Business Information Systems 1

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1 Information Processing Perspective of Organizational Theory

1.1 Theoretical underpinning of BISs

- **Technology** represents a process (or a set of processes) that a given organization can perform, together with all the resources needed to perform the process (skills, tools, etc..)
- **Technical System** represents a set of machines supporting a given technology.
- **Information System** is a set of coordinated processes producing an information output and executing information processing activities.
- An information system is a technology, an `IT architecture` is a technical system supporting a given information system.

1.2 Organizational impact of technical systems

- Technical innovation increases organizational efficiency (not effectiveness)
- Technical innovation enables scale economies
- Technical innovation causes an increase in the optimal minimum organizational size
- Technical innovation increases individual specialization
- Tayloristic assumption: there exists an organizational optimum, optimal process obtained through optimal synchronization of individual tasks
- Groupwork was not an issue (not studied)
- Technical innovation increases bureaucracy and formalization of work
- Overall, technical innovation increases the complexity of managerial tasks

1.3 Information processing perspective of organizational theory

- Organizational theory started in the '60s-'70s, when IT becomes pervasive inside organizations
- Involves a complete change in traditional beliefs on the organizational impact of technical innovation
- It introduces a radical change in the management principles of technology, because IT processes information, which is the resource of managerial processes.

- By impacting on managerial processes, IT has an impact on the effectiveness of organization (not only efficiency)
- IT can also cause virtuous and vitious circles of information processes.

1.4 The Decision School

1. Organizations as open systems
2. Uncertainty as the variable describing the environment in which organizations operate
3. Uncertainty measures the ability of an organization to predict market demand.
4. Several determinants of uncertainty
    - Market dynamism
    - Number of suppliers in the market
    - Variety and variability of market requirements
    - Degree of innovation

1.5 Bounded rationality

- **Bounded rationality** represents the limited ability of individuals to process information
- It causes a need for cooperation
- In turn, cooperation involves individual specialization
- Specialization generates information interdependencies among individuals/organizational units
- Information interdependencies must be coordinated (or organized) in order for organizations to reach beyond the limits of individual rationality
- The need for coordinating information interdependencies is the reason why organizations are created
- **IT is a coordination** (or an organizational) **technology**

By definition of bounded rationality, no single individual can process all the information required by an organization

1.6 Hierarchical coordination system

- A hierarchy is a coordination system based on command and control (no delegation of decision-making activities).
- Practically, a hierarchy is a company or an institution
- Hierarchies are associated with **vertical information systems** and **horizontal** (or lateral) **information systems**
- The goal of information systems is the reduction of uncertainty

1.7 Vertical information systems

- Relationships between units are purely hierarchical
- A vertical information system manages information flows along hierarchical relationship

1.8 Environmental uncertainty and information processing capacity

- Environmental uncertainty - exception
- Exceptions - planning and control needs
- Planning and control needs - information processing requirements

1.9 Limits of the vertical information system

- Environmental uncertainty - exceptions
- Exceptions - vertical information flows towards higher hierarchical levels

1.10 Horizontal (lateral) information system

- It coordinates direct lateral information exchanges between units at the same hierarchical level
- It is accompanied by a higher degree of delegation of decision-making activities

Liaison roles, task force, teams, matrix structures

How can companies deal with environmental uncertainty?

They either increase their information processing capacity by implementing:

1. Vertical information systems
2. Horizontal information systems

Or they increase their slack resourcing by implementing

1. Slack resources (e.g. warehouse)
2. Independent organizational units according to the divide et impera paradignm (e.g. divisional organizational forms)

1.11 Limitations of the decision school

- It considers hierarchies as the only coordination mechanism
  - Market coordination is a coordination mechanism that can replace hierarchies when they come inefficient
- It considers environmental uncertainty as the only form of uncertainty
  - Behavioural uncertainty caused by the opportunistic behaviour of individuals can impact on the effectiveness of hierarchies

Transaction cost economies aims at overcoming these limitations

1.12 Economic transactions

- An economic transaction is an exchange between a customer and a supplier in which the customer receives a product/service from the supplier in exchange for a given amount of money
- A transaction represents a very old and simple way for individuals and organizations to cooperate
- A transaction is executed when an individual/organizational objective is beyond the limits of individual/organizational rationality

1.13 Market systems

- **They reduce behavioural uncertainty by leveraging opportunism**
- In market systems, individuals produce for themselves and have maximum benefits from their own efficiency
- However, coordination involves the execution of a transaction, that has a cost (transaction cost)
- The overall cost of a coordination mechanism is the sum of production cost and transaction cost
- In market systems production costs are low, as individual tend to be very efficient.
- Transaction costs are low only in perfect market conditions

The phases of an economic transaction are:

- Match-making
- Negotiation
- Execution
- Post-settlement

The purchasing of a consumer good has the following phases:

