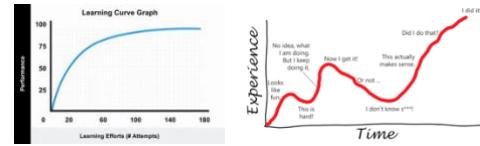
- **Technology:** a change in the way the organization selects, uses and manages technology
- **People:** a change in the reporting and authority structure of the organization
- **Process:** a novel way of task accomplishment or a new set of task



Managing it requires significant 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, suppliers) and **transactional** data (sales, invoices). This interconnections generates the **integration** problem related to data or applications that need to cooperate.

The 5<sup>th</sup> dimension for IS is **time**, year by year the technology trends and devices evolve, when this happens people often show a certain **resistance to change**. Technology innovations have a cost and have a certain **learning curve** that usually is different from the expected.



There are different **issues** when dealing with **time**:

- **Application portfolio:** in big organizations is quite difficult to make a census of present applications with their goals, the AP knowledge helps to evaluate the IS and define acquisitions/changes of applications
- **Integration of data and applications**
- **Legacy software:** when the IS is too old it can happen that the development environment, the documentation, the source code or the vendor are unavailable, this can lead to expensive and risky substitutions.

### [FACTORY + WAREHOUSE EXAMPLE]

An IS is **needed** to:

- **Transfer information** (real time)
- **Document** (past and present):
  - **All the steps must be recorded** answering the questions who, what, when and also why because we need to understand more when something goes wrong
  - **Documentation of the flow:** instructions for the activities to be performed
- **Monitor** (past and present): summary data for the **Management Control Loop** (managers)

When we create an IS the **technology** must be decided after analyzing the process:

- **Flow:** list of activities to be performed when something happens
- **Data:** entities and events that we need to record into the IS
- **Business rules**

When choosing the **technology** we have two choices:

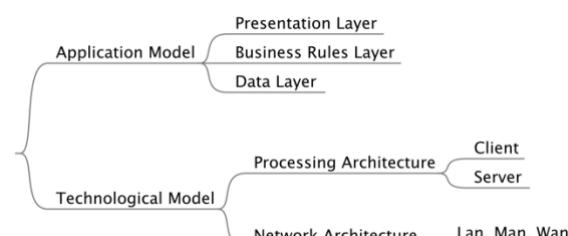
- Use a different application for each piece of structure (production, warehouse, purchase office, accounting...)
- Use one overall db with a single application that has all the functions needed

In the example analyzed the **information flow** is parallel to a **physical flow**, in other cases there's no physical flow at all (bank, insurance).

### IT Dimension

The IT dimension has two main parts:

- **Application Model:** describes the software architecture and the software programs:
  - **Presentation Layer:** an IS communicates with the user through a GUI and different inputs.  
This layer can change a lot without touching the business process.
  - **Business Rules Layer:** represent the logic driving the processing of data entered in the IS through the Presentation layer.



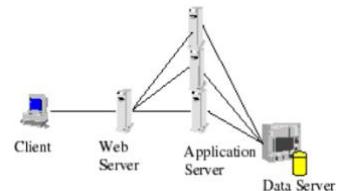
If the process changes surely this layer changes while the data layer remains stable.

Can be defined using the **code** or with **Drools**

- **Data Layer:** database

- **Technological Model:** describes the hardware architecture.

The typical architecture that is always assumed is **3-tiers** and **client-server** but can also have only two tiers (fat to thin client).



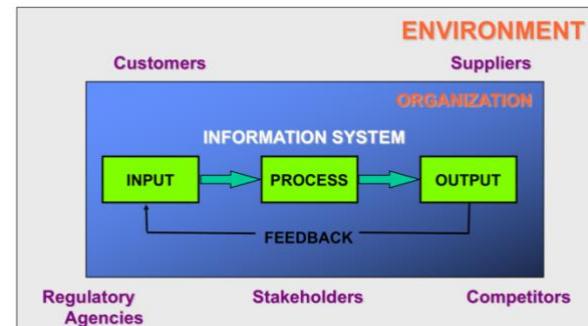
A processing architecture must satisfy a few basic quality requirements:

- **Response time:** the interval between the request and the display of the response
- **Scalability:** the work load a system is able to sustain
- **Availability:** percentage of time the system is working

## 2. High level models

The **control loop model** has 4 parts:

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

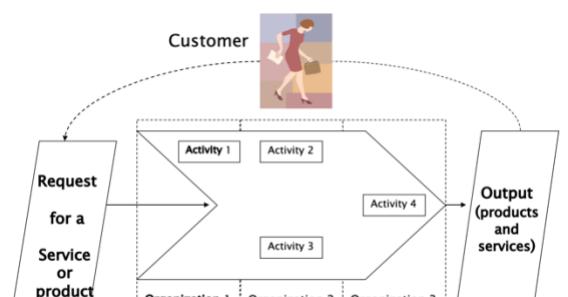


This model gives a view of the context and the environment, organizations (and the related IS) are influenced with 5 types of actors:

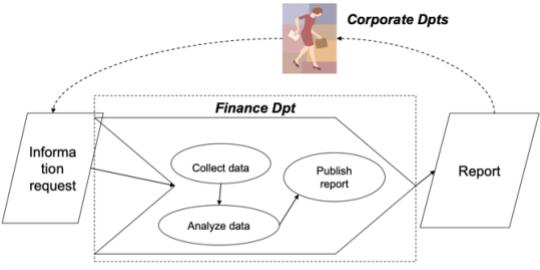
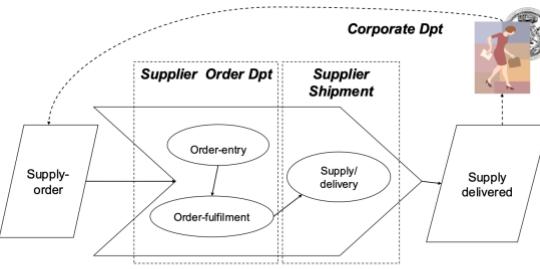
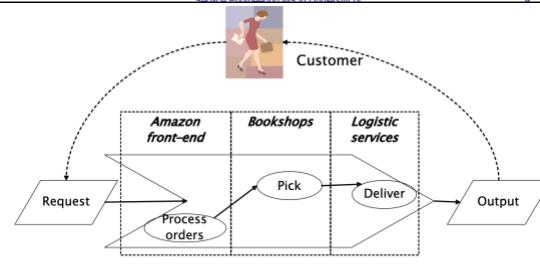
- Customers
- Suppliers
- Stakeholder
- Competitors
- Regulatory agencies (including law system)

The **CRASO** (Customer Request Activity organiSation Output) **model** shows the activities, the actors doing activities and the assets treated by them.

The **customer** is always the start and the end of the loop.



The CRASO model can be:

<b>Mono-organizational:</b> involves only one organization	<b>Mono-functional:</b> involves only one business function (exceptional case)	 <table border="1" data-bbox="849 460 1389 534"> <thead> <tr> <th>Business Process</th><th>Customer</th><th>Request</th><th>Activities performed (summary)</th><th>Organizations involved (summary)</th><th>Output (summary)</th></tr> </thead> <tbody> <tr> <td>Management reporting</td><td>Corporate Departments</td><td>Information request</td><td>Data-collection Data-analysis Report-publication</td><td>Finance</td><td>Report</td></tr> </tbody> </table>	Business Process	Customer	Request	Activities performed (summary)	Organizations involved (summary)	Output (summary)	Management reporting	Corporate Departments	Information request	Data-collection Data-analysis Report-publication	Finance	Report
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	<b>Inter-functional:</b> involves many business functions in the same organization that can have different SI and DB	 <table border="1" data-bbox="849 819 1389 932"> <thead> <tr> <th>Business Process</th><th>Customer</th><th>Request</th><th>Activities performed (summary)</th><th>Organizations involved (summary)</th><th>Output (summary)</th></tr> </thead> <tbody> <tr> <td>Production Planning</td><td>Sales-dpt</td><td>Production-request</td><td>Assemble-production-plan, Give-information, Negotiate and execute the plan</td><td>Production-planning-dpt, Materials-management-dpt, Factories</td><td>Approved production plan</td></tr> </tbody> </table>	Business Process	Customer	Request	Activities performed (summary)	Organizations involved (summary)	Output (summary)	Production Planning	Sales-dpt	Production-request	Assemble-production-plan, Give-information, Negotiate and execute the plan	Production-planning-dpt, Materials-management-dpt, Factories	Approved production plan
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The **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 (example for a retail company):

- **Operational level:** composed by the employees that work day by day and with repetitive activities.  
(Implement a sale, replenish products on shelves)
- **Knowledge level:** composed by knowledge and data workers that design new products/services on the present/future time frame (the number of employees depends on the complexity of the product/service). This level is 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 (limited number of employees).  
(review of sales, monitor employees)



- **Strategic level:** composed by seniors and high managers that takes key decisions on future (1-10 people).  
(decide type of offer and products and opening/closing of new shops)

The necessity and importance of an IS depends on each level

- **Operational level:**
  - **Information intensity of product (IO):** level of information needed to describe the product (A PC has a higher IO than a water bottle)
  - **Information intensity of process (IP):** level of information needed to describe the process (How to build a bottle? How to build a PC?)  
Higher are the IO and IP for an organization more useful is the implementation of an IS.
- **Management level:** the IS supports the management control loop (MCL) so the goal definition, the analysis of results and the corrective actions.  
For the goal definition, budget goals per expense type and per function are often used, but there are also goals related to item produced and item quality.
- **Strategic level:** the IS is needed for analyzing customers (profiling), products (dependability) and performance (dashboard), this kind of data can be provided by BI and DW.

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

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

	Operational	Management
Usage	Continuous	Periodic (eg. weekly)
Information	Simple, Current	Aggregate, Historical

For each level are defined the kind of applications needed:

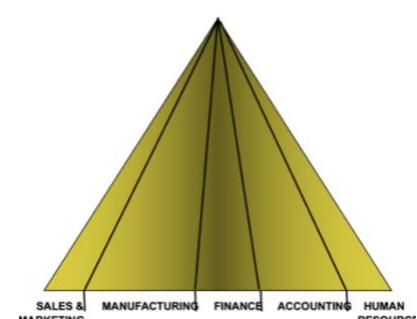
- **Strategic level:**
  - Executive support system (ESS)
  - Decision support system (DSS)
- **Management level:**
  - Management information system (MIM)
- **Knowledge level:**
  - Knowledge work system (KWS)
- **Operational level:**
  - Office automation system (OAS)
  - Transaction processing systems (TPS)

As shown in the figure for each level, the Anthony's model, describes the activities for which the IS is needed.

TYPES OF SYSTEMS					
Strategic-Level Systems					
Executive Support Systems (ESS)	5-year sales forecasting plan	5-year trend operating budget	5-year profit forecasting	Personnel planning	Personnel planning
Management Information Systems (MIS)	Sales management	Inventory control	Annual budgeting	Capital investment analysis	Relocation analysis
Decision-Support Systems (DSS)	Sales region analysis	Production Cost scheduling	Pricing/profitability analysis	Contract cost analysis	Contract cost analysis
Management-Level Systems					
Knowledge Work Systems (KWS)	Engineering workstations	Graphics workstations	Managerial workstations		
Office Systems	Word processing	Document imaging	Electronic calendars		
Knowledge-Level Systems					
Transaction Processing Systems (TPS)	Machine control	Securities trading	Payroll	Compensation	
	Order tracking	Plant scheduling	Accounts payable	Training & development	
	Order processing	Material movement	Cash management	Employee record keeping	
Operational-Level Systems					
Sales and Marketing	Manufacturing	Finance	Accounting	Human Resources	

The **business functions** are represented as vertical sections:

- **Sales and Marketing:**
  - **Marketing:**
    - Identify the customers
    - Determine what they need or want
    - Plan and develop products/services to meet their needs
    - Advertise and promote these products/services
  - **Sales:**



- Contact customers
  - Sell products/services
  - Take orders
  - Follow up on sales
- **Manufacturing and Production:**
  - Plan, develop and maintain production facilities
  - Establish production goals
  - Acquire, store and keep available production materials
  - Schedule equipment, facilities, materials and labor required
- **Finance and accounting:**
  - **Finance:**
    - Manage the financial assets, such as cash, stocks, bonds and other investment in order to maximize the return
    - Borrow money with the best conditions
  - **Accounting:**
    - Maintain and manage the firm's financial records/receipts, disbursements, payroll, general ledger to account for the flow of funds.

Was invented by Luca Pacioli who invented "partita doppia" which tracks debit and credit.

There are three types of accounting:

    - **Sectional:** towards customers and suppliers (incomes and expenses)
    - **Institutional:** towards stakeholders and law (taxes and balance)
    - **Management accounting:** towards internal structure (cost of producing a product)
- **Human resources:**
  - Understand what skills are needed
  - Identify potential employees
  - Maintain complete records on employees
  - Create programs to develop employees skills
  - Compute salaries
  - Evaluation and compensation system
  - Outplacement

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

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

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

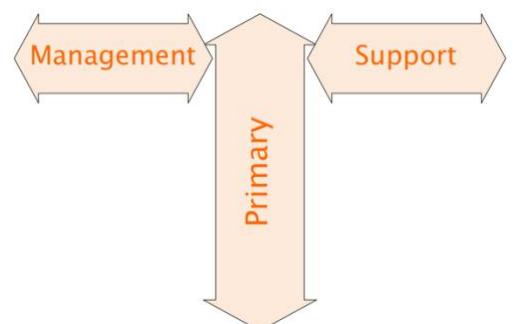
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System	Description	Level
Training and development	Track employees training, skills and estimate performance	Operational
Career pathing	Design career paths for employees	Knowledge
Compensation analysis	Monitor fairness in employees wages and benefits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

The **T model** is a model that has an horizontal part common for every kind of organization and a vertical part specific for the business sector/domain.

