Chapter 2: System Information Modelling

High-Level Models

- **Craso model:** there is a feedback loop around the customer, who is requesting a service or a product, then the organization must be capable of satisfy this request by producing an output.
- **Anthony's pyramid:** this model is a pyramid because for every level there is an increase in the number of people involved, in the strategic level there is the least number of people, instead, the operational level is the one in which the greatest number of people are involved. The horizontal levels are:
    - Strategic: which is about the strategic decision and whatever impact the future
    - Management: monitors what happens in the other levels
    - Knowledge: is the design of the products/services
    - Operational: are the day-by-day operations of the company.
- **Value chain:** primary activities are inbound logistics (for example manage the warehouse where all components are located), outbound logistics, operations (coordinating various activities), marketing & sales and service (such as maintaining contact with customers). Horizontal activities (support) are very important but at the same time their effects on the final product are less visible because it is indirect.

Business domains/sectors evaluated by value chain

- **Process industries**. They produce volumes of substances such as gas, oil, electricity, etc. By using the value chain model, we can say that operations, inbound logistics and outbound logistics are the key processes for this domain.
- **Telecom operators**. Here there are three high level primary process: network, service and workforce management. By using the value chain model, we can say that operations, marketing & sales and (after sale) service are the key processes for this domain.
- **Utilities**. In this sector there are all the companies which supply natural resources such as electrical energy, natural gas, water, etc. By using the value chain model, we can say that operations, marketing & sales and (after sale) service are the key processes for this domain. Process industries are different from the utility industries which sell the substance to more customers (for example the electricity).
- **Banks/insurances**. This is one of the domains that deals with information management. By using the value chain model, we can say that operations, marketing & sales and (after sale) service are the key processes for this domain.
- **Retail**. This domain involves a flow of physical item. By using the value chain model, we can say that procurement, inbound logistics, operations and marketing & sales are the key processes for this domain.

Others

- A **bill of materials** is a list of the raw materials, sub-assemblies, intermediate assemblies, sub-components, parts, and the quantities of each needed to manufacture a product

Chapter 3: ERP and CRM

These tools which go under the name of Enterprise Systems (ES), which contains ERP, CRP and SCM, typically share some concepts:

- **Data**. In several (legacy) systems the same data is **replicated** multiple times, which requires dedicated interfaces to synchronize this data with the consequent problems of increased costs, delays, impracticality, etc. To solve this problem, either a single shared DB is used, or replicas of this data (with the same model) should be used with an automatic synchronisation mechanism.
- **Modularity**. Vendors sell their products in pieces (the modules are independent) and therefore organisations buy only the modules they need.

- **Prescriptivity**. The ready-to-use software modules of an external company contain a partially modifiable business logic.
- **One vendor**. In fact, although it is theoretically possible to buy from different vendors, each of them (Microsoft, Oracle, etc.) pushes the organisation to buy only from itself. There is always some hidden trick to make switching providers difficult.

ERP

Enterprise resource planning (ERP) is software designed to help companies store, manage, and use data regarding their daily and regular processes. ERP software covers a lot of different areas within a company – accounting, sales, purchasing, manufacturing. One of the most important needs it addresses is the need to communicate all pertinent information to the many departments that may require the data.

CRM

CRM (Customer Relationship Management) is a set of tools, as well as an approach, covering the interaction with the customer. Three typical service chains (maintaining contact with the customer from before purchase until the end of use) are:

- **Reservations**: database with availability of product/service plus (multichannel) front end. For example, the sale of right to a service (not the service/product itself).
- **Product sale**: where there is a complete service chain with delivery included. For example, sales + delivery (Amazon style) or sales + production + delivery (e.g., Dell)
- **Customer care**: complex service chain to assist customer after the sale.

The higher the number of customers and the number of contacts the more important it is to have a CRM suite (e.g., in the case of banks and TLC). On the other hand, organisations with few contacts and a small number of customers (e.g., companies selling durable goods or commodities) probably don't even need CRM. One can therefore guess that not all business domains have the same need for CRM, but rather it depends on the intensity of the relationship with the customer (frequency and duration of contact), the number of customers, their loyalty and whether it is a multi-channel domain or not. Also, the CRM tools are organized in certain number of modules:

- **Sale person**: require the ability to produce offers, produce offers from a template, validate an offer and keep track of contracts and offers. Another important aspect is planning and control, i.e., having overviews and being able to see current sales.
- **Call center**: all services offered through the Internet are instead offered by a person in voice. The required functionalities are related to CTI (computer telephone integration), which consists in recognising the voice, the caller, controlling the caller's flow and forwarding them to operators or waiting messages, etc. Call centres also work to attract new customers or sell something (telemarketing) using ACD (automatic call distribution).
- **Internet** (websites): interaction with users usually through web interfaces and integrating various services such as shipping, cancelling orders, refunds, etc. In this case there is a difference between B2C (like Amazon) and B2B where the interaction is different because payment is made after delivery.
- **Campaigns and marketing**: responsible for contacting its customers (or a subset) to propose new offers, understand what they want, propose new products, etc. The functions required are therefore the selection of customers to be contacted, the design and planning of the campaign and the transfer of data from analytic CRM to the operational part of the IS.
- **Analysis** (Analytic CRM): interactions with customers produce a lot of data that can be analysed to classify customers into categories, data mining to make predictions, producing reports and more.