- Choice of shop
- Choice of good
- Payment
- Replacement of good if flawed

1.14 The price system

- The price system is the information system of the market coordination mechanism
- Prices are not set by production costs only, but also by the market system
- If the market system works properly, price is not too far from production costs and is a good indicator of quality

1.15 Causes for failure of market systems

1. Shortage of good/service
2. Complexity of good/service
3. Specificity or need for personalization of good/service
4. Environmental uncertainty and information asymmetry
5. Negotiation power of customer/supplier
6. Frequency of transaction

1.16 Markets vs. Hierarchies

1. The choice between market and hierarchical coordination mechanism is driven by cost (make or buy choices)
2. When markets fail, hierarchies replace markets

1.17 Impact of information technology

1. IT is an organizational technology that reduces coordination costs
2. IT has a greater impact on market systems and should reduce hierarchies (smaller and more numerous companies)

1.18 Limitations of transaction cost economics

- They consider markets and hierarchies as alternative coordination mechanism
- They ignore the impact of behavioural uncertainty inside organizations

Agency theory aims at overcoming these limitations

1.19 Agency theory

1. There exists a continuum between markets and hierarchies
2. There exist market coordination mechanisms inside organizations

Agency theory aims at overcoming these limitations by explaining how organizations can apply market coordination mechanisms to increase their efficiency

- Organizations are seen as networks of contracts among individuals
- Coordination inside organizations can be based not only on command and control, but also on the execution of transactions
- There exist transaction costs inside organizations that are called agency costs
- Agency costs emerge every time a decision-making task is delegated towards lower levels of the hierarchy

Delegation and agency costs are declined as:

- Fixed salary
- Fixed salary + percentage on sales
- Fixed salary + large bonus upon fulfilment of sales objectives (sales threshold)
- Fixed salary + all gains from sales - structure costs
- As we move from solution 1 to solution 4, the degree of delegation increases.
- In solution 4, the employee acts as an entrepreneur inside the organization.
- Soft managerial levers can be used to make sure that internal entrepreneurs do not go against organizational objectives:
  general rules and constraints, organizational culture, image, shared branding actions.

1.20 Agency costs

Delegation is accompanied by internal contracts similar to market contracts and, thus, creates an internal market with additional coordination costs called agency costs

Agency costs = control costs + warranty costs + residual loss
Transaction costs (Market) > Agency costs (Hierarchy)
Production costs (Market) < Decision costs (Hierarchy)

1.21 Hierarchical control inside market systems

- In perfect market systems, customers have no control over their suppliers
- Pure markets work well when trust is high and delegation is total
- In non perfect markets, customers can control their suppliers to some extent
- They have visibility over their production process and, in some cases, apply to their suppliers hierarchical forms of control
- The overlap between internal markets and hierarchical transactions is diverse.

1.22 Limitations of agency theory

- There exist hierarchical coordination mechanisms inside market transactions
- Agency school neglects the uncertainty caused by the nature of the task to be executed
- Role of technology is strongly tied to the nature of tasks
- Technical innovation represents a driver of organizational change that, depending on the nature of tasks, can change the cost balance among different coordination mechanism

Information system theory aims at overcoming these limitations

2 Administrative portfolio

- ERP systems have vertical solutions tailored to the needs of specific industries
- Vertical solutions are usually fine grained
- We make a coarse grained distinction between manufacturing and service companies
- Manufacturing companies produce tangible products, service companies produce intangible products

The administrative portfolio in manufacturing companies is declined into:

- **Administrative Portfolio**
- **Operational Portfolio**
- **Executive Portfolio**

These three functional areas have developed separately and are now integrated inside ERP systems. They constitute the **core functionalities** of ERP systems

2.1 Administrative Portfolio

It automates administrative and bureaucratic organizational activities, including:

- Account and tax payments
- Finance
- Human resources
- Project management
- Governmental procedures
- It is (almost) industry independent
- It is country-specific
- It represent the first step of automation
- It involves limited decision-making, while it is procedural and repetitive
- It is traditionally considered stand-alone, but it is not - activity based costing
- It can be functionally complex

2.2 Porter's concept of information intensity

1. Information intensity represents the size and complexity of the information used by the processes of an organization (minimal in cigar manufacturing, maximum in banks)
2. IT intensity is the actual ability of IT to satisfy the information processing requirements of organizational processes (it is greater in banking than it is in insurance)
3. Management inclination is the degree to which a company's management considers IT as a strategic lever (it depends on a number of factors such as computer literacy, culture, company history, etc.)
4. In general, information intensity is greater in services than it is in manufacturing
5. In general, information intensity is greater in services than it is in manufacturing
6. Historically, the management orientation towards IT was greater in manufacturing. Services have experienced a delay in IT development of about 10 years

2.3 Porter's drivers of IT intensity

IT diversity

1. Degree to which information processing activities are structured and, thus, can be easily translated into a computing procedure
2. Volumes, i.e. the amount of information to be processed
3. Frequency with which a given operation is repeated
4. Computational complexity of operations, the simpler, the better