There are three kind of processes:

- **Support processes:** IT, HR, accounting , finance and firm infrastructure, is not visible for the final customer  
(goal: provide services to the organization and comply with law obligations)
- **Managerial processes:** strategic planning, BI and management control (loop)



(goal: lead the organization)

- **Primary processes:** produce and provision the products/services  
(goal: serve the customers)

Primary processes for each business domain:

- **Manufacturing:** companies designing and producing individual items in large quantities  
(different from process industry that produces quantities of substances)

Models used:

- **Value chain** (Porter): the value is what a customer is willing to pay for a product, to create this value the organization must follow multiple activities performed in succession, as a **chain**
- **Planning/execution model:** describes vertical phases (inbound logistics, operations and outbound logistics) and their lower level processes



#### ▪ Planning:

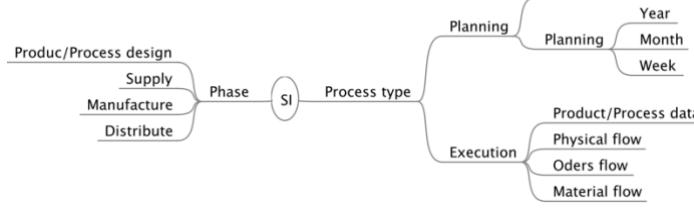
- Time planning
- Strategic analysis

#### ▪ Execution:

- Process and product data
- Order management
- Material management
- Physical operations

	Goal	Issues	Horizon
Strategic analysis	Understand Market and technology trends	Complex and heterogeneous data	Months years
Plan 1 year	Define requests and needs	Scope: plants	
Plan 1 month		Scope: plants and cells	2 months
Plan 1 week	Define request and needs	Scope: cells	2 weeks
Product and process data	Capture know how or products how to produce II	Complex and heterogeneous data	company
Order flow	Define store and process orders from customers.	Large data volumes	Intercompany and interfuction
Material flow	Input to planning. Define, store, and process orders to support customer available materials.	Large data volumes	Intercompany and interfuction
Physical flow	Monitor all events (materials, assemblies)	Real time	Intercompany and interfuction

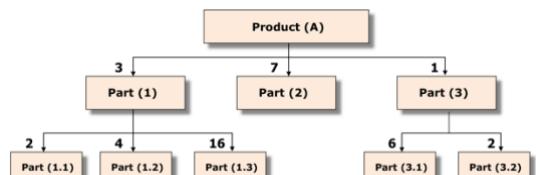
We can put together process types and phases:



	Product/process design	Supply	Manufacture	Distribute
Strategic plan	Technology and market overview	Survey suppliers	--	Market studies, Customer studies
Plan - 1 year	Plan new products/plants	Plan purchases	Plan production	Sales forecast and sales plan
Plan - 1 month	Plan/assign design tasks	Plan and assign purchases	Plan production - plant	Plan distribution
Plan - 1 week	Plan/assign design tasks	Plan purchases, Expedite late supplies	Plan production - cells	Plan / assign distribution tasks
Product/product data	List of parts: specifications, designs	List of suppliers, Bill of materials	List of plants, machines, working cycles	List of customers, Catalogue of products
Physical flow	Store and distribute designs, specs		Move parts and assemblies, Monitor state of production.	Manage and ship products, Manage inventories
Orders flow		Send orders to suppliers	Send orders to production	Receive orders
Material flow		Test and store received parts		

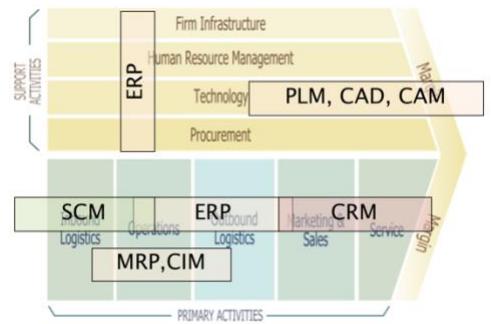
The product/process data can be modeled using:

- **PLM tools:** product lifecycle management (storage, retrieval and processing)
- **Bill of Materials (BoM):** list of components for each product



Common acronyms and functions:

- **CAD CAM systems:** product design (knowledge level)
- **PLM** (Product Lifecycle Management): store and process designs (VCS, git)
- **Planning** (Manufacturing Resource Planning): from product data and customer orders to orders for the suppliers
- **Execution** (CIM Computer Integrated Manufacturing): control the manufacturing starting from the product data
- **SCM** (Supply Chain Management)
- **CRM** (Customer Relationship Management)



- **Process industries:** are organization related to process materials (oil, petrol) that have two primary processes: production and maintenance of plants
  - **Inbound logistics:** raw material, spare parts and maintenance material supply
  - **Operations:** plant supervision, process control and machinery maintenance
  - **Outbound logistics:** product distribution and sale

The main issues for this kind of organizations are:

- Simple supply processes (just raw substances)
- Absent product design processes
- Importance of maintenance of facilities
- Importance of process control (safety, strategic products, environment)
- Importance of coordination of multi-plant productions

- **Telecom operators:** have three primary processes: network, service and workforce management:

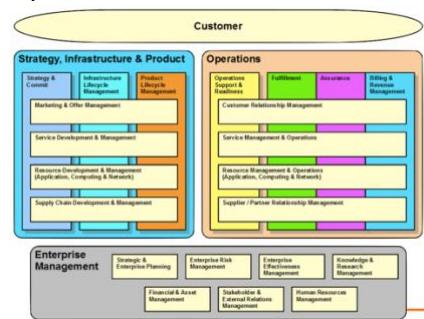
- **Operations:**
  - Network: plan, design and maintain network
  - Service: design, activation and delivery of services
  - Workforce:
    - Plan and execute jobs
    - Procure and store spare parts
    - Manage technical documentation
- **Marketing and sales:**
  - **Marketing and sales per customer type** (business or retail customers) (website, call center and shops)
  - **Billing:** strictly connected with backend that activates SIMs
- **After sales service:** complaints, technical support (website, call center and shops)

The main issues for this kind of organizations are:

- There are two customer/product categories (single person and big organizations)

- Strict link between process (network management) and product: call data records for billing, see prepaid cards and real time billing
- IT has a key role
- Continuous innovation in product and process (billing modes and new products)

The **eTom framework** is a scheme of processes for Telco organizations.



- **Utilities:** organizations that supply natural resources/energy, they have three roles:
  - Production of resources: production and extraction
  - Trading of resources (Enel, Sorgenia)
  - Network for distribution (Terna)

And three processes:

- Service management (trading role): buy/sell resource, offers, bill, design and market service
- Network management (network role): core network, last mile and meters
- Workforce management

The value chain is similar to Telco:

- **Operations:**
  - Service: activation and delivery of services
  - Network/workforce: meters and lines management
- **Marketing and sales:**
  - **Marketing and sales per customer type** (business or retail customers)
  - **Billing**
- **After sales service:** complaints, technical support

The main issues for this kind of organizations are:

- Little innovation of product
- Some innovation of process (digital meter connected, solar production...)
- Process control (network monitoring and control)
- Little customer turnover
- Manage retail and business customer classes

- **Banks and insurances:** the main process for both is service management:
  - Banks: account and investment management, mortgages, loans
  - Insurance: vehicles, life, pension plan and health plans

The value chain is:

- **Inbound logistics:** managing cash flow from the customers
- **Operations:**
  - Service: activation and delivery of services
- **Marketing and sales:**
  - **Marketing and sales per customer type** (business or retail customers)
- **After sales service:** complaints, technical support

The main issues for this kind of organizations are:

- Banks:
  - Customer segmentation: divide business, individuals, SMEs and private banking
  - Products: accounts, financial services (loan, mortgages and investments)
  - Data replication: often customer data replicated among units
- Insurances:
  - IS for local agency and for the main site
  - Data replication: life, vehicles, buildings...
- **Retail:** the two main process are:
  - Procurement-inbound logistics
  - Stores management

The value chain is:

- **Inbound logistics:** products supply, procurement
- **Operations:** stores management, supervision, control
- **Marketing and sales:**
  - Billing
  - Campaign management, advertising

The main issues for this kind of organizations are:

- Large number of stores, suppliers and customers
- Perishable goods (food)
- Simple process, big volumes, small margins

Issues in common for all service provider (banks, insurances, telco operators, utilities, retail):

- Large number of customers (QoS compromised)
- Multichannel interaction (web, mobile, desk, call center)
- String competition, need to understand the customer (CRM,BI)

- **Health:** several needs and actors:
  - **Patient:** manage and share medical data among all actors (EPR Electronic Patient Record, standard HL7 for patient description and treatment descriptions)
  - **Private and public care centers** (hospitals, labs):
    - Logistics: patients, drugs, doctors, nurses and medical equipment
    - Administration: payments, reimbursements, communications and maintenance
    - Medical data: results of treatments, analyses
  - **Private and public entities paying services** (national health system and private insurances)
  - **Medical devices:** are embedded systems that can be source of medical data
- **Public administration:** several different entities, interacting with citizens and companies that can be local, regional, national entities:
  - **Transport**
    - Public infrastructure management (roads, bridges, tunnels, traffic lights)
    - Registry of vehicles, ships, planes

- Registry of driving licence
- **Land and estates:** cadaster, building and monitoring
- **Tax:** collection and monitoring
- **Health (see above)**
- **Security:** police, army, fire departments, identity management
- **Agriculture, rivers, forests**

The main issues for this kind of organizations are:

- Management process often absent
- Support processes more automated
- Primary process:
  - Services to citizens and companies
  - Political processes at different levels (design, discuss, approve, promulgate laws)
  - Lack of reference frameworks (AGID)
- Basic horizontal services (SPID, PagoPA, IOApp, PEC), in Italy are missing a digital signature service and public cloud

The **segmentation** is the concept of separating the software, that an organization is selling, in different software modules dividing them by business function and domain.

There are 2 types of segmentation:

- **Segmentation by vendor:** is made by organizations who produces the software (SAP, Oracle)
- **Segmentation by integrator:** is private and made by organizations that integrate different softwares to a merged solution, customizing and parameterizing applications

Sustainable Product Innovation	Manufacturing and Logistics	Responsive Supply Networks	Marketing, Sales and Aftermarket	Smart Mobility and Transportation
4 Solutions	3 Solutions	5 Solutions	4 Solutions	2 Solutions
Human Resources	Finance	Procurement		
4 Solutions	6 Solutions	9 Solutions		
Analytics	Application Platform and Infrastructure	Database and Data Management	IT Management	Security Software
3 Solutions	4 Solutions	4 Solutions	2 Solutions	2 Solutions
IoT Business and Technology Services				
3 Solutions				

The PICK chart is a graphic representation that divides the possible process improvements in four different categories:

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



It helps in effectively select the best improvements for the organization.

### 3. Low level models

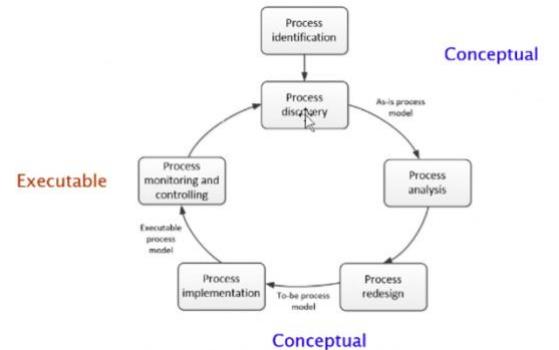
#### 3.1 Low level models – process

The easiest way of representing business processes is by using **free text**, but is difficult to have a clear distinction between the processes.

Another way a little bit more structured is by using a **table** that has four columns: process name, input/output of the process and description. Each one of the processes are represented by a row, but there could be overlapping between them.

The **business process lifecycle** is composed by:

- **Process identification and process discovery:** modeled using text, tables, CRASO, Anthony and T Model
- **Process analysis and process redesign:** modeled using BPMN and other high level models
- **Process implementation and process monitoring and controlling:** performed using BPMN, low level models, programming languages

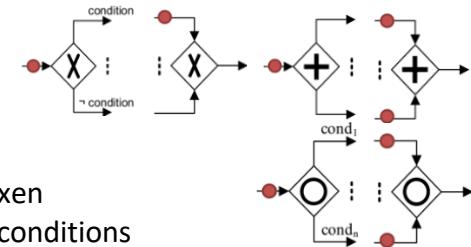
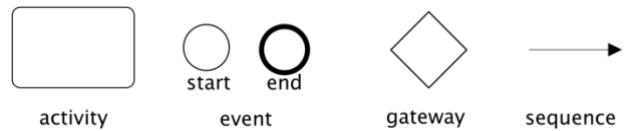


The **BPMN** (Business Process Modeling Notation) is a graphical representation for specifying business processes that we can use as a model, but more importantly as an enactment of the process than can be executed by a **process engine**.

A BPMN has four types of **core elements**:

- **Activity (or 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:**
  - **XOR:** act as a condition, the token can take only one way
  - **AND:** create parallel flows for every branch, cloning the token
  - **OR:** create different parallel flows depending on different conditions

**Attention:** Every gateway should have a closing

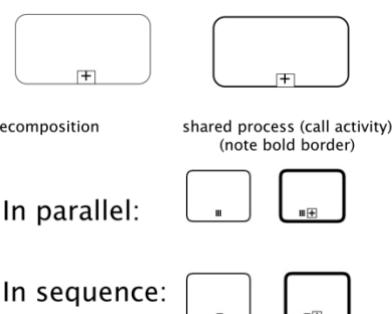


There are different **naming conventions** for BPMN:

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

An activity can invoke a **subprocess** and this is optimal in two cases:

- To decompose a large model
- To reuse a shared subprocess



A task or a subprocess can be **repeated**, this repetition can be made in **parallel** and in **sequence**.

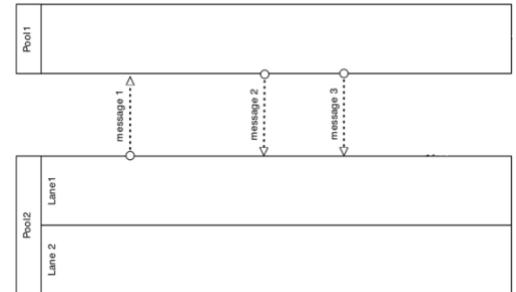
There are different type of tasks:

- **Manual task:** executed by person, with no software tools

- **User task:** executed by person with software tool
- **Service task:** completely automated
- **Message send/receive task**

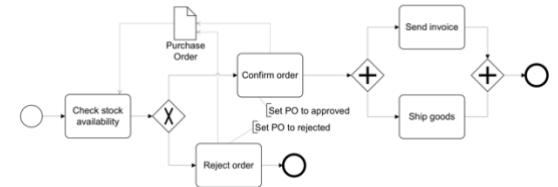
A **pool** contains a single, complete process. The flow cannot cross a pool but can communicate with other pools using asynchronous messages.

A pool contains different **lanes** which are units of the same organisational entity that share a common system to communicate.



Other organizations are considered as a **black box** and are represented by an empty pool because is not a relevant information for us.

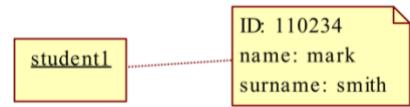
An **artifact** is a way we can use to connect the BPMN with the Data Model, in fact they represent data required or produced by any activity. Using artifacts out diagram could become messy, so instead of using them, we connect the BPMN to the Data Model associating the name of the classes into the UML to the name of the events or activities into the BPMN.



## 3.2 Low level models – data

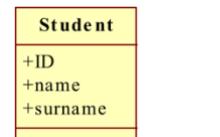
The **Unified Modeling Language (UML)** standardized by the OMG capture the main concepts of the IS and the relationships between them.

An **object** is the model of an item characterized by attributes, can perform certain operations and receive messages.



A **class** is the description of a set of objects that have common properties.

An **attribute** is an elementary property of classes and associate to each object a certain value.



The purpose of this model is to represent the **concept** and not other things like the system or the software classes.