Chapter 4: Strategy

The strategy must constantly adapt to changes, in particular the technology changes (innovation) are a key factor to decide the strategy. The strategy of an organization is decided by few people (CEO).

Porter Model

This model consider that a certain organization can decide to focus on different approaches coming from two dimensions: the **competitive advantage** and the **focus**. The focus can be **wide** or **narrow**. For example, in the car market an organisation may decide to compete in the whole (or most) market (wide focus), which for the car market is about 70 million cars, or it may compete in a more niche market (narrow focus) such as electric cars, which is a market of 5 million cars. On the other hand, the value proposition may be to offer the **lowest** possible cost for the product or to offer the **most unique ones**. Depending on the approach, the strategy changes of course. An organisation whose aim is to offer products at the lowest possible cost and to play on the whole market must sell as many products as possible. If, on the other hand, the organisation seeks to sell unique products, it does not focus on the quantity of goods sold but on quality, on uniqueness. Even in niche markets these two extremes are present, and the reasoning is practically the same with the difference that the number of customers reached as well as the number of different products is smaller. The Porter model defines that to define a strategy, five entities must be considered: **substitute products** (subjects that put on the market products different from those of the reference company), **customers** (in particular number of customers: less == more power), **suppliers** (like customers), **new entrants** (parties that could enter the market in which the company operates) and **competitors** (players offering the same type of product on the market).

Business Model Canvas

The canvas has the following structure:

<table>
<tr><td rowspan="2">Key Partners</td><td>Key Activities</td><td rowspan="2">Value Proposition</td><td>Customer Relationship</td><td rowspan="2">Customer Segments</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td colspan="3">Cost Structure</td><td colspan="2">Revenue Structure</td></tr>
</table>

- **Value proposition**: is the **list of products/services** that the organisation produces and provides to customers/users. The **reasons why customers/users should buy** these products/services are mainly two: **gain creators**, it has useful functions, social gains, positive emotions or cost savings and **pain relievers**, it reduces costs, time in doing something or it is a new proposal that creates benefits do not present before. Possible value propositions are **newness**, customers often buy something only because others do not have it (e.g., mobile phones in 1991) and this refers to gain creators; **performance** (e.g., speed and storage in PCs); **customization** (e.g., possibility to choose colours and comfort for the car); **getting the job done** (e.g., outsourcing airplane maintenance for airline); **price** (e.g., low-cost airlines); **status** (e.g., luxury cars), **design** (e.g., beauty furniture); **cost reduction,** that unlike the price we mean those "things" which are necessary and not superfluous (e.g., CRM as a service); **risk reduction** (e.g., insurance on engine break downs for used car buyer); **accessibility** (e.g., private jet) and **usability** (e.g., iPhone, iPod).
- **Customer segments:** is usually done together with the value preposition or at least there is a close link between them. It is one or more **group of customers** that the organisation **wants to serve and** others that it does **not want** to serve. In the case of the **mass market**, the entire world population can be considered as a target (e.g., for the sale of toothpaste). In the case of the **niche market** (e.g., sale of luxury cars), only the population with the highest revenue should be considered. There are also other types: **segmented**, to focus on different segments, e.g., Toyota has several brands covering different markets (Lexus for luxury cars) with different offers; **diversified**, to focus on different segments, e.g., Amazon sells cloud services but also books and other objects and **multisided**, to have different categories of customers, e.g., commercial TV has both audiences and advertisers as customers. To define a segment, one must bear in mind that each has **different needs** to the extent that they require **different offers**, the **distribution channels**, the **type of relationship**, the **profitability are** often **different** and finally, they **pay for different aspects** of the offer.