2.4 Manufacturing activity cycles

1. **Development cycle**: in charge of designing and industrializing:
   - products
   - production processes
2. **Logistic cycle**: in charge of managing customers' orders with the following activities:
   - Procurement
   - Production
   - Sales and distribution

2.5 Interfunctional information processes

1. **Order management process**: it manages the information regarding orders from order check in to post-sale services
2. **Materials management process**: it manages the information regarding materials from outgoing orders towards suppliers to usage within transformation processes
3. **Operations management process**: it manages the information regarding operations from materials dispatching to production plants to product delivery

Different products and different divisions involve all production processes and all interfunctional information processes. The information system is tightly bound to organizational structure. Different production cycles share information

- Information on stocks is created by the materials management and used by order management during sale activities
- Information on stocks is created by the materials management and used by production
- information on orders is created during sales activities and used by production
- information on orders is created during sales activities and used by internal logistic

1. Interfunctional information is used by the planning and control processes (or management processes)
2. Interfunctional information is used by administrative activities. Examples are: cash flow management and project management

2.6 Standard vs. Custom production

- **Standard production**: products have a finite set of predetermined features that can be changed to accommodate customer preferences
- **Custom production**: products are designed according to customer requirements and then produced on demand
- There is a continuum between standard and custom production
- Intuitively, custom production is associated with complex artifacts, while standard production is associated with simple artifacts
- Actually, the degree of standardization and the degree of complexity of products are independent variables and all combinations exist
- Information technology (IT) applies to all combinations, but functionalities are substantially different

2.7 Classes of operational

1. **Transaction Information**: it describes the flow of operational activities
2. **Operations planning information**: it described the objectives and the expected results of operational activities
3. **Catalog information**: it represents a basic knowledge that is independent of the flow of production activities. It is referred to as a static type of information (although it is not)

2.8 Transaction Information

Describes the flow of operational activities in terms of exchanges between responsibilities (or organizational units) and between internal responsibilities and external players
Examples:

- Contracts with customers and suppliers
- Status of production activities
- Transfers of materials and half-finished goods between responsibilities certification of events

2.9 Operations planning information

Describes the objectives and expected results of operational activities. In short, it stores the production program

2.10 Catalog information

Stores a basic knowledge that is independent of the flow of production activities.
Examples:

- Product catalog
- Customer directory
- Supplier directory
- Workforce directory
- Product structure

It is complex, needs continuous maintenance and impacts on organizational learning capabilities (it can limit the consequences of personnel turnover).

Observations

1. Transaction information is the largest in terms of volumes
2. Catalog information is the most complex in terms of number of attributes (data schema)
3. Operations planning information is a key link between the operational and the executive portfolios

The level of detail of operational information is a driver of the efficiency of coordination inside an organization.

2.11 The value of operational information

In and of itself, operational information is an organizational asset.
In some cases, the operational information can be sold.

2.12 CIM (Computer Integrated Manufacturing)

Historically, IT functionalities have been developed separately for each organizational function, with no process view, with the goal of automating (instead of supporting/changing) existing activities. Different functions had separate data, individual instead of shared objectives. **Information is created at the beginning of a cycle to be used later on**. A proactive approach is needed to exploit information at an executive level with an integrated view of an organization.

- **Horizontal IT integration**: integration of systems along operating processes - **CIM**
- **Vertical IT Integration**: integration between the operational portfolio and the executive portfolio - **MRP (Material Requirements Planning)**

Enabling technologies

- Numeric control machines and robots
- Mini computers

Main objective of CIM: optimal scheduling and production resource management: **Production Efficiency**

2.13 Sample functionalities of CIM

- **Transformation processes**
- **Workforce management**
- **Plant management**
- **Materials management**
- **Quality management**

2.14 MRP (Materials Requirements Planning)

Enabling technologies

- CIM
- local area networks

Main objective of MRP: flexibility and scale economies through optimal planning - **Production Effectiveness**

Main idea: integrate product structure through:

- Concurrent engineering of products
- Inside-out production processes

MRP allows greater effectiveness by enabling scale economies with a more flexible materials requirement planning process (production is closer to market demand)

- Master production plan (sales objectives and actual sales)
- Materials requirements plan (product structure)
- Operational activity plan

3 Operational Portfolio in Service Companies

3.1 Services vs. Manufacturing

- Manufacturing companies produce tangible products, service companies produce intangible products
- Services are made of "bits".
- Manufacturing products are made of atoms
- In service companies, IT is a production technology
- Services are produced while they are delivered
- In services, IT is simultaneously a production technology and a distribution channel

3.2 Services value chain

In service companies, the overlap between production and distribution is called service delivery

- **Service set-up**: all the tasks that are needed to set up the production capacity of the company (e.g. for a bank, opening a new branch, or defining contracts with external data entry services).
- **Back-office tasks**: : production activities that are performed without the physical/virtual presence of the client, upon a client's order
- **Front-office tasks**: production activities that are performed with the physical/virtual presence of the client, upon a client's order
- **Marketing & sales**: tasks needed to advertise the company's services, attract prospect customers, and sign service contracts with new customers.