Usually a class in a conceptual model can be:

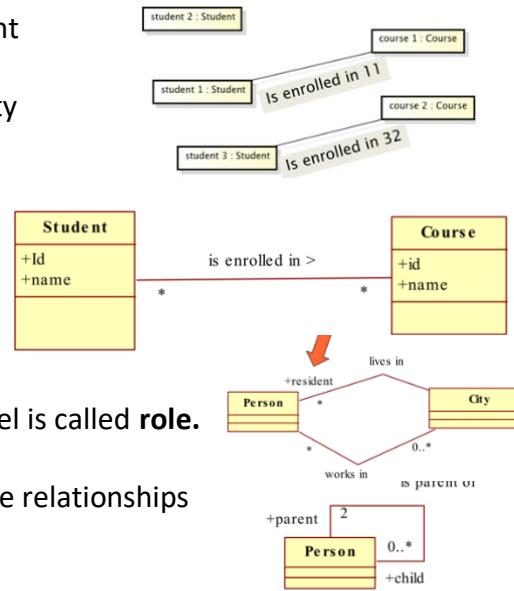
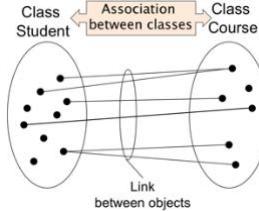
- **Physical entities:** Person, Car
- **Roles:** Employee, Director, Doctor
- **Social / legal / organizational entities:** University, Company
- **Events:** Sale, Order, Request, Claim, Call
- **Time intervals:** Car rental, Booking, Course, Meeting

- **Geographical entities:** City, Road, Nation
- **Reports, summaries:** Weather report, Bank, Account statement

A **link** is a relationship between two objects, we use it when a property cannot be represented on one object only.

An **association** represent a set of links between objects of different classes.

There can be more than one association between two classes.



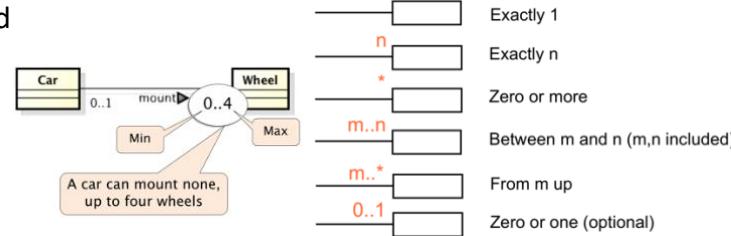
It is possible to associate a name to an end of the association, this label is called **role**.

Roles become useful when dealing with **recursive** associations that are relationships of a class to itself.

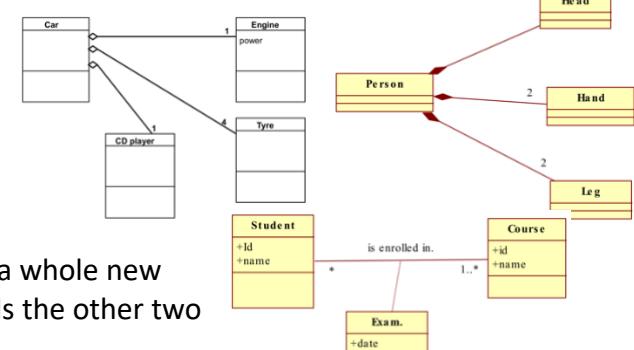
Style suggestions:

- For class names use **singular nouns**
- For association names use **verbs**
- For attributes specifying the type is not needed

**Multiplicity** describes the maximum and the minum number of links in which an object of a class can participate and should be specified for each class partecipating in an association.



An **aggregation** is an association where one object B is part of another object A but object B can exist without being part of A. A **composition** instead specify that B can't exist without specifying A.

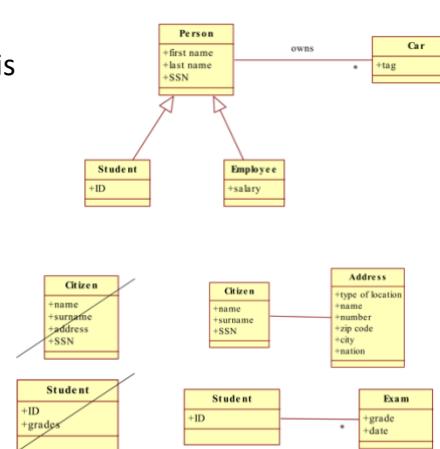


An **association class** allows to attach attributes to an association. Instead of an association class we could also use a whole new class that has its own attributes and two relationships towards the other two classes.

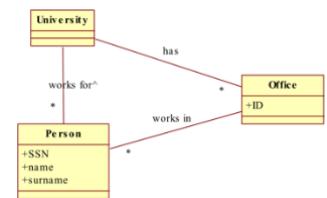
B is a **specialization** of A if the objects described by B have the same properties of the objects described by A and also others attributes. In this case A is a **generalization** of B.

DO NOT:

- Use **plural** for classes
- Forget **multiplicities**
- Forget **roles / association classes**, when needed
- Use **class as an attribute**
- Use attributes that represent **many objects**



- Use **transient relationships** that represent events that are not interesting, because they can clutter the diagrams (student “exits” the or “enters” the class physically)
- Specify the **id** related to an associated class
- Use **loops** in relationships
- Model classes related to the **implementation** of the system



### 3.3 Low level models – organization

An organization is divided in different parts called **Organizational unit (OU)** and we can use two different kind of models:

- **Inter organizational:**
  - List the organizations involved
  - CRASO model

- **Intra organizational**

- **Organizational chart:**

In this model at each node corresponds a different **OU** and a line represent that the lower node is a part of the upper one. This chart can be used also to represent **roles** in an organization where the top nodes commands and controls the down nodes.



It is also possible to **mix** roles and OU into the same organizational chart.

- **Linear Responsibility Chart (LRC)**

Having the processes as the rows and the OU as columns of a table it represent at each intersection the **degree of involvement** of the OU in the specific process.

**P** if the OU is a main actor in the process or **C** if the unit just receives something from the process but doesn't perform any action, **nothing** when the OU is not involved at all.

Processes (samples)	Organization's Structures							External Actors	
	Purchase	Design	Production	Sales	Admin.	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	

If a certain process implies too many OU it means that there is something wrong in the process.

- **BPMN Pool and lanes**

We can model an organization by a pool where each OU is a lane.

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

### 3.4 Low level models – 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 which are more or less **automated** and **formalized** (if they are formalized, they will be implemented in the same way by everyone).

A business rule is usually **encoded** with a computer language into the application layer (in other cases could be implemented into the presentation or data layer).

A **policy** is a general direction and will be implemented using different business rules.

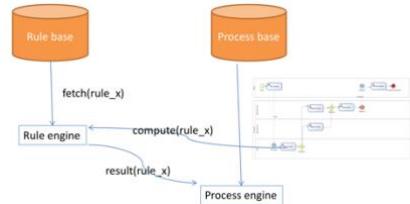
A business rule should be:

- **Declarative:** the statement of a policy, not how the policy is enforced, this characteristic has different advantages:
  - Force formal definition of rules
  - Separate business rules and business processes
- **Precise:** the rule must have only one interpretation
- **Atomic:** a business rule marks one statement, not many
- **Consistent:** a business rule must be internally and externally consistent with respect to other business rules
- **Expressible:** a business rule must be able to be stated in natural language
- **Distinct:** business rules mustn't be redundant
- **Business-oriented:** a business rule is stated in terms that businesspeople can understand

The implementation of a business rule can be:

- **Manual**
- **Automated:** can be embedded in computer programs, or written in a declarative form and executed by an engine

During the execution of a process when the **process engine** encounters a condition/decision, it calls the **rule engine** which after accessing the **rule base** gives the result.



The **Business Rules Management Systems (BRMS)** is a software system that can be used to define, deploy, execute and monitor business rules. The **Business Rule Engine** is the part of the BRMS in charge of executing the business rules.

Some **examples** of BRMS are:

- Drools (Red Hat)
- Camunda DMN (Camunda)
- Oracle BR engine (Oracle)
- Operational decision manager (IBM)

A **Drools rule** has two parts: when the **condition** is verified, the **action** is carried out.

In the example if the two people have the same address, their informations are printed.

```
rule ...
when
    $p: Person( $address : address )
    $p2: Person( address == $address )
then
    system.out.println( "Person" + $p + $p2 );
end
```

This kind of rules can also do pattern matching and every type of condition.

Another possibility is to use **Decision Tables** that are a compact way of representing conditional logic. They are expressed with spreadsheets or CSV files where each row is rule.

Each rule contains input entries which represent the conditions and output entries that are the conclusion of the rule.

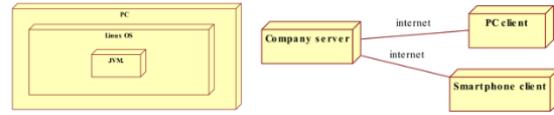
### 3.5 Low level models – Technology

There are different notation to model the **technological implementation** of the IS:

- **Application portfolio**: is composed simply by a list of applications
- **UML deployment diagram**: describes the applications into the context where they are executed.

A **node** is a physical or software entity capable of doing some processing, they can be nested.

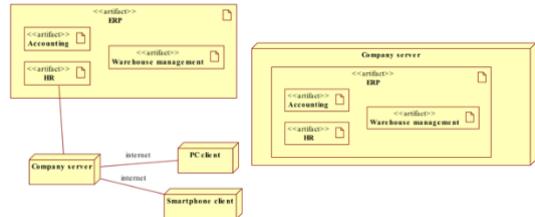
Nodes are physically linked by **associations**.



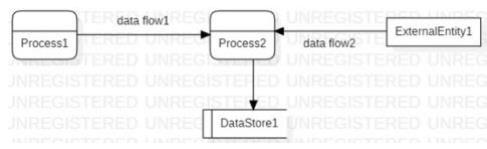
An **artifact** is a software part that is interesting for the business process like source file, library, db table. It doesn't represent a single function but a structured program.



The **deployment diagram** represent how the artifact are integrated inside the nodes, and the general structure of the technology. Instead of using links, artifacts can be nested inside the corresponding node (but it is not the best solution).



This diagram has the potential of putting all the information related to technology together in a condensed view.



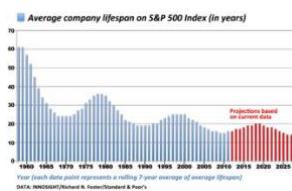
## 4. Organizations

An organization have different characteristics that are related to the **organizational variables**.

The **organizational design** defines the organizational variables of an organization.

The **changing** of an organization is strongly related to a change to their organizational variables, changes and innovations are needed for evolution but most of the less successful companies tend to resist to it.

Due to higher competition and bigger market, organizations' **lifespan** is shortening.



Information systems are one of the key factors to be considered in the evolution of an organization. The implementation of automations via an IS increases the efficiency but decreases the flexibility of a certain process.



There are different **organizational variables**:

- **Size:** can be estimated in different ways:
  - **Number of employees:** manage the different kinds of employees (full time, part time and collaborators)
  - **Turn overs**
  - **Number of sites**

**SMEs** (Small Medium Enterprise) are the majority of companies (90%+) and employ the majority of employees.

This possible metrics for estimating the size of a company could not be strictly correlated.

- **Goal type:**
  - **Coercitive goal** (Prison)
  - **Utilitarian goal** (Profit)
  - **Normative goal** (University)
- **Culture:** is the tacit social order of an organization and define what is encouraged, discouraged, accepted or rejected by the people. A cultural change will involve a transformation of an organization through multiple phases.

Examples:

- We are the best
- Working is fun
- Women are paid less
- Working more is better
- The boss knows more/is always right
- Dressing codes
- Innovation and change vs “we always did it like this”

For example the organization “Patagonia” is an example of “good” culture.

The culture is a unifying factor and restraint change.

- **Politics:** activities related to making decisions in groups related to the allocation of resources and status.
- In a company **conflict** is the rule, not the exception, so the conflict resolution must be ongoing, using differente techniques:
  - Brute force, hidden decisions and rules
  - Discussion, transparent decisions and rules
- **Environment:** composed by:
  - Resources and constraints (cost of labour, currency)
  - Governments/regulatory agencies (right of employees/power of trade unions, taxation, pollution laws, freedom of trade)
  - Competitors
  - Financial institutions
  - Knowledge

	staff	Turnover
Large		
Medium	<250	< 50M Euro
Small	<50	< 10M
Micro	<10	< 2M

Size definitions by the European Commission

	Google	Amazon	Toyota	Ford
Employees	57K	230K	345K	200K
Turn over (US\$)	74B	107B	240B	150B
Profit (US\$)	16,3B	0,6 B	17,3 B	7B
Profit / turnover	22%	0,5%	7,2%	5%
Brand value (US\$)	23B	63B	29B	13B

- **Structure:** describe the role of people
- **Formalization:** level of description of an activity. If an activity has a complete formalization it becomes a sort of algorithm also called **SOP**. **SOP** (Standard Operating Procedures): precise rules, procedures and practices that cope with virtually all expected situations, starting point for automation using the IS.
- **Centralization:** where to allocate decision power in the hierarchical levels
  - **Centralized organization:** decision power only at higher levels
  - **Decentralized organization:** decision power also at lower levels

Example: centralization in a bank for deciding mortgage allocation.

-If the structure is completely centralized all decision are taken by the main branch financial director, this case is not ideal because there should be too many request for a single individual.

-If the structure is decentralized every single agency director takes the decisions, this case is more realistic.

-The **best solution** is to rise up the decisioner accordingly to the difficultness of the decision.

- **High centralization:** more homogeneity and slower responses
- **Less centralization:** better response times and less homogeneity
- **Specialization:** the level of detail of activities and the level of specificity of employees, specific activities are often assigned to specialized roles.

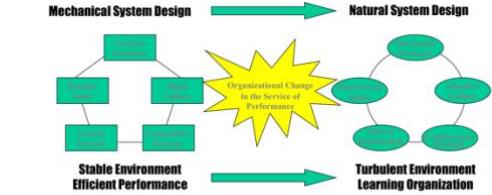
An higher level of specialization allows to differentiate di activities:

- Mortgage for industrial activities
- Mortgage for first houses
- Mortgage for vacation houses

More specialization is typically linked with more **formalization**, is **efficient** and **precise** but is **less flexible** (it's difficult to balance the work of each "specialization").

An high level of the last three organizational variables is related to **high bureaucracy**.

The **organization design** spans from a **mechanical/hierarchical system design** where the organization works as a machine having a vertical structure, rigid culture, routine task having a stable and efficient environment (army); to a **natural system design** that has an horizontal structure, adaptive culture, shared information and empowered roles.

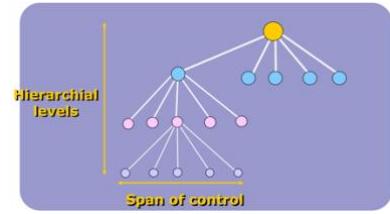


There are different **organizational types**:

- **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 part of the activities should be efficient and repetitive and the other part are difficult and custom for each customer
- **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 a OU, and a link represent a formal dependency.

This structure must be completed with mechanisms that supports **communication** and **coordination**.



Given the same size of organization a **lower depth** of the hierarchical levels (horizontal organization) gives **faster reaction** (the command chain is really close) but **increases the workload** on the upper levels.