- **Channels:** is the **way** the organisation **reaches** out to **customer** segments. The channel may be **owned** by the product manufacturer (sales force, web, own stores) or **use** those of a **partner** (partner stores, wholesalers). It is also possible to have both channels, e.g., to buy an iPhone the customer can either go to the official shops or to a partner shop (Mediaworld).
- **Customer relationship:** is the **type of interaction** between organization and customer segment. It can be **strict**, as in the case of *personal assistance* (face to face, email, call centre) to offer the customer a feeling of friendship (and not to lose him) **at a higher cost**, or **less strict** as in the case of *self service* (the least strict possible), *automatic service*, *community* or *co creation* (YouTube, reviews, etc.) **at a lower cost**.
- **Key resources:** are **essential to survive and work**. They can be **physical**, such as structures, vehicles, shops, platforms, networks, etc., **intellectual**, such as brands, trademarks, customer data (essential in IT companies), **human**, such as workers, researchers, designers, sales forces, etc., and **financial**, such as money, credit lines, stock options, etc. In this part it is important to have an overview of (only) the key resources, the most important ones, so it is not necessary to create a list of everything that is used.
- **Key activities:** as with resources, only **those without which the organisation could not work** are mentioned. Key activities are not outsourced because it could be risky.
- **Key partners:** not all **suppliers** and **partners** are **crucial**, but some of them might be. If you consider a company that produces computers, the relationship with a company that produces CPUs (Intel for example) is crucial, because a computer without a CPU is useless. Relationships could be **between non-competitors**, **between competitors** on specific products/services, **joint ventures** for new business, **buyer-supplier** and **outsourcing**. In some cases, some organisations share a factory to achieve a higher economy of scale (e.g., two car manufacturers might share the same factory producing engines) or to achieve a reduction of risks in producing a new product/service (e.g., Sony, Panasonic and Philips agreed to produce blue ray).
- **Cost structure:** includes **all the main services and items at a cost to the organisation**. Costs are related to key resources, activities and relationships (left side of the canvas). There are two extremes, i.e., the cost structure can be **cost driven**, i.e., the objective is to reduce costs as much as possible (Ryanair, EasyJet, etc.) or **value driven**, i.e., to offer the best possible service (7-star hotel for example) without worrying about costs. In the first case, the customer relationship is oriented towards a non-personal, typically self-service relationship and some activities are usually outsourced because due to the competition of the various markets (in the case of frequent activities) advantageous prices are obtained. In the value-driven structure the services are all customised and no activity is outsourced to ensure the highest quality. Costs are also divided into **fixed** costs, which do not depend on the number of items sold/products, and **variable** costs, which depend on the number of units sold (e.g., electricity costs). Costs depend on whether the **economy** is one of **scale**, where maximum resources are used to produce a product/service, or one of **scope**, where the greatest number of products/services are produced.
- **Revenue structure:** includes **all income and is useful to understand if you can sustain the costs and earn money**. Earnings can be produced through **asset sale**, the most common, where a customer buys a product/service; **usage fee**, where you pay in proportion to usage; **subscription fee**, where you pay per month, per access, per download, etc.; **renting/leasing**, for exclusive use for a period; **licensing**, to buy the rights to use a copy of a content or software usually; **brokerage fees**, as a % of the transaction value and **advertising.** Of course, the best option for the organisation must be selected from all these options. The next point, which is not an easy one, is to decide on the price of an item as one must consider the competitors, what are the customer segments, volume, product characteristics, demand/offer, etc.

BM Patterns

- **Product innovation**: the core of the BM is innovation (**value proposition**). This is the case with mobile phones, where new technologies are introduced almost every month. So, the aim of the companies is to produce new products that maybe the competitors don't have yet. The main activities concern research and development, to improve or develop new products. Having the best products available translates into being able to sell them at the highest possible price (like Apple with iPhones) but needing the best possible employees (high employee costs).
- **Infrastructure management**: this pattern includes logistics and telecommunications companies. The key aspects concern the **relationships with partners** (e.g., Amazon with logistics) which are strict. The **key activities** are therefore the maintenance and updating of the infrastructure, while the **key resources** are the volume as it is based on an economy of scale (the cost advantage a company has with the increased output of a good or service).
- **Customer focus**: in this case the organisations focus on the **relationship with the customers**, it is the example of banks and insurance companies where the final product is more or less the same. In this case it is based on an economy of scope, which means the average total cost of a company's production decreases when there is an increasing variety of goods produced. The main gains come from selling as many services/products as possible to the same customer.
- **Long tail**: is a business strategy that allows companies to realize significant profits by selling low volumes of hard-to-find items to many customers, instead of only selling large volumes of a reduced number of popular items. The term was first coined in 2004 by Chris Anderson, who argued that products in low demand or with low sales volume can collectively make up market share that rival or exceeds the relatively few current bestsellers but only if the store or distribution channel is large enough. While mainstream products achieve a greater number of hits through leading distribution channels and shelf space, their initial costs are high, which drags on their profitability. In comparison, long tail goods have remained in the market over long periods of time and are still sold through off-market channels. These goods have low distribution and production costs yet are readily available for sale. So, in the long tail approach you aim to sell small quantities of as many items as possible because if they are digital the cost of maintaining them, shipping them, etc. is low. This model is particularly suitable for content industries such as music, books and films. The conditions that have made this possible are the democratisation of production tools, the democratisation of distribution (Internet and digital content) and better links between supply and demand (search engines, recommendation systems, reviews, etc.)
- **Multisided**: in this case the organizations bring together distinct but interdepended groups of customers. For example, for commercial TV there are both customers and advertisers who are the ones who provide income. Another example is Google, which can be used free of charge by users. Its profits come mainly from providing advertising or visibility to its customers (other organisations/companies).

Chapter 5: Management IS

Management Cycle

The **management cycle** starts with defining objectives (what the company should do) defined during strategy planning, e.g., produce 100k models of a certain model per year at a cost of $10k each. Day by day the results are monitored and controlled and if necessary (if after one year the target has not been reached for example) corrective actions are applied. The analysed data is aggregated with measures defined by the strategy, e.g., the number of cars produced and the total cost of production. The **measurement process** can be divided into several steps: define/modify indicators/measures, verify, collect and store data, use day by day and check if useful and used, then go to step 1.

Management Accounting

In management accounting there are both **direct costs**, those directly attributable to a certain product/service sold to a customer, and **indirect costs**. For example, if we consider a company that produces cars, the direct costs are the components and materials of the car and the effort and energy in production. Indirect costs are machinery (if shared with other models), effort in design and advertising, human resources, etc. The other distinction is between **fixed costs**, which are independent of the number of units produced (long-term staff, machinery, factories, etc.) and **variable costs** which are dependent (material costs, energy, short-term staff). An important aspect is **cost accounting**, which concerns the collection of data and their characterisation in terms of fixed/variable and direct/indirect variables, in order to carry out various analyses, the most important of which is to calculate the **unit cost** of a product or service.