Service Delivery = Front office + Back office tasks

3.3 Inter-functional information processes

- **Order Management**: manages the information regarding orders from order check in to post-sale services
- **Knowledge Management**: manages the new information on customers acquired during service production and distribution by transforming into knowledge that can be used to in future production and distribution activities to improve customer satisfaction
- Order management and operations management coincide
- Materials management is replaced by knowledge management

3.4 Knowledge management in services

- Service customization requires knowledge about (individual) customers
- Knowledge about customers is acquired during service production and distribution, but usually it is unstructured
- Knowledge management processes gather this unstructured information and transform it into structured information and related customer service processes
- Knowledge management is a continuous learning process
- The environment changes (environmental uncertainty), therefore organizational processes must change through continuous learning.

3.5 Horizontal and Vertical IT integration in service companies

1. **Horizontal Integration**: **Personal Computers**
2. **Vertical Integration**: **Client-server architectures**

3.6 Personal computers as a production technology

- Personal computers have emerged in the '80s
- In service companies, service production activities are executed by individuals called knowledge workers (e.g. bank employee exchanging money)
- Personal computers represent the technology that supports knowledge workers in the execution of production activities
- Robots play a production automation role
- **PCs play a support rather than an automation role**
- PCs have brought technology to an individual level
- Mainframe applications are procedural, repetitive
- PC applications are:
  - Flexible and user-oriented
  - Various
  - Usable

3.7 Obstacles to IT integration in service companies

- The knowledge management process requires:
  - The extraction of new knowledge on customers from knowledge workers,
  - The transformation of this knowledge into structured information to be stored in the mainframe
  - The design of new procedures to use this knowledge to obtain greater service customization

This **learning process is more difficult than the MRP planning process**; it is a knowledge management process.

3.8 Business process reengineering

- The term refers to the change process involved in IT integration in service companies
- It has become a common term to indicate any IT-driven organizational change
- In the '90s people were wondering why BPR was impacting on services rather than manufacturing

3.9 BPR as a means to overcome the knowledge barrier

- Higher degree of delegation
- Greater complexity of the tasks of sales personnel; service procedures embedded in desktop applications
- From the sale of services to customer care; customer history stored on mainframes

With BPR, knowledge workers become generalists

4 Executive Information Systems

4.1 Traditional planning and control

Antony's pyramid

1. **Strategic Planning and Control**
2. **Management Planning and Control**
3. **Operational Planning and Control**

Control models and variables:

- **Financial performance** composed of:
  - Planning, budgeting and reporting
  - Activity based costing
- **Process performance** composed of:
  - Management dashboards
  - Input-output process models
- **Clients and markets** composed of:
  - Executive CRM
  - Analytical CRM
- **Innovation and critical resources** composed of:
  - Strategic planning
  - Strategic control
- **Information to stakeholders** composed of:
  - Communication to customers
  - Portals

4.2 Information in data warehouses

- Key Performance Indicators, i.e. aggregate information providing a summary evaluation of a set of production activities or performance parameters
- Indicators have a value by different dimensions:
  - Time
  - Organizational unit
  - Customer
  - Product
  - Process and activity
  - Other dimensions such as channel, geographical area, project

4.3 Design steps of executive information systems

- Business requirements (KPIs)
- Information sources
- Information transformation
- Information storage
- Processing level

4.3.1 Information sources

Operational DBs represent the main sources of information. They include:

1. ERP operational data
2. CRM data
3. Operational information from custom applications
4. Operational information from legacy applications
5. Information from the administrative portfolio

4.3.2 Information transformation (ETL)

1. Selection of data source
2. Data quality control and data cleaning
3. Data integration
4. Data aggregation

4.3.3 Information storage

1. Load is periodical
2. Data are loaded in a datawarehouse and subsequently copied in smaller databases called data marts to improve time performance
3. Datawarehouses and data marts may have different schemas and involve an additional transformation step

4.4 CSF Method

- CSF stands for **critical success factor**
- It is a business decision variable critical for the success of the whole company, i.e. a must for success
- The CSF method is a Requirements Analysis and Specification method for executive information systems

CSFs are abstract concepts.
CSFs are complex constructs and correspond to multiple KPIs.