So the **links** can be:

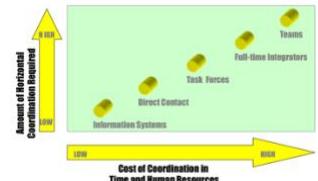
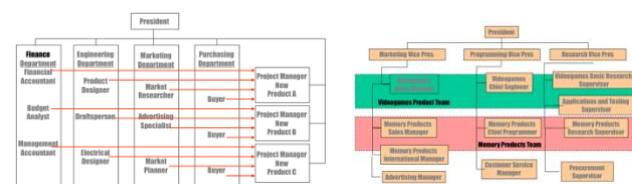
- **Vertical:** control and communication, lower level employees must perform activities coherent with goals set by the higher level, managers at higher level must know activities and results of lower level
- **Horizontal:** communication, employees in different units must share information and coordinate themselves

**Hierarchy**, denoted by **vertical** links, can be implemented in different ways:

- **Plans:** the controlling/commanding is made with plans, for example budget plans
- **Rules/procedures:** higher level gives a standard way for performing activities to the lower level
- **Command chain:** a problem that can't be solved at level x is reported at level x-1
- **Vertical IS:** to define and diffuse reports and internal measures like KPI

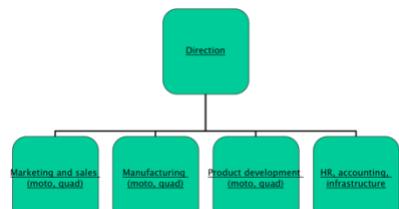
**Horizontal** links can be implemented in different ways:

- **IS:** database of shared informations
- **Direct contact:**
  - Liaison person: charged of contact with other units
  - Temporary collocation of employees from different units
- **Full time integrator role:** project manager, product manager, brand manager
- **Task force:** temporary group of people from different units
- **Team:** same as task force, but permanent

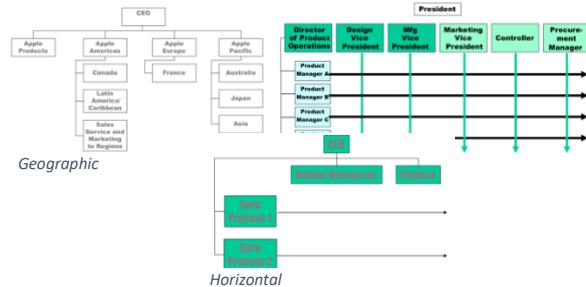
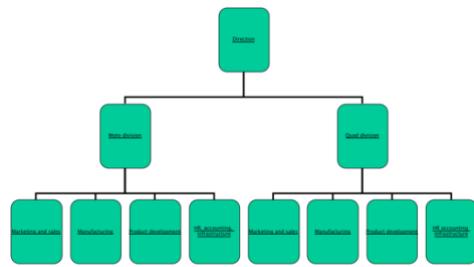


The **structure** of an organization can be:

- **Functional:** employees are grouped according to similar functions/skills, functions are not repeated
  - **Strengths:**
    - Allows economies of scale (if a unit does more thing it costs less)
    - Enables in-depth knowledge and skill development
    - Enables organization to accomplish functional goals
    - Is best with only one or a few products
  - **Weaknesses:**
    - Slow response time to changes
    - May cause decision pile on top, hierarchy overload
    - Leads to poor horizontal coordination among departments
    - Results in less innovation
    - Involves restricted view of organizational goals



- **Divisional:** employees are grouped by product, functions are repeated for each division
  - **Strengths:**
    - Suited to fastly change in an unstable environment
    - Leads to client satisfaction because the product responsibility and contact points are clear
    - Involves high coordination across functions
    - Allows units to adapt to differences in products, regions and clients
    - Best in large organizations with several products
    - Decentralizes the decision making
  - **Weaknesses:**
    - Eliminates economies of scale in functional departments
    - Leads to poor coordination across product lines
    - Eliminates in-depth competence and technical specialization
    - Makes integration and standardization across product lines difficult
- **Geographic:** functions are repeated for each geographical area
- **Matrix/multifocused:** grouping by more than one criterion
- **Process/horizontal:** employees grouped by process



## 5. 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, public company)
- Interaction with social environment
- Interaction with environment

The **Nace taxonomy** list the possible business sectors.

In his lifetime, a company can change its business sector and his strategy radically.

Nokia:

- 1865: pulp mills
- 1922: rubber and cables
- 1967: electronics
- 1981: mobile phones
- 2014: mobile phones unit sold to Microsoft

EPA code	ISIC Rev. 4 / NACE Rev. 2	Divisions
1 A	Agriculture, forestry and fishing	01 to 03
2 B	Mining and quarrying	05 to 09
2 CA	Manufacture of food products, beverages and tobacco products	10 to 12
4 CB	Manufacture of textiles, apparel, leather and related products	13 to 15
5 CC	Manufacture of paper products, printing and publishing	16 to 18
6 CD	Manufacture of chemicals and chemical products	19 to 21
7 CE	Manufacture of chemicals and chemical products	20
8 CF	Manufacture of pharmaceuticals, medicinal and botanical products	21 to 23
9 CG	Manufacture of basic metals and fabricated metal products, except machinery and equipment	24 to 25
10 CH	Manufacture of basic metals and fabricated metal products, except machinery and equipment	26
11 CI	Manufacture of computer, electronic and optical products	27
12 CJ	Manufacture of motor vehicles, trailers and semi-trailers	28
13 CK	Manufacture of machinery and equipment n.e.c.	29
14 CL	Manufacture of transport equipment	30 to 32
15 CM	Other manufacturing, and repair and installation of machinery and equipment	33 to 35
16 DN	Electric power, gas, steam and air conditioning supply	36 to 39
17 E	Water supply, sewerage, waste management and remediation	40 to 43
18 F	Construction	44 to 47
19 G	Wholesale and retail trade, repair of motor vehicles and motorcycles	48 to 51
20 H	Transportation and storage	49 to 53
21 I	Accommodation and food service activities	54 to 56
22 J	Publishing and audiovisual and broadcasting activities	57 to 60
23 JH	Telecommunications	61
24 JC	IT and other information services	62 to 63
25 K	Financial and insurance activities	64 to 66
26 L	Real estate activities*	67
27 MA	Legal, accounting, management, architecture, engineering, technical testing and analysis activities	69 to 71
28 MB	R&D, technical research and development	72
29 MC	Other professional, scientific and technical activities	73 to 75
30 N	Administrative and support service activities	77 to 82
31 O	Public administration and defence, compulsory social security	83
32 P	Education	85
33 QA	Human health service	86
34 QD	Social work, except social work activities	87 to 88
35 R	Arts, entertainment and recreation	90 to 93
36 S	Other services	94 to 96
37 T**	Activities of households as employers, undifferentiated goods- and services-producing activities of households for own use	97 to 98*
38 U**	Activities of extra-territorial organisations and bodies	99*

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

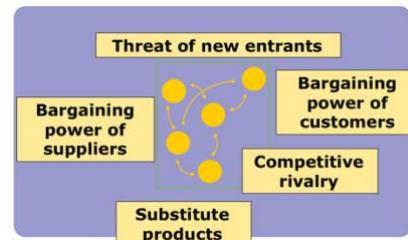
- **Competitive advantage:** the product is unique (luxury) and costly or common and low cost



- **Market focus:** the product is for the mass market or for specific niches  
(Airlines: Emirates vs Ryanair, Retail: Esselunga vs ALDI)

Porter also defined the **5 forces model** that identifies and analyzes five 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 can lead to a form of dependence to them
- **Bargaining power of suppliers:** higher costs for the supplier's products cause your prices to increase, if they increase too much you can be out of the market
- **New entrants:** the ease with which a competitor can enter the company's market
- **Intensity of rivalry:** how many competitors there are



Example: Kodak vs Fuji

While Fuji changing its business sector from the picture domain to chemical products increased its lifespan, Kodak decided to remain in the cameras sector taking a wrong strategic decision

Technological innovation can change the market really fast and my hugely impact strategy. The diffusion of innovations is shrinking:

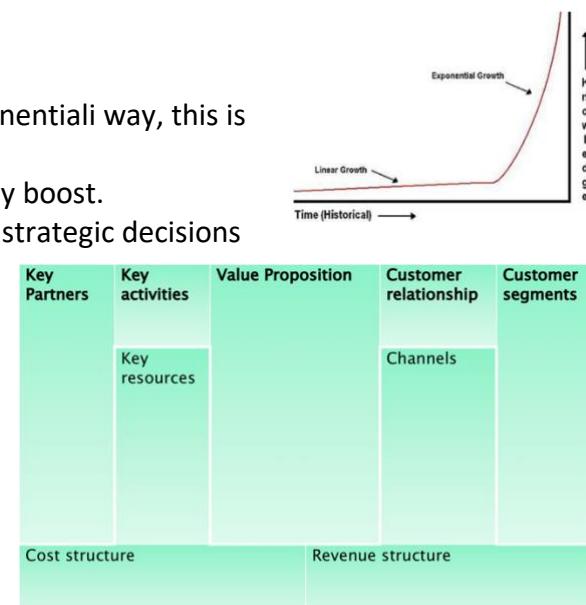
- Steam engine: 100 years
- Electricity: 50 years
- TV: 13 years
- Facebook: 2 years

Also the amount of available knowledge is increasing in an exponential way, this is shown in the **Knowledge Doubling Curve**.

Companies' lifespan is decreasing also because of the technology boost.

The **Business Model Canvas** is a tool to express all the essential strategic decisions in an organization, can be used to invent a new company and to model the reality.

- **Value proposition:** list of all products and services, how they produce benefits and provide gains for the customer (**Gain Creators**), how they alleviate problems, reduce negative emotions and undesired things (**Pain Relievers**):
  - Newness
  - Performance
  - Customization
  - 'Getting the job done'
  - Price
  - Status: the social status that the product gives
  - Design
  - Cost reduction
  - Risk reduction
  - Accessibility



- Usability
- **Customer segments:** groups of customers the organization is aiming to serve (and not to serve):
  - Mass market (consumer electronics)
  - Niche market (luxury cars)
  - Segmented (luxury cars+normal cars, Toyota+Lexus)
  - Diversified (Amazon: cloud services+books and items)
  - Multisided (commercial TV, audience + advertisers)
- **Channels:** the physical or non-physical way of reaching the customer segments:
  - Raise awareness about organization
  - Explain the value proposition
  - Purchase the product/service
  - Deliver the product/service
  - Provide post purchase support
- **Customer relationship:** type of relationship between organization and customer segment:
  - Personal assistance (face to face, email, call center)
  - Dedicated personal assistance (a strong relationship, financial advisor)
  - Self service (website)
  - Automated service (as self service but customized for the customer, google search)
  - User community (share knowledge and support customers)
  - Co-creation (youtube, amazon book reviews made by customers)
- **Key resources:**
  - Physical
    - Facilities, buildings, vehicles, stores, point of sales
    - Platforms (credit card companies, stock trading)
    - Networks (logistic companies)
  - Intellectual: brands, patents, trademarks, customer data
  - Human: workers, researchers, designers, sales force
  - Financial: cash, credit lines, stock options
- **Key activities:**
  - Design, production (automotive, electronics)
  - Problem solving (hospitals, law firms, consultancy firms)
  - Platform management (credit card companies, stock trading)

Key activities are not **outsourced**.
- **Key partnerships:** relationships with other organizations:
  - Alliances between non competitors
  - Coopetition: alliances between competitors on specific product/service
  - Joint ventures for new businesses
  - Buyer supplier relationships
  - Outsourcing relationships
- **Cost structure:** costs related to key resources, activities, relationships:
  - Cost driven (Ryanair)
  - Value driven (7 star hotel)

Must be considered fixed and variable costs.

Economies of:

  - Scale: maximize utilization of resources to produce one product/service to increase the volume of production

own	direct	Sales force
		Web
		Own stores
partner	indirect	Partner stores Wholesaler

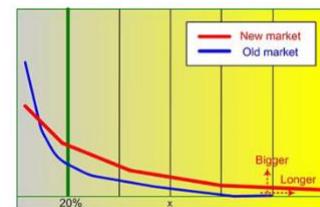
- Scope: maximize utilization of resources to produce many products/services to increase the set of products/services
- **Revenue streams:** how much and how customer segments pay for the product/service:
  - Asset sale (one time payment)
  - Usage fee (proportional to usage, telephone calls paid per duration)
  - Subscription fee (for amount of time, monthly fee for gym)
  - Renting/lending/leasing (exclusive use for a defined amount of time)
  - Licensing (copyright, right of using a copy)
  - Brokerage fees (fee for intermediation service, real estate agent, booking.com)
  - Advertising

Price can be:

- **Fixed:** based on static variables
  - List price (fixed)
  - Number of features dependent
  - Customer segmentation dependent
  - Volume dependent
- **Dynamic:** the price changes depending on market conditions:
  - Negotiation (depends on discussion between parties)
  - Yield management (depends on inventory and time of purchase, flights)
  - Real time market (based on demand and offer, stock exchange)
  - Auctions (bidders compete)

There are different kinds of **Business Model Pattern:**

- **Unboundling:** consist in dividing the activities in three macro-categories:
  - Product innovation
  - Infrastructure management
  - Customer relationships
- **Long tail** (books industry): consists in selling **small quantities of many items** (while in the traditional way the aim is to sell large quantities of few items).



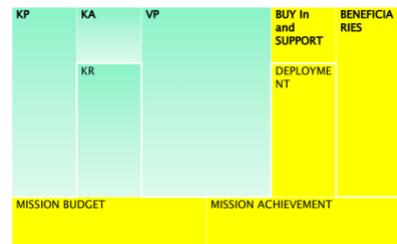
This approach is applied the most to **content industry** and can be more profitable than traditional.

There are many conditions that made this approach possible:

- Democratization of tools of production
- Democratization of distribution (internet+digital content, lower transaction and inventory cost)
- Better link supply-demand (search engines, recommendation systems, reviews and communities)
- **Multisided:** consists in selling to two different, but interdependent, group of customers.  
Google, for example, brings together customers, content providers and advertisers.
- **Free:** offer a service for free, to have a high demand (revenues arrive from advertisers)
- **Freemium** (Skype, Flickr): the basic service is offered for free and the premium one requires a fee (it works if the cost of serving the free service is low)

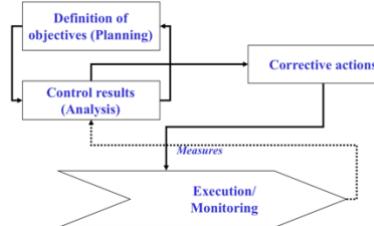
- **Bait and hook:** upfront there is a free or a very cheap offer, but later there are fees to pay

The **Mission Model Canvas** is an adaptation of the BMC for non profit organizations.



## 6. KPI CSF BSC

The **managers** of an organization need to have control of what is happening. The best way is using metrics and measures. The entire cycle is shown inside the **Management Cycle**.



The IS should support managers in monitoring and controlling the organization, using reliable indicators that needs to be defined.

An **indicator** is an high level aim of the company that implies **many measures**.