Balanced Scorecards (BSC)

According to the BSC, four perspectives are needed to monitor an organisation:

- **Financial**: how much profit is made by the organisation. The indicators used are **cash flow** (amount of money available every day), return on investment, financial result, return on capital invested and return on equity (stock market).
- **Customer**: the indicators are **customer satisfaction**, returning customers, market share and **quality**. This represents the value proposition.
- **Internal process**: is quite like the KPIs. The indicators are number of activities, opportunities success rate, accident ratios and manufacturing indicators (loading, availability, **performance quality**).
- **Innovation and learning**: the indicators are investment rate, illness rate, internal promotions percentage, **employee turnover** and gender ratios. They are used to understand if the company can change and learning.

Chapter 6: Organization

Characteristics

- **Formalization:** ***level of description of an activity***. The activities which can be completely formalized are called **Standard Operation Procedure (SOP)** and they could normally be automatized. Typically, formalization means more efficiency, predictability and resistance to change but also less flexibility. An example of SOP is the bank transfer.
- **Centralization:** where to allocate the decision power. Usually in a ***centralized organization*** the decision power is only at higher levels (with the advantage of more homogeneous decisions but also the ease of having bottlenecks that cause long response times), instead, in ***decentralized organization*** the decision power may also be at lower levels (response times improve but there is no more homogeneity in responses).
- **Specialization:** more specialization is typically linked with more formalization. Specific activities are assigned to specialized roles (employees) in the organization. For example, the are specialists in industrial mortgages, in home first mortgage and in home vacation.

The first type of organization is the **bureaucracy** related one. They present a high level of formalization, specialization and centralization. The typical case is the Public Administration where the lower levels have always to ask to the superior what to do or what they can do (in many cases). The organization design can follow two different approaches (pattern) which are **mechanical system design,** characterised by a very hierarchical structure (as in the case of the bureaucracy), well defined with a rigid culture (they are not favourable to change), a stable environment and efficient performances and **natural system design**, characterised by a turbulent environment (can change from week to week) requiring an adaptive organisation with a horizontal structure (more details later), composed of empowered roles (anyone can do anything or almost anything), with shared information and using a collaborative strategy.

The common organizational types are:

- **Entrepreneurial**: start-up business which usually follow the nature system design approach
- **Machine bureaucracy**: mid-sized manufacturing firm where the product can remain the same for years (mechanical system design)
- **Divisional bureaucracy**: fortune 500. In general, the larger a company is, the more it needs a hierarchical structure
- **Professional bureaucracy**: law firms, hospitals, etc. where some activities are very bureaucratic and others less so (the problem-solving part)
- **Adhocracy**: consulting firm where in addition to the problem-solving aspect, for each project there are different teams working in a completely different way from others.

Organizational Structures

There are five different organizational structures:

- **Functional**: employees are grouped according to similar functions and skills. For example, all manufacturing together. The **strengths** are that it allows economies of scale within functional departments (because that's all they do), enable in-depth knowledge and skill development, enables organization to accomplish functional goals and is the best with only one or few products. On the other hand, it has some **weakness** like slow response time to environmental changes, it may cause decisions to pile on top (hierarchy overload), leads to poor horizontal coordination among departments, results in less innovation and involves restricted view of organizational goals.
- **Divisional**: employees are grouped by product and all the functions are repeated in each division per product. The **strengths** are that it is suited to fast change in unstable environment, leads to client satisfaction because product responsibility and contact points are clear, involves high coordination across functions, allows unit to adapt to differences in product, regions, clients, it's the best choice for large organizations with several products and it decentralizes decision-making. On the other hand, it has some **weakness** like eliminating economies of scale in functional departments, leads to poor coordination across product lines (it may happen that the divisions develop the same thing), eliminates in-depth competence and technical specialization and makes integration and standardization across product lines difficult.
- **Hybrid**: divisional and functional structure can be used together. In this case all horizontal activities (accounting, marketing, HR, etc.) are common and the other activities are divided into divisions.
- **Geographic**: functions are repeated per geographical area

IS

The information system can be **decentralized** or **centralized.** The advantages of the last one mentioned are the increasing effectiveness of economy of scale (no duplications of assets), the standardization of career paths (in IT), architectural choices and tools (DB, OS, …), the data sharing, the enforcement of common policies (risks, recovery, backup, security) and of IT strategy and the control of IT budget and cost. The disadvantages are the less reactivity to requests from other business functions/units and less specialization. According to the **Conway's "Law**" the structure of an IT system mirrors the communication structure of the organization that produces it. For example, if a company has three IT offices, it will have three IT islands which cause data replication problems. The data replication (same data in several systems), made in the decentralized approach, needs a dedicated interfaces to synchronize which involves cost, delays and unfeasibility. The solution to this problem is sharing the data or having replicas with automatic synchronization (one data model). If the IS area is centralized, the interaction between it and other functions can be described by the following models:

- **Push**: IS services are imposed from IS area.
- **Pull**: IS services requested from business function. Note that IS functions are closer to business functions but not independent of the CEO.