4.5 CSF Method - steps

1. **Predefinition**: desk analysis
2. **Interview**: aimed at identifying CSFs
3. **Robustness analysis**: aimed at selecting KPIs
4. **Refinement and documentation**: presentation to customer, possible modifications, specification

4.6 CSF Method - Robustness Analysis

Criteria to evaluate/select KPIs:

- Cost of information
- Significance, that is contribution to understand corresponding CSF
- Frequency, if information is seldom updated, KPI should be eliminated
- Structuredness, quantitative is preferred against qualitative

5 ERP Architecture

ERP (Enterprise Resource Planning) core is composed of

- Administrative portfolio
- Operational portfolio
- Executive portfolio

while its extension regards the integration with customers and suppliers.
Extended ERP modules include:

- CRM
- PLM (Product Lifecycle Management)
- SCM (Supply Chain Management)

ERP has involved a major change in the IT industry (starting from the mid '90s)

- It has represented a global phenomenon
- It has transformed the approach to computerization from coding to purchasing a package
- It has integrated all three portfolios

The ERP Paradigm

1. Information Integration
2. Extension and Modularity
3. Process Prescriptiveness

5.1 Information Integration

Information integration involves the integration of legacy systems: order, payment and shipment data. Issues are represented by inconsistencies, slow batch alignment and obsolescence.

- Horizontal data consistency (information sharing)
- Vertical data consistency (from operations to executive dashboards)
- Conceptual consistency (integrated data model)

5.2 Extension and Modularity

Involves functional completeness and modularity(one stop shopping – one supplier – or best of the breed – multiple suppliers).

5.3 Process Prescriptiveness

- ERP packages embed a process logic
- Custom applications are developed ad hoc based on process requirements
- ERPs bring in a process and organizations have to change and conform to the logic embedded in the ERP
- There advantages (speed and costs) and disadvantages (diversification/competitiveness)

No single ERP provider can offer all functionalities for all industries. There exist niche players focused on industry-specific functionalities (e.g. cashier systems for the retail industry or machine-to-machine and machine-to-ERP integration in manufacturing). There's room for system integration to integrate software from different suppliers (or with legacy systems). Small and medium size companies typically adopt simplified ERP packages, SaaS. We have talked about horizontal/vertical integration of portfolios. ERPs complete integration of operational and executive with the administrative portfolio. This enables a real-time reconciliation of budgets, resource consumption, progress of operations and cashflows.

5.4 Activity-based costing (ABC)

- Operations are associated with costs
- Operations can be associated with an internal pricing system
- Progress can be assessed from both a project management (time, quality) and financial (cost) perspective
- Progress can be reconciled with administrative cash flows

6 Business Intelligence Introduction

SDG Group is a global management consulting firm, having a leading vision in the practices of:

- **Business Analytics**
- **Corporate Performance Management**
- **Data-driven Services**

SDG Group works on the pillars of specific expertises, incorporating **technological knowledge partnering** with the most important and innovative software vendors.
With an in-depth **industry**, **functional expertise**, SDG offers clients the capabilities needed to capture data in order to boost their performance:

- Practices in the field of the key **business functional processes**, including Finance, Sales & Marketing and Operations
- Business-oriented, with a **Cross-industry approach**, in Fashion & Retail, Industrial & Consumer Products, Pharma & HealthCare, Financial Services, Public Services
- **Key technology knowledge**, delivering Analytical Solutions through the most well known tehcnology platforms

"**Business Intelligence (BI)** is a set of methodologies, processes, architectures and technologies that **transform raw data into meaningful and useful information**"

How is a **Business Intelligence** system usually designed?

1. Data identified and structured
2. Expected output definition
3. Database model and design
4. Dashboards and visual design

Technical Focus

- Big volumes
- Immediate answers
- "Zero" time to delivery
- Information mobilization

Business Focus
Proactive Management: from **reporting-centric** to **analytics-centric**

Self Service Analytics: Answers to Unpredictable Questions
Business Key Issues

- **Free Analysis for Users**
  Set up of Dynamic Structure Environment to analyze Business & Financial facts:
  - At an atomic detail level
  - In a "ready to use" platform, used by:
    * Business & Financial Users
    * Controllers
    * Sales Analysts
- **Free Analysis for Expert Users**
  - Based on "click & drag" approach
  - Designed to fit expert users needs
  - By a "drawing table" easy-to-use structure

Deliverables

- **Tables & Graphs developed by users**
  - Cruising data with a Google style approach
  - Analyzing the facts time by time
  - Saving the analysis creating "bookmarks"
- **Visual dashboards designed by expert users**:
  - To analyze and understand elementary data without IT support
  - To show analysis results in an effective way to the Company Management
  - Build Dynamic Booklets to show Company results to Board Members & Top Management

7 Project Methodology and Development Standards

Project Definition: "A piece of planned work on an activity that is finished over a period of time and intended to achieve a particular purpose"

7.1 Project Team

- **Steering Committee**
  - Customer: CEO, PM Customer, IT Manager
  - SDG: Account Manager, PM SDG
- **Project Management**
  - Customer: PM Customer
  - SDG: PM SDG
- **Project Team**
  - Customer
    - Functional Team: Business Key Users
    - Technical Team: IT Users