Indicator = Brand recognition

Measures

- % Population aware of the brand
- Number of announces in press

A **measurement** is the process of 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→ age, salary, machine, web server)
- Activities (design→duration/cost of design, production)
- Products/services (car→cost/defects of car, book, insurance)

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

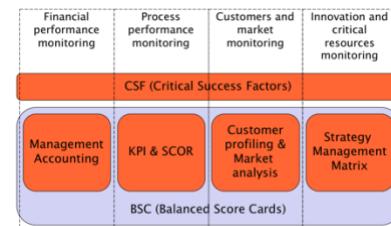
The **measurement process** is composed of different phases:

- **Define/modify** indicators and measures using approaches as Management accounting, CSF, KPI
- **Verify** measures and indicators:
  - **Meaningfulness:** does it measures what is supposed to measure?
  - **Cost** to collect and process the measure
  - **Coverage:** how much the measure covers the indicator
  - **Frequency/Obscence:** how often the measure changes and has to be recomputed
  - **Objectivity:** how much the indicator is objective and not ambiguous
- **Collect and store** the measure:
  - **Data collection** (Human based, automatic)
  - **Data storage** (DB schema)
  - **Measure computation**
  - **Measure presentation**
- **Present the results** to the managers and use them day by day

- Check if they are used and useful

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

- **Time window**: sales per hour/day/month
- **Hierarchical nodes/geographical**: sales per country/region/shop, expenses per company/division/group/person
- **Product/Product category**: sales per phone xy / sales per business phones
- **Customer/Customer category**
- **Activity in process**: cost/defect per design/production
- **Project**: cost/defect per project



There are different **approaches** to define indicators.

The **management accounting** base indicators on costs, revenues, cash flow, investment, capital, return of investment.

There are two aspects to consider:

- **Financial accounting**: public data, accounting standards and laws, historical perspective
- **Management accounting**: private, sensible data, fit for use of company/managers

There are different **indices** and **measures** that must be considered:

- **Expenses**: costs for the organization (fixed and 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: will be converted to cash within one year (cash, inventory, account receivable)
  - Fixed: will provide benefits in more than a year (machinery, real estate, land)
- **Liability**: what is due
  - Current: payable within a year (account payable)
  - Long term: payable in more than one year (mortgage)
- **Equity**: assets – liability
- **Cash flow**: sum of cost – sum of revenues, over a certain period (3-6-12 months) (can be positive or negative)
- **Operating profit**: sum of invoices issued – sum of invoices received, over a period. Cash flow and operating profit are not the same thing, because there is often a delay between the issue of an invoice and its effective payment, also some invoices may never be paid.
- **Profitability**:
  - **Net profit margin**: net income / revenues
  - **Operation profit margin**: (net incomes – taxes – interests)/revenues
  - **EBITDA**: Earnings before interest taxes depreciation amortization
- **Balance sheet**: the summary of assets, liabilities and equity at a certain time

In the management accounting the **cost accounting** is an important part, it includes budget and actual cost of operations, processes, departments, products. It is needed to analyze the **variances** and the **profitability** to compute the **unit cost** of products and services.

A **direct** cost is directly traceable to a product/service sold to the customers while **indirect** costs are usually related to the horizontal functions that are not directly traceable and difficult to compute.

Example for car manufacturing:

- Direct: car components, materials, labor, energy to manufacture
- Indirect: machine to manufacture, effort to design, advertise, HR, purchase

A **fixed** cost is a cost that doesn't depend on the number of units produced, while **variable** costs depend on quantities.

Example for car manufacturing:

- Fixed: infrastructure (factory buildings, long term contract personnel, machinery)
- Variable: cost of raw materials and parts, cost of energy, short term contract personnel

The indirect costs can be allocated in two ways:

- **Proportional** to number of elements manufactured
- **Activity based costing**: consist in splitting the cost on different activity in function of actual consumption, so requires a precise measure of how cost is split, it aims to understand the true cost of product/service to identify profitable ones.

- Design cost – proportional
  - ♦  $50M / (3+2) M = 10 \text{ euro / car}$
- Design cost – activity based
  - ♦ Compute how much effort (time) was spent by R & D per activity (per model)
    - 75% of time for model B
    - 25% of time for model A
  - ♦ Model A =  $(0.25 * 50)/3M = 4\text{ euro/ car}$
  - ♦ Model B =  $(0.75 * 50)/2M = 17\text{ euro/ car}$

To allocate costs related to **personnel** we need to consider:

- Salary (direct cost): average or specific per person
- Overheads (indirect cost): office cost as percentage of the employee's cost

ID: Name: Surname: Dept:	mon	tue	wed	thu	fri
Task / project ID					
Project X	4				
Project Y	4				8
Training				8	
Vacation / Leave		x			
Sick		x			

The **FTE** (Full Time Equivalent) is the virtual number of employees working full time on a process.

Are also used tools like **timesheets**.

Another approach is the **CSF** (Critical success factors), where the concept is that only a **few factors** are really important in an organization, so they should be monitored constantly.

CSF exists at different **levels** among the organization structure (corporation, function, single role).

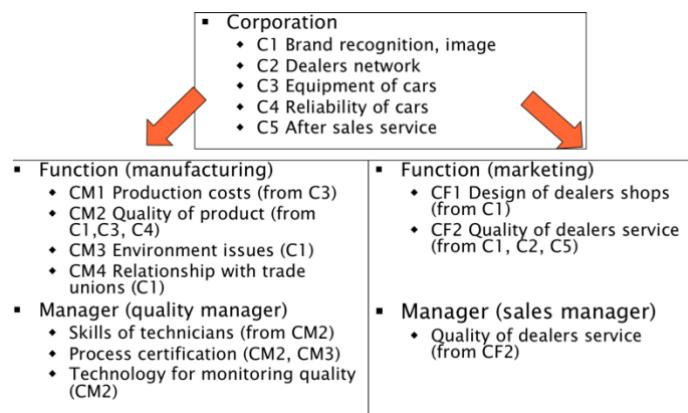
CSF can come from different **areas**:

- **Business domain**: key areas for all companies in same business domain (cost for PC manufacturers, skill of personnel for consulting companies)
- **Competitive factors**: factors that differentiate company from others (for airlines, low cost vs QoS)
- **Environmental factors**: constraints from outside such as norms, rules, standards (pollution norms)

- **Contingency factors:** temporary constraint (merge IS of two companies after financial merge, recover brand reputation after failures)

A CSF is composed by:

- **Name:** (brand recognition)
- **Description:** (how brand is known by a sector of population in a geographical area, how the brand is associated to a product or service)
- **Type:** (business domain, competitive...)
- **Level:** (corporation, function...)



The selection, decomposition, assignment of CSF is not algorithmic, there must be a continuous verification on the field to improve them constantly.

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

While the CSF focuses on the different areas of the company, the **KPI** (Key Process Indicators) approach focuses on measuring certain indicators on the **processes**.

The **KPI descriptor** is composed of four parts:

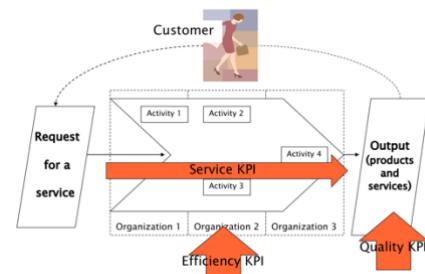
- Name
- Definition: how the KPI is computed
- Type
- Segmentation

There are four **types** of KPI:

- **General:**
  - **Input volume:** how many times the process starts
  - **Output volume:** how many times the process ends
  - **Human resources**
  - **Non-human resources** (plants, machines, facilities)
  - **Inventory** (ex. number of cars in the rental cars process)
  - **Other resources** (website, IS)
  - **Output Volume / Input Volume:** to get the ratio of actually completed operations
- **Efficiency:**
  - **Cost per unit:** total cost/volume
  - **Productivity of resources:** volume/resource
  - **Utilization of resources:** used resource/available resource, describes how well we are using the resources

In general costs are **low** when productivity and utilization are high.

- **Quality:**
  - **Conformity:** non conform items/total # items, measures the conformity with the product description
  - **Reliability:** is the probability that the product satisfies its functions after time T
    - **MTTF:** mean time to failure



- MTTR: mean time to repair
  - MTBF: MTTF+MTTR, mean time between failures
- **Customer satisfaction:** measure the satisfaction of the product using interviews and questionnaires and using qualitative scales (1 to 5 votes)
- **Service:**
  - **Lead time:** time to satisfy an order from the beginning to the end
  - **Response time:** lead time + queue, is the total time needed (the queue is considered only for people waiting)
  - **Punctuality:** actual lead time – nominal lead time, represent the delay of an order
  - **Perfect orders:** on time and within specifications
  - **Flexibility:** the flexibility towards the customers of changing an order
    - # Modified orders / total # orders
    - Value of modified orders / total value of orders

The **Balance Scorecards** (BSC, Kaplan and Norton 1992) is a technique that consists in focusing on four key perspective of the organization that must be balanced:

- **Financial:**
  - Cash flow
  - Return of the investment
  - Financial result (profitability)
  - Return on capital invested
  - Return on equity
- **Customer** (the value proposition):
  - Customer satisfaction
  - Returning customers
  - Market share
  - Quality
- **Internal process** (that delivers the customer value proposition):
  - Number of activities
  - Opportunities success rate
  - Accident ratios
  - Manufacturing indicators (loading, availability, performance quality)
- **Innovation and learning:**
  - Investment rate
  - Illness rate
  - Internal promotions %
  - Employee turnover
  - Gender ratios

All the important information related to the balanced scorecards are represented and visualizable by the **Dashboard BSC**.

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

There are different possible **statistics** applicable to a measure:

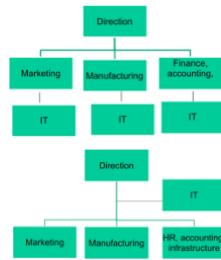
- **Central tendency:** mode, median, mean
- **Frequency distribution**
- **Variance**

## 7. IS

The **IT area** is the organizational entity that supports/offers IT services to an organization. Only companies above a certain turnover/size **threshold** can sustain an IT area.

In the past the IT area worked only under the finance department, after some time it started working also for every other department (**Decentralized IT**) and this led to a divergence because each application was different and not correlated (data is not consistent or must be synchronized among divisions).

Nowadays it works directly for the direction as a “**staff**” function (**Centralized IT**).



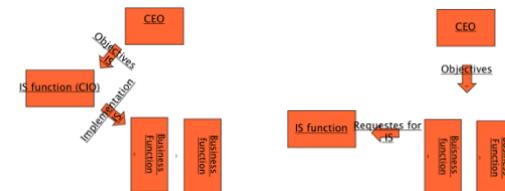
The **centralized** approach has different advantages and disadvantages:

- Advantages:
  - Economy of scale (no duplications of assets)
  - Standardization (of tools, architectural choices, and career paths)
  - Data sharing
  - Governance: control of IT budget and costs, enforcement of IT strategy
  - Consistency of the data
- Disadvantages:
  - Less reactivity to requests from other business functions
  - Less specialization

But even with the centralized approach, if there is no control, it will flow to a decentralized approach because of entropy, this is called the **Conway's Law**.

There are two 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:** 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
  - **General manager:** in charge of an entire organization or business unit
  - **Functional manager:** in charge of a functional area or a team
- **End users:** individuals who have direct contact with sw applications and they use them to carry out specific tasks
- **Executives:**
  - **Chief Information Officer (CIO):** the individual in charge of the information systems function
  - **Chief Digital Officer (CDO):** the individual in charge of digital transformation and digital innovation in established organizations
  - **Chief Data Officer (CDO):** the individual who oversees all aspects of data use in an organization (collection, compliance, extraction)
  - **Chief Information Security Officer (CISO):** the individual in charge of digital risk management and cybersecurity
- **Technical Staff:**
  - **Architect:** the individual in charge of developing a framework for the development of a system

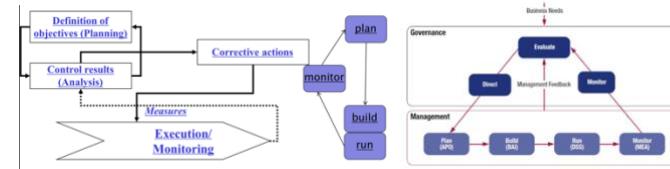
- **Developer:** the individual who builds the software using the framework provided by architects
- **Administrator:** the individual who is charged with the day-to-day maintenance of a system or collection
- **Analysts and Managerial Staff:**
  - **Analyst:** the individual who performs analysis in a specific field or topic area
  - **Project Manager:** the individual ultimately responsible for delivering the IS on time, within budget and scope
  - **IS Manager:** the individual in charge of a team within the IT function of an organization (is under the CIO)
- **Data science and analytics:**
  - **Data scientist:** the individual in charge of analytics on data
  - **Data engineer:** the individual that does data access and preparation
  - **Subject matter expert:** individual with a deep understanding of the business and the functional domain of analysis
- **IT Consultant:** the individual that moves assuming roles like the ones described previously.

## 7.1 COBIT

The **COBIT** (Control Objectives for Information and Related Technology) is a reference document that aims at aligning Business and IT Strategy meant for managers and auditors.

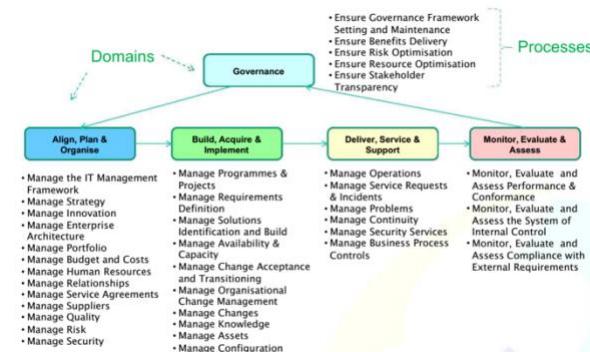
Implements, in some way, the management control loop:

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



Each process for governance and management are further decomposed in activities and practices, with input and outputs for each one.

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



## 8. ES – ERP – CRM

ES, ERP, CRM are software applications that help managing the business.

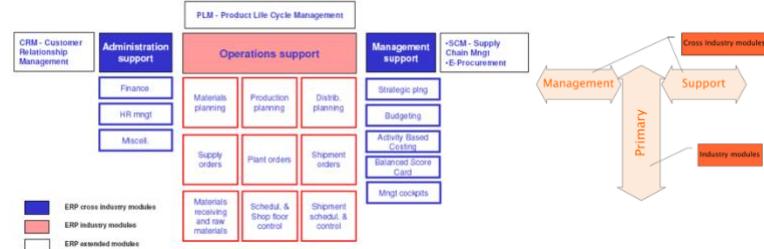
**ERP:** Enterprise Resource Planning

**CRM:** Customer relationship management

**SCM:** Supply chain management

**ES** Enterprise System: ERP + CRM + SCM

Originally there was only the ERP, while CRM and SCM were added later. An ERP is composed of different modules, where we can recognize the T of the T model: the vertical line is related to modules specific for the business, while on the horizontal line there are the cross-industry modules.



The ES is organized in three levels:

- **Software functions:** that 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 three main **principles**:

- **Data sharing:** all the sw applications share the same data.  
In the past the same data were stored by different systems that needed dedicated and costly interfaces for synchronization.  
This because different and independent applications were sold by different companies.  
In the case of data sharing there are:
  - **Horizontal integrity:** all applications share the same data
  - **Vertical integrity:** data are the same from operational level to management level



The management support applications aggregate data and show (for example) KPIs.