The main roles of the IT area are:

- **Chief Information Officer**, **CIO**, is the top-level manager responsible of IT area and usually reports to top management (Chief Executive Office, CEO).
- **Chief Technology Officer**, **CTO**, is responsible of technology scouting and technology choices and reports to CIO or CEO.
- **IT enterprise architect**, defines and maintains the IT enterprise architecture such as applications, data models, communication patterns between applications.
- **Analyst** is the one who should translate business needs into information technology, i.e., writes the requirements, what the IS should do in terms of business functions. It is important to have knowledge of the sector.

COBIT

It is a reference document for IT governance and IT process and risk management. It aims at aligning business and IT strategy. There are five domains divided into two main ones **Governance** (evaluate) and **Management** (plan, build, run and monitor). The next idea inside the COBIT are the **RACI charts** which are a similar idea of the LRC. RACI is the acronym of the four entities involved in each practice. In more details they are:

- **Responsible**: the person/people who does the work to achieve the task.
- **Accountable**: the person who is accountable for the correct and thorough completion of the task (A approves the work reported by R).
- **Consulted**: the people who provide information in a two-way communication.
- **Informed**: the people kept informed of progress in a one-way communication.

A RACI chart defines whether the people involved in a project activity will be Responsible (R), Accountable (A), Consulted (C), or Informed (I) for the corresponding task, milestone, or decision. The RACI chart presents in the top row all project roles or team members (also including those outside the IT area) and in the left column a list of tasks, milestones and decisions. For each task, a RACI value is assigned to each role or person in the team. For a certain activity, there is also a table showing its description and its inputs and outputs. It is at this level that one understands what happens within an activity. At this point you have a complete picture of the IT area, as you have the complete list of activities, roles and who does what. The last piece of the puzzle is the measurements which make it possible to monitor and assess whether the IT area is doing what it should. COBIT defines in sufficient detail the **possible goals and all measures/indicator**s attached to these goals.

Chapter 7: IT Economics

- **Economy of scale**: maximize the number of units produced to minimize cost of unit.
- **Economy of scope**: use the same infrastructure (fixed cost) to produce a larger variety of different units. For example, amazon went from sell books to sell everything.
- **Network effects**: the more people who use a service, the more value it gains. If you consider a telephone network with only two people using it, it has no value. But if a billion people use it, the value is huge.
- **Total Cost of Ownership (TCO):** the correct way to make such an estimate is to define a product/service life cycle and then estimate the costs at each stage. This approach is also typically used for the make/buy case, i.e., to understand whether it is cheaper to buy a product/service or to make it. The life cycle consists of an initial construction phase, in the case of make or selection in the case of buy. Then there are the deployment, operation and maintenance, and finally dismissal phases. The decision on which machine to buy may also **depend on the usage scenario**. In short it makes no sense to consider only the 'label' price of an item at time of purchase to understand its cost. Particularly if the time interval in which the item will be used is long (as for IT products).

- **Return on Investment (ROI)** which basically represents what the benefits are versus what the investments are. ROI = Profit / Cost = (Benefit – Cost) / Cost. For example, buying a house at 100 and reselling it after a period at 120 gives an ROI of 20% (20/100). If, on the other hand, you buy shares at 130 and sell them at 111, you have an ROI of -14% (-19/130). The problem with this measure is that it does not take time into account, but obviously getting a 10% return in 10 years is not the same as getting it in 1 year. However, ROI is used to evaluate the return (if it is negative, you are not interested in the investment) when buying new applications or materials. The alternative is to evaluate ROI over several time periods which leads to the concept of **break-even** (evaluate how long it takes to recover the investment (at least to match it). Evaluating the ROI over different periods of time (usually years), costs are predominantly present at the beginning and that benefits are usually not present immediately but later. Technically from the break-even point there are only profits and benefits. Example:

Period	0	1	2	3	4	Total
Benefit	0	400	400	400	400	1600
Cost	500	200	170	150	150	1170
Benefit - Cost	-500	-300	-70	180	430	430

TCO = 500 + 200 + 170 + 150 + 150 = 1170

ROI = (1600 – 1170)/1170 = 36.75%

BREAK EVEN = 3 TIME PERIODS

Transaction Theory

A **transaction** is an exchange of product or service between two parties (vendor, buyer). Transactions can be **internal**, when they take place within the organisation (typically not involving the exchange of money) and **external**/**market** when they take place outside. In the market transaction the two parties are independent (buyer pays an amount, vendor delivers product / service) while in the internal transaction the two parties are two roles/organizational units inside an organization. Attention must be paid to the fact that internal transactions may seem of little value because they are "free", but this is not the case. Because of the inherent difficulty in description, either asymmetric information allows opportunistic behaviour of (one of) the parties. In an internal transaction all these problems are not present because it is the same organisation. Obviously, for the same reason the details provided will be less (the information is not complete) and the costs are unclear or even unknown. As always, there is no single right solution, but it depends on the case. In general, in market transactions there is no hierarchy (both parties are at the same level), so in case of problems a third party is needed to decide the dispute, prices are defined by the market and information is not distributed. In contrast, in internal transactions there is a hierarchy, the price is imposed or not defined, and all information is centralised. To sum up:

	Market Transaction	**Internal Transaction**
Efficiency (cost)	Lower (for standard products). Defined upfront	Higher. May be undefined
Know how on building product / service	External (not available anymore internally)	Internal (but probably lower than available to specialized producer)
Problem resolution	Contract (must consider all cases)	Hierarchy (no need to consider all cases

The more a company is involved in external transactions, the smaller it can become (**vertical disintegration**). However, it may also happen that the size of a firm increases when it buys a supplier (**vertical integration**). Because of disintegration **network companies** are created, i.e., organisations that integrate the work of independent companies specialising in a few components. There are two types of market transactions:

- **fixed price**: a contractual agreement on the outcome and its value. The problem is that the price is known in advance and therefore the vendor may reduce the quality. To avoid this, the contract must describe the quality perfectly.