    SDG: PM SDG and Developers

7.2 Project Structure (Phases)

- **Project Preparation**: high level requirements are collected. A global implementation strategy is defined, together with staffing and resource planning
- **Blueprint**: analysis is performed. Requirements are collected in onsite meetings with business users. Solution is defined and summarized in Business Blueprint document
- **Realization**: solution defined in the previous steps is implemented and tested by developers. Solution is realized to be tested by users
- **Final Preparation**: solution is tested by business users (UAT). Test cases previously identified are reproduce through a suitable dataset
- **Go Live**: solution approved by users, if necessary integrated with changed required during UAT, is released to Production environment and populated with real data.
- **Project Management**: organization and planning of project activities. Monitoring, check of actual respondence to plans, relationship with client

7.3 Project Structure (Activities)

- Plan
- Analysis
- Design
- Build
- Test
- Deploy

7.4 Project Preparation and Blueprint (Requirements Analysis)

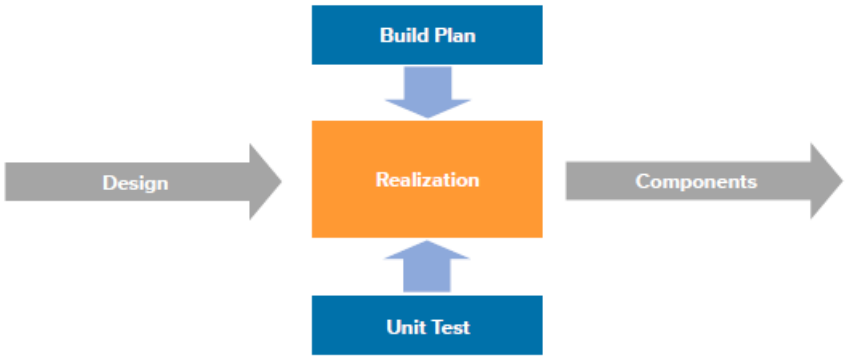
Other there are different end users with different needs. It's important to collect all the requirements, leading the analysis towards the final goal.
There is always a trade-off between *"having as much information as possible"* and *"having an easy-to-use application"*

7.5 Project Preparation and Blueprint (Technical Solution)

- **Technical solution** design, based on project goal (user requirements)
- Design document to be delivered to the customer
- **Design document** approval

7.6 Realization

The central phase of a software implementation project is **realization**
Schema is the core of an implementation phase



7.7 Realization (Release Management)

- SAP Technologies fall into category of **Packaged Software**: software not built from scratch, but with a preconfigured model where developer can work on (customization)
- Customization takes place on applications **deployed on a server**
- Application Build is performed on a **Development environment**, that relies on a server different from the Production environment
- To move developments from Dev to Qua and from Qua to Prod, **transports** need to be performed
- Before moving from an environment to another, developments need to be tested
- Tests require a **suitable set of data** to give a reliable outcome on the software components.

7.8 Final Preparation (User Acceptance Test)

- During this phase, users have to verify the quality of the solution developed in terms of correctness and compliance to their requirements
- There might be rework during the UAT phase, due to misunderstanding between business users and developers. The requirement analysis and the Blueprint document have the goal to avoid this cases

7.9 Go Live

- Project Go Live
- End user training
- Post Go Live support

7.10 Testing

- Testing is a process of checking the final product to ensure it meets requirements and expectations under operating conditions
- Testing is done by executing system functions through a series of predefined use cases and evaluating compliance with expected results
- Software testing involves the execution of a software component in order to check whether:
  - meets the requirements that guided its design and development
  - responds correctly to all kind of inputs
  - performs its functions within acceptable time
  - is sufficiently usable
  - can be installed and run in its intended environments
  - achieves the general result its stakeholders desire

7.11 Test Types

- **Unit Test**: performed by **Developer**. Unit testing refers to tests that verify the functionality of a specific section of code, usually at the function level. These types of tests are usually written by developers as they work on code (white-box style), to ensure that the specific piece of code is working as expected. Unit testing alone cannot verify the functionality of a piece of software, but rather is used to ensure that the building blocks of the software work independently from each other.
- **Integration Test**: performed by **Developer**. Integration testing works to evaluate interaction between integrated components (modules). Integration testing is any type of software testing that seeks to verify the interfaces between components against a software design. Software components may be integrated in an iterative way or all together ("big bang"). Normally the former is considered a better practice since it allows interface issues to be located more quickly and fixed.
- **User Acceptance Test**: performed by **Business User**. UAT is used to conduct operational readiness of a product, service or system. UAT is a common type of functional software testing, used mainly in software development and software maintenance projects. UAT focuses on the operational readiness of the system to be supported, its respondence to business requirements and the capability of the system to become part of a production environment.