- **Modularity:** the companies that produces software sells different modules that fits different business functions (horizontal and primary). (SAP example).  
This principle offers a smoother transition and an extensible software that can perfectly match the company's needs.
- **Prescriptivity:** the ERP sold is, in general, the same for every customer, but there is a limited capability of customization.



Before buying or building an ERP, a company need to do **gap analysis**.

Gap analysis help to decide if it is convenient or not using (or transition to) a software to do a certain activity and if the software should be bought or produced internally.

The transition to an ERP has different **costs**:

- **License + personalization**
- **Delay:** the time for doing the transition
- Changes to business processes (acceptance, human factor)
- Loose flexibility on some operations

The cost depends also on the size of the companies:

- **Large corporations** (turnover > € 50M) have difficult constraints like multi-currency, multi-language, multi-legal systems, big IT dept.
- **SME** (turnover < € 50M) has less constraints because they have one language, one currency and one legal system, small or no IT dept.

There are different kinds of vendors:

- **Major players:** SAP Business One; Oracle ERP cloud, Microsoft Dynamics NAV that sells to the biggest companies
- **Local producers and products:** Metafresh, StartERP, ERPNext, ePromis that sells to SMEs
- **Open source:** Adempiere, Apache OFBiz, Blueseer

There are different **vending options:**

- **Installation:**
  - **Cloud**
  - **On-premise:** installed on the local pc
- **Payment:**
  - **Per license:** one shot cost
  - **Per user per month**

**SAP**, founded in 1972, was the first offering a flexible software that could be sold to different companies, in the following years was implemented multi language and client-server and now is a really big and complex software.

It has a Kernel, a DB, Packages and has approximately 64000 tables

**Oracle**, in principle, was selling only the DBMS, in 1995, thanks to some buyouts, enters the ERP market.

## 8.1 CRM

A CRM (Customer Relationship Management) implements an **integrated and structured process to interact with customers** (acquire new customers and retain existing ones).

The goal is to build a long-term relationship with the customer, increase their satisfaction and increase the value of their companies.

With the **CRM approach** the customer becomes a core aspect of the commercial strategy, in fact the company:

- Makes **access** to product/services as **easy** as possible
- Produces **customized offers**
- Provides **complete access**, from pre-sale to post-sale
- Collects **complaints** and **suggestions**

The CRM approach is not feasible without tools, the first tool created was made by **Siebel in 1993**.

The main principles of CRM are:

- **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:** is an evolution of Porter's value chain where the company appears as a chain of services that are connected, it can be more or less complex:
  - Reservations: db with availability of product/service plus (multichannel) frontend
  - E-commerce: when the delivery is included.

- For example, sale of product + delivery (Amazon), sale of product + production + delivery (Dell)
- Customer care: complex service chain that assists the customer after the sale

Evolution of CRM tools:

- 80's
  - Sales Force Automation (SFA)**: a tool to support salesperson for
    - B2B**: few buyers buy many items and negotiate the price
    - B2C**: many buyers buy one item at a fixed price and pay immediately
- 90's
  - Toll free numbers, call centers
  - Informational and reservation services
  - After sale support (help desk)
  - Sales (telemarketing)
- 1995
  - Informational websites
  - Sales made via web (B2C Amazon, B2B Cisco)
- 00
  - Integration of SFA, call center and website into the CRM suites

Not all the business domains have the same **need for a CRM**, that depends on:

- Intensity of relationship with the customers (frequency of contact, duration of contract)
- Size of the customer pool
- Loyalty of customer
- Multichannel or not

The **key functions** of a CRM are:

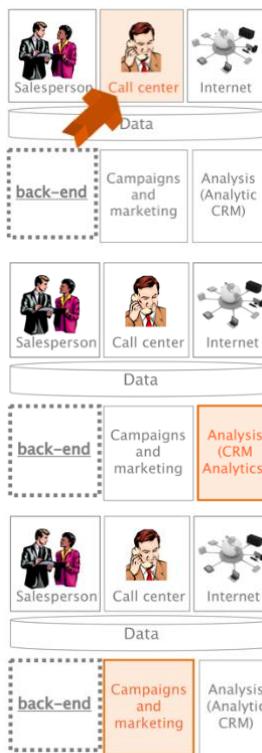
- Commercial logistics (inbound, transformation, sales, distribution and post-sale)
- Support for multichannel interaction
- After sale support
- Analysis of customers

A CRM can have different **modules**:

- Sales Force Automation**: find new customers and interact with him for the sale (offer creation)
- Internet channel**:
  - Different for Business vs Consumer customers
  - General information, catalogue of the products
  - Purchase: product suggestion, shopping cart, checkout
  - Information of all transactions of the customer
  - After sale: complaints and suggestions
  - Log of all customer actions



- **Call center channel:** with a CTI (Computer Telephone Integration) that has (interactive voice response, automatic call distribution, voice recognition, caller recognition, speech to text), and has different functions:
  - Information on company and products
  - Purchase
  - Status of purchases
  - Complaints
  - History of interactions
  - Telemarketing
- **CRM Analytics:** using data from the DW:
  - Segmentation indexes
  - Data mining to compute predictive indexes
  - Reports on customers, production of dashboards
  - Definition of segments, customers per segment
- **Campaign management:** planning and execution of campaigns:
  - Selection of customer lists using the Analytic CRM
  - Design and plan campaign
  - Transfer data from analytic CRM to operational IS



There are different CRM vendors:

- Full liners: they sell the CRM with the ERP and BI:
  - Peoplesoft, Siebel (Oracle)
  - SAP CRM
  - Salesforce
  - Microsoft Dynamics
- Analytic CRM, BI (SAS, BO)
- Telephone technology vendors

## 9. IT Economics

Let's now analyze value and cost of IT in an organization, 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  $(fixed\_cost / \#units\_produced) + var\_cost$ .

**Economy of scale** consists in maximizing  $\#units\_produced$  to minimize the cost of unit to make the most out of the “fixed costs”.

#units produced	Unit cost
3	$300M / 3 + 0,001 = 100M$
30M	$300M / 30M + 0,001 = 10,001$
With fixed cost = 300M, var cost = 0,001	

**Economy of scope** consists in using the same infrastructure to produce different units/products so you can divide the cost of infrastructure among different products.

Examples:

- **Parmalat:** which started selling only milk and later started selling biscuits

- **Bank**: that started selling only bank services and later also insurance services reusing the same infrastructure

When considering **informational** units, the variable cost becomes negligible while the fixed costs refer to the entire IS.

Examples:

- **Booking**: the single operation of reservation doesn't have a cost
- **Easyjet**: the single ticket doesn't have a cost

**Network effect**: the value of a service **increases** with the number of users.

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

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

Examples:

- **Car (buy)**:
    - **Selection**: define needs, find and select model and vendor, define and sign contract, pay
    - **Deployment**: transportation and registration of the purchase
    - **Operation**: fuel, taxes, cleaning
    - **Regular maintenance**: oil, filters, tyres, wipes
    - **Exceptional maintenance**
    - **Dismissal**: resale value or scrapping cost
  - **Car (make)**:
    - **Construction**: define needs, buy materials and machines, design, implement
    - The rest is the same
- Similar story for a software product.

When comparing two possible solution is better to consider the one with a lower TCO instead of the one with lower "label" cost.

Example: if an airplane costs more, but the fuel is cheaper, maybe is the best choice

The **downside** of the TCO is that you need to make **assumptions** on the future so is uncertain, the best way of computing the TCO is by computing the **best** and the **worst case**.

Nowadays, when buying with the "**as a service**" payment mode, the estimation of the TCO is **easier and less uncertain**. Typically, the final cost is a bit more in exchange of price certainty.

The **Return On Investment (ROI)** that represents the gain percentage related to a certain cost is computed as  $\frac{\text{Benefit} - \text{Cost}}{\text{Cost}}$  or  $\frac{\text{Profit}}{\text{Cost}}$ . The **problem** of the ROI is that it doesn't consider the time, the Net Present Value (NPV) fixes it.

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

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

Another way to address the problem is to consider the **ROI** on several time periods.

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

In the example we can see that in the first case we buy something cheaper with less benefits, instead in the second case a more expensive thing, which recovers the costs first.

Complete example:

#### Ex: construction of ERP (make)

	0	1	2	3	4	Total
Cost	Construction 400	Operation 100	Operation 100	Operation 100	Operation 100	1170
	Deployment 100	Maintenance 70	Maintenance 50	Maintenance 50	Maintenance 50	
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	Operation 100	Operation 100	Operation 100	Operation 100	1000
	Deployment 100	Licence 70	Licence 50	Licence 50	Licence 50	
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	Service fee 250	1100
	Deployment 100	300	300	300	300	
Benefit	0	350	350	350	350	1400
Benefit - cost	-100	-50	0	50	100	100

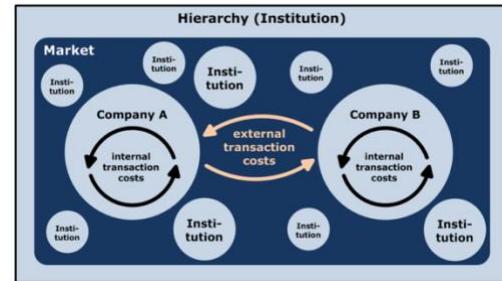
- Time frame: 5 years, acquisition (as a service)
  - TCO: 1170
  - ROI:  $(1200-1170)/1170$
  - Break even: 3 years

## 9.1 Transaction theory

A **transaction** is an exchange of products or services between two parties, there are two kinds of transactions:

- **Internal transactions**: happens inside a company between two organizational units
- **Market transactions**: happens outside the organization, the two parties are independent and there is always an exchange of money that is higher than the nominal cost.

Their cost is computed using the TCO, the phases before and after the manufacturing (physical) or deployment (software) are called **transaction costs**.



A transaction must be described by a **contract** with legal value that should be the perfect and **complete** description of what is exchanged and what happens in case of exceptions (that are not always predictable).

It's hard to describe the product completely because of the intrinsic difficulty in description or **information asymmetry** that allows for opportunistic behavior of one of the parts.

For this case there is the example of a famous lawsuit. Liebeck was a person who bought a muggle of coffee that was hot, for this he sued McDonalds and won the case. (Now there is product liability).

An **internal** transaction requires a looser description, and the contract is **not needed**.

In **market transactions** the information is not controlled/distributed, there is no hierarchy, and the price is decided by the market.

In **firm transactions** the information is controlled and centralized, there is a hierarchy and the price is imposed.

The **transaction theory** makes some assumptions:

- Actors takes decisions rationally to maximize utility and profit

- All actors have all information
- All products (within a specified category) are equal

The consequences of this assumptions are that the market defines the “best” price and the market is the “perfect” place to do transactions.

But in practice actors do not always behave rationally, all information is not available to all and not all products are equal, and the consequence is that the market becomes **less suitable for complex products** that are hard to describe completely, and for having **full control on process and product quality**.

So, the higher the **unclarity** of the item description, the higher the advantage of the firm to produce it internally.

	Tyre	Engine design		IT service / accounting	IT service / price definition for airline
Product requirements	Standard (circumference, width, weight, speed, duration)	Specific (..)	Product requirements	Standard	Specific (..)
Service requirements	Standard (conditions in case of faulty product, delay in delivery, ..)	Specific (what is faulty design? What is delay?)	Service requirements	Standard (conditions in case of faulty product, delay in delivery)	Secrecy, reliability, fast changeability
	Market preferred	Internal preferred		Market preferred	Internal preferred

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

- **Efficiency:** is lower in market while higher in firm
- **Cost:** while in market is defined upfront in firm is undefined
- **Know how:** while in market is external and not available, in firm is internal but can be lower than available to specialized producers
- **Problem resolution:** in market is performed with the contract and 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, in this case the team that working internally on the product/service that is going to be outsourced becomes useless, so the company becomes **smaller**.
- **Vertical integration:** vice versa

Two examples related to IT services are:

- Vertical integration: General Motors that bought EDS sw company in the 90s
- Vertical disintegration: also in the 90s the IS of Fiat was extracted and put in a company called GlobalValue (joint venture IBM-Fiat) which was external and working also for others (the IS transaction becomes a market one)

As a consequence of disintegration there is the “**network**” company which is a company that integrate many independent companies each one specialized on few components.

An example is **MSC** that owns all the supply chain nodes: inland transportations, port terminals, towage services and shipping line.



The (dis) integration depends on:

- The **cost** of internal transaction vs the one of the external transaction
- The importance of the **know how**

- The need of specific product/service

For example, in the case electronics for cars:

- Fiat: when Marelli was sold to Samsung the design of electronic circuits and diesel injection control unit became a market transaction
- BMW: manage the design of electronic systems internally while the design of diesel injection was outsourced to Bosch
- GM (General Motors): the design of diesel induction control units is internal

Other kinds of collaborations are:

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

There are different types of **market transactions**:

- **Time and material:** there is a contractual agreement on cost of work (time) and materials.  
Build a house: pay material + n person days  
Issues:
  - The buyer may control quality in more depth
  - The vendor may try to reduce productivity, the final price is not known in advance
- **Fixed price:** there is a contractual agreement on the result and its value  
Issues:
  - The price is known in advance so the vendor may try to reduce quality, to overcome this problem, the quality should be perfectly described in the technical annex of the contract
  - In case of inflation the price remains the same, so the vendor could lose something

## 9.2 Agency theory

The **agency theory** is a classical economy theory used to explain and resolve issues in the relationship between business principals and their agents.

The firm is made of:

- **Principal:** owner or shareholders
- **Agents:** employees and managers

The firm is based on a web of (explicit or implicit) contracts between principal and agents.

The agents have their own interests and goals, the **contrast** between goals of agents and principal causes **agency costs**.

There are three types of **agency costs**:

- **Monitoring costs:** control of the agents by the principal
- **Bonding costs:** the 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

The IS can have the role of decreasing these costs.

Example: For a retail shop there is the owner (principal) and 3 vendors

- Monitoring: the time spent by the owner checking what agents are doing (instead of doing other work)

- Bonding: time spent by vendors to report to the owner (instead of selling)
- Residual lost: the customer asks a discount, the vendor says no, the customer does not buy; the owner instead would have granted the discount completing the sale

In this case a solution could be to implement a form of compensation (profit sharing/bonus related to sales goals)

### 9.3 Decision theory

There are three types of decisions (Gerry and Scott Morton, 1971):

- **Structured:** follows an algorithm and is repeatable
- **Semistructured:** output is defined, inputs and decisions are partially defined
- **Unstructured:** no algorithm, subjective



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

Also, **decision** can be:

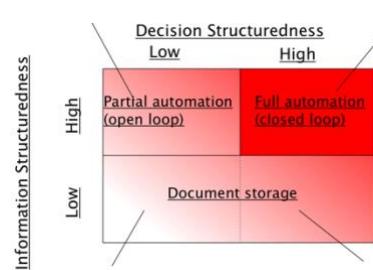
- **Planned** (Production budget at the end of the year)
- **Unplanned** (Adjust strategy for covid19)
- **Under certainty:** the outcome of every alternative is known (Turin to Milan, road vs train (no traffic, weather is good))
- **Under noncertainty:**
  - **Under risk:** some knowledge about probability of each outcome (Turin to Milan, road vs train (there could be traffic, there could be weather issues))
  - **Under uncertainty:** no information on outcomes

The **decision process**, for structured and planned decisions, has many steps:

- Identify problem
- Identify alternatives
- Evaluate alternatives (effect/probability of each one)
- Select one
- Implement decision
- Evaluate decision

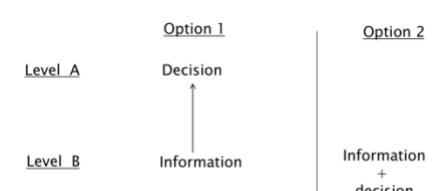
Depending on the **structuredness** of the information and of the decision, the IS can become powerful.