- **time and material**: a contractual agreement on the cost of work (time) and material. By doing so, the buyer has more control over quality, but the vendor may reduce productivity. In general, the final price is higher than expected.

Agency Theory

According to agency theory there are three agency costs:

- **Monitoring**, control of agent (employees and managers) by principal (owner or shareholders)
- **Bonding**, reporting on activities done by agent to principal
- **Residual loss**, lost profits by principal, due to suboptimal behaviour of agent

The typical approach is to share the profits between the agents and the principal. This could translate in a fixed salary plus a profit sharing or a bonus if sales goal achieved.

Decision Theory

The decision theory regards decisions taken at many levels of organization. The first point concerns deciding where to allocate decisions. In principle, decisions should be allocated where the information is. The other option is to delegate the decision to a higher level. However, there is the concept of **bounded rationality**, i.e., you never have all the information at your disposal. On the opposite side, having too much information does not help (**analysis paralysis**). Decisions can be **structured** (decisions repeated following a set procedure) or **unstructured** (decisions never made before) and **planned** (such as produce budget at end of year) or **unplanned** (such as adjust strategy to covid 19). The classic decision process that can be applied to structured and planned decisions is as follows: identify problem, identify alternatives, evaluate alternatives (effect, probability of each one), select one, implement decision and evaluate decision. The best decision is the one taken under certainty, i.e., when the outcomes of each alternative are known. In the real case decisions are made under uncertainty, i.e., under risk, when some knowledge about the probability of each outcome is known or in the extreme case there is no information about the outcomes. In addition to the above, there are built-in human cognitive biases that fight against rational decisions. These cognitive biases are often connected to heuristics:

- **Confirmation bias**: search for / recall / interpret information that affirms one's prior belief or hypothesis. This happens when the dataset of information chosen to make the decision is not a representative one or was chosen specifically to influence a decision. For example, a person might say that smoking is not dangerous because he or she has considered perhaps the one case of a smoker who died at an advanced age.
- **Motivated reasoning**: instead of starting with the data and trying to use an approach to analyse it and find the solution, you start with the desired solution and look for reasons to prove it.
- **Survival bias**: is to consider a dataset containing only outliers instead of considering the complete one. For example, if we consider a dataset containing Bill Gates, Elon Musk and Mark Zuckerberg, we can conclude that the degree is useless because they do not have it and they are billionaires. If you look at the complete dataset, however, you see that people with a university degree have on average a higher salary than people without one.
- **Optimistic bias**: the tendency to underestimate costs and overestimate benefits. It's also called illusion of control effect.
- **Bandwagon effect**: decide what the others decide. This is also called groupthink and is especially important within an organisation. If everyone thinks in the same way, wrong decisions are made.
- **Cognitive dissonance**: if something is not consistent, we try to fix it. Dissonance can be fixed in two ways: by keep behaviours and change/tweak beliefs or facts or keep beliefs and change behaviours.
- **Dunning Krueger**: incompetent people think they are better than they are. Incompetent people lack the ability to recognize their inability, while competent people recognize the difficulty of problems, and their inability.
- **Repetition**: the more a statement is repeated, the more the belief in it strengthens.

- **Authority bias**: statement by an authoritative person is more trusted.
- **Anchoring**: the first piece of information considered biases the subsequent process.
- **Loss aversion**: people prefer to avoid a loss than achieve a gain.

The cognitive biases are scientifically used to manipulate decisions (commercials, politics and negotiations). Another aspect related to decisions are logical fallacies which are tricks to obfuscate truth or flaws in reasoning. The cases are:

- **Ad hominem**: consists of attacking the person to attack the argument. For example, saying a person is a liar implies not trusting the person.
- **Anecdotal**: use a personal experience as an argument. Like confirmation bias.
- **Appeal to emotion**: use an emotion as argument. For example, "happy smiling family having breakfast with product A" will translate into "product A is maker of happy family".
- **Appeal to authority**: like authority bias. For example, "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.
- **Burden of proof**: make a claim and let others prove it is false.
- **Circular reasoning**: use argument to prove argument.

If the collection of information, as well as the analysis and storage, is done with any kind of software tool, the chances of lower cost and higher accuracy are much higher than if it were done manually (on paper). Monitoring and bonding activities can also be cheaper if they are automated. The classic example is to send an email rather than writing on a sheet of paper the report to be delivered. The general principle is to allocate decision capability to minimise internal co-ordination costs. There is no single best option. For example, in a trading company, where the window of opportunity is within seconds the best option is to decentralise the decision (traders make the decisions). In the case of a bureaucratic environment, it is usually the case that the lower levels do not make any decisions but send the information to the higher levels, so it is much slower.