7.12 Project Methodologies

Waterfall or Linear

- Project is executed along well-defined stages aiming at completion with expected deliverables to stakeholders

Agile

- Iterative development methodology that values and encourages communication and feedbacks, fast adjustment to changes and focuses on incremental working results along the way

7.13 Waterfall Model

- It is based on a clear definition of project phases and their sequence
- Each phase takes output of previous phase as input and generate an output used by subsequent phase
- In case of issues in a test phase, process can come back to previous phases (coding)
- Waterfall model is the most classic model to design & develop pieces of software
- All the other models are derived from waterfall

Waterfall Phases

- Requirements Analysis
- High Level Design
- Low Level Design
- Coding
- Unit Testing
- Integration Testing
- Acceptance Testing

Waterfall Model Benefits

- Lowers defect resolution cost due to earlier detection
- Provides improved quality and reliability
- Reduces the amount of rework
- Increases testing efficiency with added focus on testing objectives
- Ensures better scope definitions through requirements traceability
- Improves risk management
- Encourages focused efforts by determining the success criteria up front

Waterfall Model Limits

- Does not permit going back and forth between the development phases.
- Difficulty to implement changes when requirements change
- Inability to revisit design upon discovery of problems during implementation
- Need for constant testing
- Difficulty in estimating time and cost for each phase

7.14 Agile Methodology

- In order to avoid bad surprises at the end to stay open to changes, development becomes continuous
- Realization phases is divided in a series of cycles with the scope of realizing a subset of technical components
- Each cycle has a complete internal structure
- The overall project management is aimed to ensure respondence of cycles to the general objective of the project

Define, Build, Release, Repeat

8 Business Intelligence with SAP

8.1 Enterprise Resource Planning

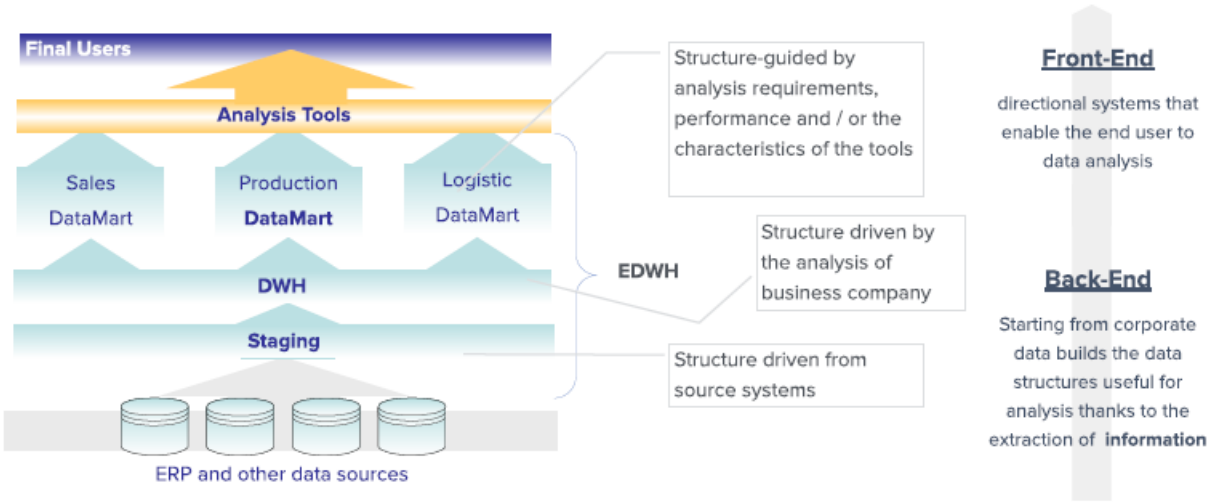
- ERP is a **modular software system** designed to integrate the main functional areas of an organization's business processes into a unified system
- An ERP system includes core software components (modules), that focus on essential business areas, such as **finance**, **accounting HR**, **production** and **materials management**, **CRM** and **supply chain management**
- What primarily distinguishes ERP software from stand-alone targeted software is a **common central database** from which various ERP software modules access information, some of which is shared with the other modules involved in a given business process. This means that companies using ERP are largely saved from having to make double entries to update information because the system shares the data, in turn enabling greater accuracy and collaboration between the organization's departments

8.2 Datawarehouse

An **Enterprise Data Warehouse** is an **integrated and centralized repository** of historical, detailed data that supports multiple decision-making applications for multiple groups and it should be the single source of data for the enterprise.
The data warehouse must:

- Make an organization's information easily accessible
- Present the organization's information consistently
- Be adaptive and resilient to change
- Be a secure bastion that protects company information assets
- Serve as the foundation for improved decision making

A **Data Mart** is a **subject oriented** archive that stores data and uses the retrieved set of information to assist and support the requirements involved within a **particular business function** or **department** within the **enterprise**



8.3 ETL

DHW and Business Intelligence environments are mainly based on data, so it's mandatory to have the right approach and the right tools to manage data with stability, robustness and in a centralized manner.
ETL refers to a process in database usage and stands for:

- **Extract**: data is extracted from homogeneous or heterogeneous data sources
- **Transform**: data is transformed for storing in the proper format or structure for the purposes of querying and analysis
- **Load**: data is loaded into final target database, more specifically, a data warehouse

9 SAP Company

Systems Applications and Products in Data Processing, is a German multinational company with headquarters in the city of Walldorf.