When the information is unclear it can only be used to store the textual description but if they are both high the IS can automate the process.



The **decision theory** says that the decisions can be taken at **many levels** of the organization.

- In the **option 1** there is a certain cost on transferring the information to the upper level and the risk that the information transferred is not completely right
- In the **option 2** there are no cost but the decision can be suboptimal because it is taken in a lower level (agents)



There are three **decision issues**:

- **Bounded rationality** (Simon): not all informations are available
- **Analysis paralysis**: too much information does not help

- **Conflictiong goals in decisions:** (time vs money)

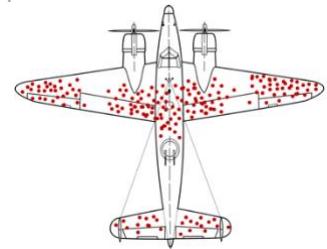
There are built-in mechanisms in humans that make rational decisions difficult, these are called **cognitive biases**.

Cognitive biases are mental shortcuts in “reasoning” because as humans we are used to take decision more rapidly than precisely.

Cognitive biases are also connected to Heuristics:

- **Confirmation bias:** related to information cherry-picking, use only the information that is convenient (My uncle died at 95 and did smoke all life long)
- **Motivated reasoning:** find reason to produce the desidered outcomes, instead of logical outcomes (Given a crime, find reason to demonstrate that person X is guilty, instead of analyze facts and find the guilty person)
- **Survival bias:** consider a dataset that contains only the “survivors” to some selection filter (Bill Gates, Elon Musk, Mark Zuckerberg are billionaires and never got a degree, so taking a degree is useless, but considering the complete dataset you can see that people with a degree earn more)

Was studied by Abraham Wald in the case of World War 2: the planes that returned alive from war were damaged in the red parts, with survival bias, seeing only the returning planes the decision would be to protect more those parts but in reality this planes are coming back because the important parts are undamaged so they must be protected. In the complete picture most of planes are not coming back because their important part are not protected.



- **Optimistic bias:** tendency to underestimate costs and overestimate benefits
- **Bandwagon effect/social comformance:** consists in doing what others do and **groupthinking** (uniform thinking in working teams), but successful organizations have people that think in different ways (Edmonton).

In the Dieselgate case the Volkswagen tweaked the software to reduce the pollution/consumption when the car was tested. In VW everybody knew but nobody talked against this because of groupthinking.

- **Cognitive dissonance:** beliefs and behaviors are not consistent, this dissonance can be fixed changing the beliefs or the behaviour

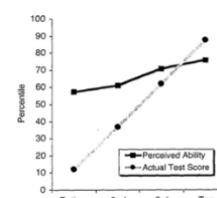
Smoke harms → I smoke

Decision 1: keep smoking and use confirmation bias (My uncle died at 95 and did smoke all life long)

Decision 2: quit smoking

- **Dunning Krueger effect:** incompetent people think they are better then 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 (ipse dixit)
- **Anchoring:** the first piece of information considered biases the subsequent process.

The “before” price influence the “after” one convincing the customer to buy.



When Gandhi died was more than 100 years old? →The answer tend to be higher.

When Gandhi died was more than 35 years old? →The answer tend to be lower.

- **Loss aversion:** people prefer to avoid a loss than achieve a gain

This biases are scientifically used to manipulate commercial, politic and negotiation decisions. Cognitive biases can be also a characteristic of algorithms and this is usually related to a bias in the algorithms or a bias in the dataset.

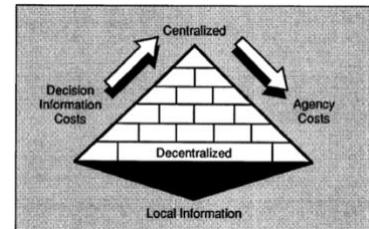


Another aspect related to decisions are the **logical fallacies** that are flaws in reasoning or tricks to obfuscate the truth to push a certain decision:

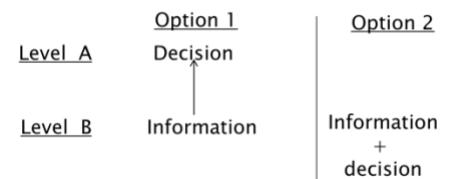
- **Ad hominem:** attack the person to attack the argument ("Bill claims that this was an accident, but we know Bill to be a liar, so we can't take his word for it.")
- **Anecdotal:** use a personal experience as an argument ("My grandmother smoked all her life and she died at 90")
- **Appeal to emotion:** use emotions as an argument (used in most of the commercials) "Happy smiling family having breakfast with product A" → Product A make a family happy "Beautiful lady with beautiful legs and Z stockings" → Product Z makes legs beautiful
- **Appeal to authority:** a person with authority is more trusted than scientific method ("the mayor said that crime rate is low so statistics saying the opposite must be wrong")
- **Ambiguity:** use an unclear description to support an argument ("I know John very well, he would never do X")
- **Burden of proof:** make a claim and let others prove it is false
- **Circular reasoning:** use argument to prove argument ("Whatever is less dense than water will float, because such objects won't sink in water.")

The **internal coordination costs (ICC)** are composed by:

- The **decision (information) costs** are costs that appear when decisions are not taken where the information is produced (means centralization):
  - **Communication, documentation (miscommunication):** cost of collection and 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 costs related to monitoring, bonding and residual loss (means decentralization)



**Jensen** said that we need to allocate the decision capability in order to minimize internal coordination cost.



So then the **overall costs** are composed by:

- **Internal coordination costs (ICC)**
- **Market/External coordination costs**
- **Operation**

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

- Cost of IT area / unit
- Cost of IT project / applications

The **cost of the IT area** can be:

- Direct
  - Fixed: personnel, facilities, hw and sw (if bought)

- Variable: services from other companies (outsourcing) like rental, licences for hw and sw, rental of personnel
- Indirect: cost outside the IT area that are difficult to compute like:
  - Learning cost of non-IT people to learn using IT tools
  - Suboptimal decisions because of IT tools
  - Time lost because of IT downtime

The **cost of an IT project** is computed using the TCO so considering all costs (direct, indirect, internal, external) on all phases:

- Construction (BAI domain in COBIT): requirement definition, design, coding, testing
- Selection (BAI domain in COBIT):
  - Requirement definition
  - Vendor/product identification, evaluation and selection
  - Contract definition
- Deployment:
  - Install product / service on machines
  - Training of users, learning curve
  - Data entry / reformat
- Operation (DSS domain in COBIT): day by day support
- Maintenance (DSS domain in COBIT): changes
- Dismissal: uninstall and dispose the product

Phase	Direct	Indirect
Selection	Effort to find and evaluate vendors	Effect of lockin to vendor Effect on processes and business
Deployment/training	Effort for training (teachers) Facilities for training (classrooms)	Effort for training (trainees)
Deployment / data entry	Effort to define data entry procedures	Effort to perform data entry Learning effect (hidden) Delay of other activities (hidden)
Deployment/ installation	Effort to install new hardware, and software	Delay of other activities (hidden)

## 9.4 Value of IT in an organization

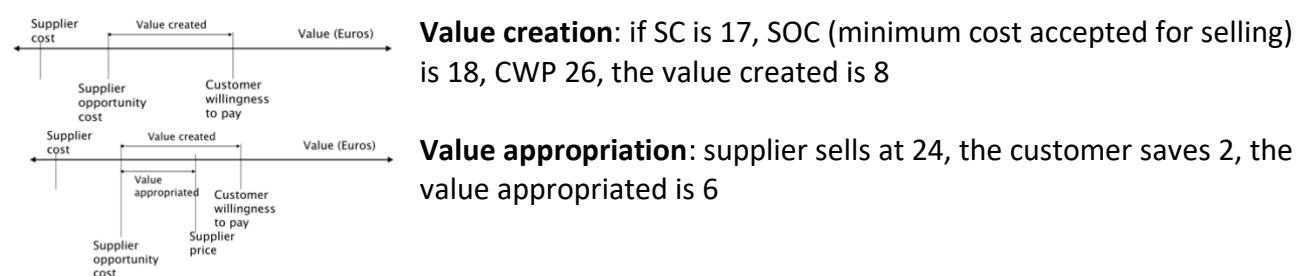
There are several definitions and theories on **value**:

- **Intrinsic**: is a property of an object
- **Labor**: depends on how much labour (effort) is needed to produce it
- **Monetary**: the price is the form of appearance of value
- **Subjective**: value depends on the consumer

The **marginal utility** is the added satisfaction that a consumer gets from having one more unit of a product / service, it tells us that value does not depend on the whole usefulness.

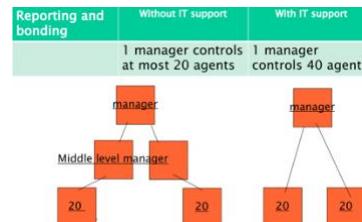
A farmer has 4 sacks of grain

1. Survival, make bread (highest value)
2. Feed animals (lower value)
3. Make whisky (lowest value)
4. Feed pigeons (lowest lowest value)



The IS can have an impact on costs:

- Transaction costs:
  - External:
    - Lower cost for search, evaluation and selection: Internet and market places
    - Lower cost for communication: internet, supply chains and integration of IS supplier purchaser
  - Internal:
    - Lower cost for coordination and communication: email, document repositories, mobile phones
- Agency costs: the eased collection of information from lower levels:
  - Reduces bonding, monitoring costs
  - May avoid needing intermediate management levels reducing the depth of the hierarchy
  - May reduce specialization needs of lower levels, increasing their decision power
- Decision costs:
  - **Better quantity and quality** of information
  - **Better decision making** due to powerful tools to support the decision process (model building, what if analysis, browsing and exploration of data)
  - There can be **information overload**



## 9.5 IT Governance

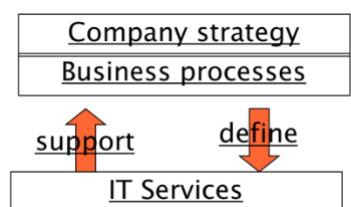
Governance processes in COBIT are all about decisions related to IT in the company:

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

The **Governance/Direction** of the organization decide the importance of IT and the budget allocated to it.

The **IT governance** choose:

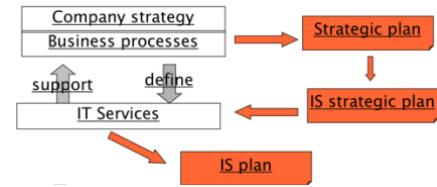
- Buy/make software
- Contractors
- Technologies to use
- Performance: cost/speed
- Risks: losing data / services are down
- Resources: people and money involved



The **corporate governance** contains all the processes by which all companies are directed and controlled, and the IT governance is a subset of it.

There are three **key documents**:

- **Strategic plan:** contains the strategy and the goals of the company
  - **IS strategic plan:** describe how IS supports the strategy and is a roadmap for IS development, rationale and budget. Has usually a time horizon of 3-5 years.
- Must be linked to and dependent from the strategic plan.



It contains:

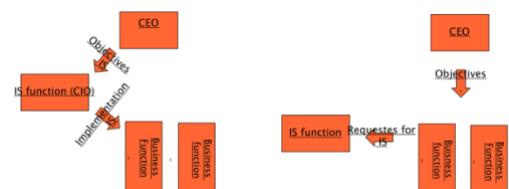
- Current situation (AS IS):
    - Architecture, Applications, Systems
    - Personnel
    - Organization: vendor choices
  - Company strategy with overall IS budget
  - New situation (TO BE):
    - Architecture, Applications, Systems
    - Personnel
    - Organization
    - New projects
  - **IS plan:** is derived by the IS strategic plan and has an horizon of 1 year
- Contains the projects:
- Schedule
  - Total budget for:
    - IT functions in the year: 1000
    - Staff, infrastructure, licenses, services: 800
    - New projects / investment ranked per priority: 200
      - 8 projects with an estimated costs >200, we need to select a subset based on priority:  
P1 80, P2 45, P3 20, P4 45, P5 40, P6 50, P8 20

### IT Governance enablers and inhibitors (Luftman Brier):

- Senior executives do (not) support IT
- IT (not) involved in strategy development
- IT (not) understand the business
- (not) strong Business/IT partnership
- (not) Well prioritized IT projects
- IT (doesn't) demonstrates leadership

### The alignment between Governance and IT Governance:

- **Explicit:** push
- **Implicit** pull



### Examples of alignment:

- Retail bank 1:
  - Strategy: attract customers with better services
  - IS function: more budget to improve services at counter, web site, call center
- Retail bank 2:
  - Strategy: attract customers with higher interest rates
  - IS function: less budget to save money, less investment in frontend
- Benetton (1990):

- Strategy: increase market share with larger offer, same or higher quality, lower cost
- Organization + IS functions:
  - Franchising shops with only Benetton firm
  - Each evening sales figures (models sold, color, size)
  - Every week rescheduling of production (increasing models and colors that are selling more)

The effects on **cost** are lower inventory and return, on **value** are that customers find what they want in the shops

#### Examples of **non-alignment**:

- Firm produces electric systems to order (Bticino that produces electrical cabinet slightly different for each room): there is a production plan that schedules the tasks of an order  
But there is not a specific and written production plan.
  - Strategy: punctuality in orders/tasks
  - IS function: buy a tool for production scheduling

The tool sometimes was scheduling idle time waiting for materials related to critical jobs, but the workers paid by the hour do not respect the sequence (if they are idle they are not paid).

This case is an example of **conflict between organizational variables**: scheduling and compensation of work force.

The result was that the due date was not respected and the tool was abandoned.

## 10. Outsourcing

The **outsourcing** is considered an **external transaction** and a **vertical dis-integration** (from internal to external people, facilities are transferred outside).

The **insourcing** is an **internal transaction** and a **vertical integration** (from external to internal).

The decision of outsourcing needs to be analyzed in terms of:

- **Cost, quality and service**
- **Strategic efforts**
- **Know-how and protection of data**

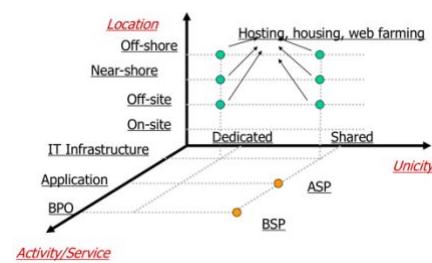
In the same organization some IT services can be outsourced and others not.