Cost and Value of IT

The cost of IT in an organization are related to the **cost of IT area per unit** and **the cost of IT project per applications.** The cost of IT area could be **direct** (typical 1-3 % of turnover)

- Fixed costs: personnel, facilities, hardware and software (if bought)
- Variable costs: services from other companies, rental of personnel, licences for hardware and software

And **indirect**, which are outside IT area, for example, learning cost of non-IT people to learn using IT tools, suboptimal decisions because of IT tools or time lost because of IT downtime. As usual, indirect costs are very difficult to compute. For the cost of IT project, it's necessary to use TCO, per period. There must be considered all costs (direct, indirect, internal and external) on all phases (construction/selection, deployment, operation, maintenance and dismissal). The value of IT in an organization are related to external (lower cost for search, evaluation, selection and communication) and internal (lower cost for coordination and communication) transaction costs. The effect of IS/IT on agency costs relates to facilitated collection of information from lower levels. It reduces bonding and monitoring costs, may avoid the need for intermediate management levels (reduces the depth of the hierarchy) and may reduce the need for specialisation of lower levels / increase the decision-making power of lower levels. The effect of IS/IT on decision costs relates to positive effect on quantity and quality of information, availability of powerful tools to support decision process but negative effect on quantity of information (information overload).

IT Governance

IT Governance is about how to use IT in an organisation to maximise value and reduce costs. Following COBIT the idea is to have a management level where plans are received, built, run and collected measures are sent to Governance for monitoring. The decisions relate to the IT strategic plan but must be synchronised with those of the company. Strategy is the result of corporate governance (a few people decide the organisation's

strategy) and is about long-term goals and how to achieve them. At a slightly lower level is the IT strategy which covers a few years. From it, decisions are made about architecture and technologies, IT processes, organisation and management of IT investments. It is a never-ending process because you always must adapt. The key decisions in Governance are what importance to give to IT and what budget to allocate to it. The key decisions in IT Governance are whether to buy or make software, and consequently which contractors to use, which technologies, etc. A key point is alignment, the IT area must support the organisations because of its strategy and business processes. In fact, one must divide the concepts of vision, i.e., what the organisation wants to do in the future, and the concept ability to execute them. The cases are:

- "**Beginner**": IT strategy is poorly defined, and the IT functions would be poorly executed against the strategy.
- "**Visionary**": a company with a defined IT strategy, but the IT function is unable to execute.
- "**Challenger**": IT strategy is not defined or is inadequate; nevertheless, the IT function can execute any strategy.
- "**Master**": IT strategy is well placed by the IT function.

IS Strategic Plan

The IS strategic plan covers first the current situation, in particular the architecture, the applications (application portfolio), the systems (hardware, OS, DB, ...), the personnel and the organisation (make/buy, vendor choices, etc.) but also the future situation concerning the modification or acquisition of new architectures, applications, and all other things described for the current situation. Typically, 80% of the budget is allocated to the current situation. And this is where the alignment problems arise, if more new projects are requested than are possible with the available budget, only a few (the most important) must be selected. This is the typical situation to be handled. For example, if a bank has as a strategy to attract customers with better services, then the IS functions must be aimed at improving the website, the call centre, etc... Typical mistakes are that IS goals are not aligned with strategy or that IS goals are incompatible, such as having better service with lower cost. Alignment is often referred to as enablers, which is about what helps it, and inhibitors, which is the opposite. Among the **enablers** are:

- **Senior executive support for IT**, which means that the CEO must understand the importance of IT (for some organisations IT is an 'obligation').
- **IT involved in strategy development**, because it is different to have a strategy and then later include IT, rather than including it at the beginning.
- **IT understands the business**, because members of IT do not always understand the overall context of the organisation.
- There must be a **partnership between business and IT**.
- **Well prioritised IT projects** because there is never enough budget to make all the projects.
- **IT demonstrates leadership**, because it must understand the evolution of technologies, business and make consistent proposals.

Inhibitors include denials of enablers:

- **IT/Business lacks a close relationship**
- **IT does not set priorities well**
- **IT does not deliver on its commitments**, i.e., it promises something it cannot achieve
- **IT does not understand the business**
- **Senior managers do not support IT**
- **IT management lacks leadership**

The alignment can be explicit or implicit, which corresponds to the push and pull interaction that takes place between the management and the IT area. If the interaction is push then we speak of **explicit alignment**, because the CEO defines the strategy and the global objectives of the company, from which the IT objectives are derived and passed to the IS function, and then implemented by the business function. In the **implicit**

alignment the objectives defined by the CEO are passed on to the business functions and then it is decided what the IT needs are, which are requested from the IT area.