History of outsourcing:

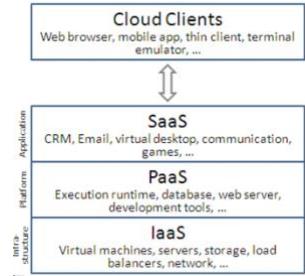
- 80s: outsourcing of management of mainframes and applications
- 90s: outsourcing of ERP, CRM packages developed
- 00s: SaaS, Software as a service

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

- **Activity/service**:
  - IT infrastructure (PaaS, IaaS): hardware, network, call center
  - Application: development and maintenance of applications
  - Business Process Outsourcing: complete business process including the people



- **Unicity**
  - Solution for one (few) customers: student subscription Polito
  - Solution for many customers: SAP
  - Solution for mass market: Office, Windows



- **Location**
    - On-site/on-premise: the service is in the same facility
    - Off-site: the service is on an other facility
    - Near-shore: the service is in an other facility in the same state or continent
    - Off-shore: the service is in another facility, in another continent (India for US or Tunisia/Morocco for french, cost of labour is lower)
- The location also implies a different law system.

Example: Web server

- Service: infrastructure (PC to run Apache and web pages)
  - No outsourcing: all costs are internal
  - Housing at provider P, off site (Location of P, Property of O): hw cost for O, other cost for P and invoiced to O
  - Hosting at provider P, off site (Location of P, Property of P)
- Location: on site, off site
- Unicity: typically web server is commodity hardware and software (Linux, Apache), with some possible customization, web pages are specific

Example: Payroll

- Service: manage payroll for org O
  - No outsourcing: sw is developed and maintained by O
  - Application buy: O buys application A from vendor
  - Application service: O rents usage of application A from vendor
  - Process outsourcing: O outsources to vendor V all payroll management
- Location:
  - For hw running the application:
    - On site: coupled with no outsourcing and application buy
    - Off site for application service and process outsourcing
  - For people using the application:
    - On site: coupled with no outsourcing, application buy and application service
    - Off site: process outsourcing
- Unicity: given the amount to be paid (specific) all the rest is ruled by law (general)

Example: Emergency assistance

- Service: process to support drivers in emergency cases (call center to receive calls from drivers, filter out, dispatch to ambulance and police)
  - No outsourcing: call center in company + emergency vehicles
  - Process outsourcing: process managed by specialized companies
- Location: on site, off site
- Unicity: close to commodity, level of service can vary for customer

Processes that are usually outsourced are reward management (for companies) and evaluation of damage to cars (for car insurances).

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

- Pros:
  - Costs for infrastructure shared among many (economy of scale)
  - No investment in non-core competence for O
  - Backup, recovery
- Cons:
  - 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, flexibility.

Example: storage service

- Cost per TB
- Availability > 99,999%
- Flexibility: time to increase/decrease capacity

For the **outsourcing decision** there are five questions shown in the table below.

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

Example: email service

	<b>Yes</b>	<b>No</b>
Is it strategic for the company?		X
The know-how is important?		X
Is it commodity (can be fully described)?	X	
Is it available at lower price, higher quality than internally?	Depends	
Is it subject to law constraints (ex. privacy)?	?	?

US officials are forbidden to use commercial email (risk of data breakage, see Clinton 2016)

Example: data storage

	<b>Yes</b>	<b>No</b>
Is it strategic for the company?		X
The know-how is important?		X
Is it commodity (can be fully described)?	X	
Is it available at lower price, higher quality than internally?	Depends	
Is it subject to law constraints (ex. privacy)?	X	

Example: airline, pricing algorithm

	<b>Yes</b>	<b>No</b>
Is it strategic for the company?	X	

The know-how is important?	X	
Is it commodity (can be fully described)?		X
Is it available at lower price, higher quality than internally?	Depends	
Is it subject to law constraints (ex. privacy)?	X	

## No outsourcing

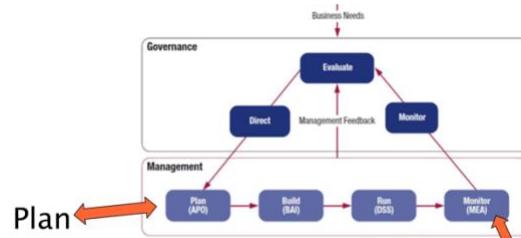
The outsourcing decision is **risky** and **long term** because there could be **changes**:

- In organization/IT strategy
- In service/vendor
- In technology/environment

Every change could bring in a state where the company could need to re-insource.

In the COBIT, the outsourcing decision could be taken:

- By the **governance** in **evaluate**
- By the **management** in **plan** and **monitor**: if the governance is not implied but gives only the general strategy



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

- **Search and evaluate vendors**
- **Write, enforce contract**
- **Hidden costs (risks)**: lock in, loss of know-how, changes, cost for insourcing in case of failure, discontinuity in the service

The **lock in** is the difficulty in changing provider and is related to **switching costs** and **risks**.

The **outsourcing process** has different activities:

- **Plan:**
  1. **Define the activity/service**
  2. **Find and evaluate vendors**: history of vendor and product, users of the product, switching costs, competitors available
  3. **Contract writing:**
    - o Legal part
    - o Technical annex: description of the product/service
    - o SLA and KPIs: to define them consider the end-to-end service chain and its effect on the business. It's **unlikely** to define suitable ones upfront, better to allow thresholds to be **changed**

Example: downtime of the invoicing process can be 1 day per year/1 hour per year/1 min per year

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

The **duration** of the contract is a key factor: the higher the risk, the shorter should be the duration.

Consider condition to change/interrupt the contract on case of changes in service description or in technology/context.

The **contract costs** are composed by the cost of writing, plus the cost of contract enforcing, typically lower writing costs may imply higher enforcing costs.

- **Monitor:**

4. **Contract monitoring:** at regular intervals the SLAs and the issues in the service should be checked, are needed competent roles to monitor the service, the context and decide possible changes to the contract/service.

In COBIT terms plan and monitor processes remain insourced and require IT competence, because outsourcing shouldn't mean no IT competence inside.

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

Example: evaluate outsource for:

1. E-commerce website (development, maintenance) to be developed
2. ERP operation and maintenance
3. Management of data center (customer and supplier), housing of servers at outsourcer site

IT area in company, 7 people

- CIO (45.000 € / yr);
- System manager (25.000 €);
- 3 programmers for ERP (30.000 € each);
- Data manager ( 20.000);
- 1 web designer (20.000 €).

	<b>Costs per year --insourced</b>	<b>Outsourced</b>
CIO	45	45
System manager	25	25
Programmers (buy, from 3 to 1)	90	30
Data manager (buy, from 1 to 0)	20	0
5 new programmers (if make)	125	0
Training new programmers (1° yr)	12.5	0
Telecommunication costs	10	0
Rental (facility)	5	0
ERP server (2 yrs)	5	5
Outsourcing fee	0	225
Search of vendor (1° year)	0	20
Negotiation (1° yr)	0	20
<b>Total</b>	<b>357.5</b>	<b>370</b>

<b>Year</b>	<b>Make</b>	<b>Buy</b>	<b>diff</b>
1	357,5	370	-12,5
2	345	330	15
3	340	325	15
4	340	325	15
5	340	325	15

The issues are:

- Re-insourcing costs and renegotiation costs are not considered
- There will be new technologies available in 5 years
- Reduction of costs for outsourcing in 5 years
- Loss of IT skills

Another possibility is **selective outsourcing**:

- Outsourcing 1+2+3, 275.000 euro/yr
- Outsourcing 1+2, 150.000 euro/yr
- Outsourcing 3, 125.000 euro/yr

The images analyze the case where only the third activity is outsourced.

	<b>insource</b>	<b>Outsourcing all</b>	<b>Selective Outsourcing</b>
CIO	45	45	45
System manager	25	25	25
Programmers	90	30	90
Data manager	20	0	20
web designer	20	0	0
5 new programmers	125	0	0
Training	12.5	0	0
Telecom	10	0	10
Rental	5	0	5
ERP server	5	5	5
Outsourcing fee	0	275	125
Search of vendor (1° year)	0	20	20
Negotiation (1° yr)	0	20	20
<b>Total</b>	<b>357.5</b>	<b>420</b>	<b>365</b>

Let's focus on the "**find and evaluate vendors**" phase:

- Vendor:
  - Size
  - Reputation
  - Time on the market
  - Availability of local offices/local support
  - Availability of services about the product from other vendors
  - Risks: vendor bankrupt, product discontinued, product changes, vendor acquired by competitor

- Product:
  - Functions
  - Nonfunctional requirements → ISO 25010:
    - Reliability: failures per period, availability per period
    - Usability: time to learn, clicks per function, evaluation by 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

To evaluate the vendors is usually used an Excel where each line is a different criterion and the columns are the different possible vendors.

This Excel uses the **MCDA (Multiple Criteria Decision Aid)**, where is possible to give a score to every criterion.

Product:	Criteria	Software Vendor Evaluation Matrix			
		Weight:	Vendor A	Vendor B	Vendor C
1 SW Features	Critical functionality Exist each specific item				
2					
3					
4	Important functionality Exist each specific item				
5					
6					
7	Nice to have functionality Exist each specific item				
8					
9					
10					
11	Productivity features Exist each specific item				
12					
13					
14					
15					
16					
17					
18 Vendor	Stability Size - Revenue Size - Support staff Size - Number of clients Years in business Location				
19					
20					
21					
22					
23					
24					
25					
26 Costs	Strategic plans Investment in R&D Software development Software implementation Software support Hardware requirements cost Hardware maintenance Other costs Additional features options Data migration cost TCO (Total Cost of Ownership)				
27					
28					
29					
30					
31					

	Option1	Option2
Criterion1	5	1
Criterion2	1	5

	Option1	Option2	weight	Option1	Option2
Criterion1 (vendor)	5	1	10	5	1
Criterion2 (product)	1	5	5	1	5
Sum	5+1 = 6	1+5 = 6	5*10+1*5 = 55	1*10+5*1 = 15	

	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
Portability  5: windows, unix, 2 only linux 1 only windows	2	
SUM	14	9

	WEIGHT (10)	Option1	Option2
Size of vendor 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	3/10	To windows and unix	To unix
WEIGHTED SUM		$4*3/10 + 5*7/10 = 1,2 + 3,5 = 4,7$	$2*3/10 + 2*7/10 = 0,6 + 1,4$

Two rules for choosing criteria are:

- Sufficient: all the needed functionalities should be considered
- Redundancy: criterion shouldn't be redundant and interdependent (ex. size of vendor, turnover and market share are all dependent)

There is no **best choice** but there is a most **suitable** to a certain **need**.

## 10.1 Product functions

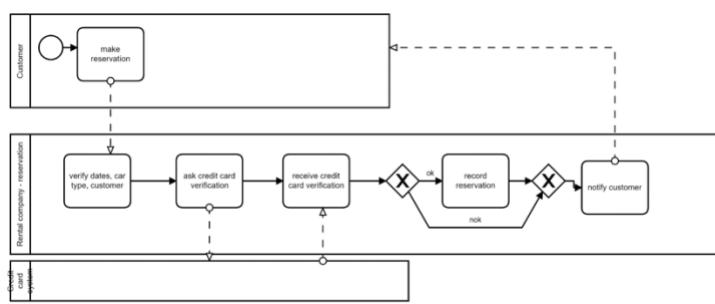
The **product functions** are described in different levels of detail and are related among them, so they are typically organized in a numbered hierarchy.

The **key activities** during 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

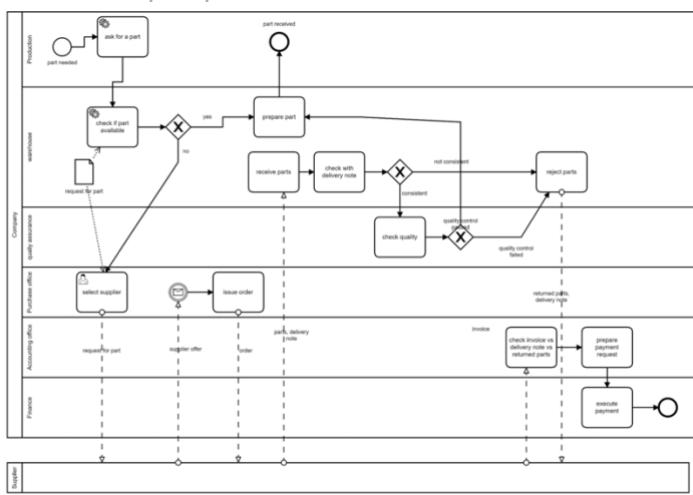
		Option (product) 1	Option 2
1 Manage customer	1.1 Create customer		
	1.2 Delete customer		
	1.3 ..		
2 Manage invoice	2.1 ..		
	3 ...		

Example: car rental, reservation process



Activities in BPMN	Software functions
<b>Make reservation</b>	CRUD reservation Search for reservation CRUD account Attach account to reservation
<b>Verify dates, card, customer</b>	Verify car type available at desired location and dates Verify customer history
<b>Check credit card</b>	Send credit card info to credit card circuit to verify credit card
<b>Record reservation</b>	Send request for process payment on given credit card to credit card circuit Save reservation Delete reservation

Example: purchase



activity	Accounting	Warehouse management	Purchase management
Ask for a part		-Create a request for part -Search a request for part -Copy a request for part -edit a request for part	
Check if part available		-Search part in inventory -Get n available for a part	
Prepare part		-remove n part from inventory	
Receive part		-Search part in inventory -add n part to	

## 11. Change management

The **change management** is the process from a situation A to a situation B, it applies to any social system, but we consider it related to ISs.

The four 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 to change is also function of the type of change:

- First-Order: Automate

- Second-Order: Informate
- Third-Order: Transform

The resistance can be:

- Explicit or immediate
- Implicit or deferred

And can come from:

- Individuals: employees, managers, owners and comes from:
  - Habit
  - Security: fear of new conditions, fear of being laid off
  - Economic factors
  - Fear of the unknown
  - Selective information processing
- Organization: comes from
  - Threat to established power relationships
  - Threat to established resource allocation
  - Threat to expertise
  - Group inertia

The **change management process** has six key activities:

- Identify potential change
- Assess change
- Plan change
- Implement change
- Review change
- Close change

The **CM plan** is a document that describes the key parts of a CM process and can use any combination of tools and models from CM.

There are four **change management styles** that can be adopted:

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

CM tools:

- **Proper timing:** capability of doing things at the right time
- **Education and communication:** telling the vision of the change and provide training to adapt
- **Seeking participation:** convince people to participate in the change
- **Coercion**
- **Negotiation**
- **Manipulation and cooptation:** techniques to involve or convince people, the people on the side of the change receive more benefits (cooptation)
- **Incentives and rewards:** for accepting the change

- **Champions, leaders, role models:** having someone respected from the others that convince the others

Two CM models are:

- **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
    - Imminent negative consequence
    - Enhanced job security
    - Affiliation and sense of belonging
    - Career advancement
    - Status, or change in social standing
    - Acquisition of power or position
    - Incentives or compensation
    - Trust and respect for leadership
    - Hope in the future state
  - **Knowledge on how to** change
    - Training and education
    - Access to information
    - Examples
    - Role models / champions
  - **Ability to implement** required skills and behaviours
    - Practice of new skills / tools / processes
    - Coaching
    - Mentoring
    - Removal of barriers
  - **Reinforcement to sustain** the change
    - Incentives and rewards
    - Compensation changes
    - Celebrations
    - Personal recognition
- **John 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**