Outsourcing

In terms of transaction theory, outsourcing is an external transaction. Given a certain service there is a decision if it should be made internally or bought outside. To be clear, this is not an on/off decision, in fact, in organisations the IT area usually partly does things internally (internal transactions) and partly takes from outside, from other companies. The outsourcing can be represented in a three-axes chart, where the axes are:

- **Activity/service** (IT infrastructure, application, business process)
- **Unicity** (solution for one/few/many customers == unique, not unique)
- **Location** (on-site, off-site, (near-shore, off-shore))

The IT infrastructure (PaaS, IaaS) such as hardware, network and call centre can be used in **hosting**, when the hardware is property of outsourcer and in site of it, or in **housing**, when the hardware is property of organization but in site of outsourcer. The business level means that the people who implement the processes can also be outsourced. A typical outsourced service in organisations is emergency assistance. Without outsourcing you would have to have a call centre in the company and emergency vehicles. With outsourcing the process is managed by a specialised company (automobile association, Europ Assistance, etc.). The **location** of outsourcing is important because implies a law system, for example labour protection, environment protection, privacy law different in Europe/US/Asia. The other dimension is **unicity**, which regards the fact that a service can be made for one customer, when the application is developed by IT services for a certain organization or developed by external company on specific requirement or can be made for many customers and then customized (SAP, Peoplesoft, SAS) or could be mass market (Office, Linux, MySQL, …). **Service Level Agreements** (SLAs) are defined to monitor outsourcing. They are measures inspired by KPIs. When an organisation buys a service/product from another organisation in the contract there are SLAs, which includes cost, reliability/availability, response time, quality, flexibility, etc. To decide whether an activity/service should be outsourced, an organization needs to have clear idea of the strategic decisions and ask if the know how is important, if it can be packaged and done outside (a commodity may or may not be outsourced) and if it can be done outside at lower cost/better quality/shorter delay. The common decisions are

	Yes	No
Is it strategic for the company	Outsourcing discouraged	Outsourcing possible
Know how is important	Outsourcing discouraged	Outsourcing possible
Is it commodity (can be fully described, is standardized)	Outsourcing possible	Outsourcing risky
Is it available at lower price, higher quality than is done internally	Outsourcing possible	Outsourcing not convenient
Is it subject to law constraints (for example, privacy)	Outsourcing discouraged	Outsourcing possible

Take the example of the email service. It is a commodity, so it is possible to switch from one provider to another. One case where outsourcing is not the best choice is the pricing algorithm for an airline. It is not a commodity, as it is not standard for every company, it is strategic, and it is important to be aware of the know-how and to pay attention to privacy. Hence, the outsourcing process is divided into two parts, a first plan step (Cobit) in which the activities/services (requirements, SLAs) are defined, vendors/products are identified and evaluated and finally the contract is written. Typically, the harder is to describe activity/SLAs, the better is to insource the activity. And a second step where it is monitored (Cobit). A TCO approach is used for outsourcing costs. By lock in we mean the difficulty in changing providers. Typically, providers try to make the switch difficult, e.g., by using a proprietary data format as opposed to a standard one. In fact, a key factor is the duration of the contract (he higher the risk, the shorter

the duration) and to consider condition to change (interrupt) contract in case of changes in service description or in technology/context. An important aspect in outsourcing is the evaluation of the vendor, especially considering the main risks, such as vendor bankruptcy, discontinuous product, affected by changes, vendor bought by a competitor, and the evaluation of the product, where the main risk is that the product is not suitable. To **evaluate a vendor** the following measures should be taken into considerations: size, reputation, time on the market, availability of local offices/local support and availability of service about the product from other vendors. For the **product** the main aspects to consider are functions, not functional requirements and context requirements (compatibility, platform, skills available, TCO). By the way there is no best choice (best product) in absolute but there is a most suitable choice to a certain need, which is expressed by a set of criteria and their weights. The criteria should be sufficient and not redundant/correlated.

IS Architectures

For IS architectures there are three options:

- **Function and islands (silos approach):** the natural implementation of Information System is to create an application and a database for each unit of the organisation (e.g., sales, accounting, warehouse). Each silo is independent of the other and this generates the problem that it is very difficult to aggregate the information of the different silos and that the information is probably repeated with different semantics and values. To solve the problems of replication, synchronisation mechanisms are needed which introduce costs, delays and unfeasibility. The silos approach is typically not 'designed' but is the result of (ill governed) evolution over time.
- **One data base**: this approach presents a DB or replicas with automatic synchronisation but all with a data model. It provides horizontal data integrity, i.e., all applications/modules share the same data, with the same data model, and vertical integrity, i.e., from the operations level to the management level (data aggregates). It fits well if the organisation has only one application or a suite of applications developed by the same supplier
- **Microservices**: the central idea is that of modularity and encapsulation, like object-oriented languages but raised to a higher level (many classes together) with an interface that is independent of a specific language or platform. The service is a group of classes with a defined technology-independent interface, which is executed and distributed independently.

Integration Technologies

Assuming an organisation has several applications, how can they be integrated? **APIs** are used. Application A exposes the API and application B calls the API. The advantage is that the interaction follows a defined protocol, but on the other hand, the number of possible interactions is high (if the number of applications is high), and the application may not offer APIs, or may not offer the necessary function or use different technologies. Another common method to integrate two applications is to use a (**local**) **database**. Application A uses database DBA and Application B reads/writes on tables in DBA. The main cons are high coupling between A and B and integrity of data may be lost (owner of data on common table is A or B?). Another tool used is called **Robotic Process Automation (RPA).** Application A and B have GUI interfaces and RPA tools is introduced between A and B. It's capable of capturing data from GUI, inserting data in GUI and interacting with APIs, files system, databases. The advantage of RPA is that it can be used on any application (especially those that do not expose an API). On the other hand, it is subject to GUI analysis problems, requires effort to evolve, and application GUIs evolve faster than APIs.