9.1 SAP ERP

- SAP ERP is an enterprise resource planning software developed by SAP
- It incorporates the key business functions of an organization
- It collects and combines data from the separate modules to provide the company or organization with enterprise resource planning

SAP ERP benefits

- Allows **easier global integration** (barriers of concurrency, exchange rates, language, and culture can be bridge automatically)
- Updates only need to be done once to be implemented company-wide
- Provides **real-time information**, reducing the possibility of redundancy errors
- May create a more efficient work environment for employees
- Vendors have past knowledge and **expertise** on how to best build and implement a system
- User interface is completely **customizable** allowing end users to dictate operational structure

SAP ERP constraints

- **Locked into relationship** by contract and manageability with vendor
- **Inflexibility**: vendor packages may not fit a company's business model and customization can be expensive
- **Return on investment** may take too long to be profitable

9.2 SAP ERP Main Modules

- **SAP SD**: SAP Sales and Distribution
- **SAP PP**: SAP Production Planning
- **SAP MM**: SAP Materials Management
- **SAP FI**: SAP Financial Accounting
- **SAP CO**: SAP Controlling
- **SAP TR**: SAP Treasure
- **SAP PS**: SAP Project System
- **SAP WM**: SAP Warehouse
- **SAP IS**: SAP Industry Solutions
- **SAP HR**: SAP Human Resources
- **SAP PM**: SAP Plant Management
- **SAP QM**: SAP Quality Management

9.3 SAP Business Warehouse

- The tool, inside the SAP offering, thought for Business Intelligence initiatives. It is the main solution that SAP applied to implement the Data Warehouse
- SAP BW is known as open, standard tool with allows you to extract data from different systems and then send it to the BI system
- It also evaluates the data with different reporting tools and allows to distributed them to other systems
- Opening towards different external source systems, specifically with Big Data and Hadoop solutions.

9.3.1 SAP Hana

- SAP BW/4HANA is a specific and evolved version of the BW tool, based on Hana DB, proprietary, high-performance, in memory database of SAP. BW/4HANA is optimized for SAP Hana.

SAP Hana is a comprehensive platform that combines a **robust database with services** for creating innovative applications. It enables real-time business by converging transactions and analytics on one in-memory platform.

Running **on premise or in cloud**, SAP Hana untangles IT complexity and democratizes in-memory computing.
Main characteristics:

- Advanced in-memory processing
- Real-time insight from Big Data and the Internet of Things
- Integrated data replication and virtualization that increases scalability and lowers complexity
- Support for modern applications that use multimodel data such as geospatial and streaming data
- Tools to keep business secure, minimize down-time, and support compliance with security standards

9.4 BW4Hana Objects

BW4Hana Objects are collected into InfoAreas and can be divided into Virtual and Persistent objects.

Persistent Objects

- **InfoObject**
- **advanced Data Store Object**

Virtual Objects

- **Composite Provider**
- **Open ODS view**

Reporting-oriented Tools

- SAP Business Object Web Intelligence (WebI)
- SAP Analysis For Microsoft Office (AO)

Data-visualization Tools

- SAP Lumira Designer/Discovery
- SAP Analytics Cloud (SAC)

9.5 Data extraction and integration

Data can be imported in SAP BW from both SAP source systems (ECC) and from other databases.
In the SAP suite there are different tools to allow data extraction and integration

- **SDA**: **Smart Data Access** is the equivalent of a "database query" or a "dblink", terms most commonly used in this context. SDA allows to open a connection to a very large number of sources (databases, web services) but also to build or re-adapt a connector (called "adapter") according to your needs. The replication of tables/views from source to target database is not physical but virtual; the SDA opens a communication channel and "makes the datasource work" but the result in a Hana object can be used in reporting views (joins, union) or in BW/4HANA objects. SDA virtual tables can also be used as a BW/4HANA source system

- **SDI**: Smart Data Integration is formally the data provisioning tool embedded in SAP Hana which is responsible for extracting information and uploading it to the latter. The only destination is indeed SAP Hana, while the use of SDA as the "staging" area is mandatory as first step for any SDI transformation flow. It is possible to schedule jobs or set real-time jobs (only if supported by the source)

- **ODP**: **Standard extractors** are the most common extraction method for transferring information from SAP ECC to SAP BW on Hana or BW/4HANA. They are based on ABAP (Function Module) and are managed at the SAP ECC application level

- **SLT**: **SAP Landscape Transformation** is the real-time replication instrument of SAP. It allows real-time replication at the table/physical view level and performs it thanks to the installation of a trigger database. SLT is a NetWeaver based application that replicates any DB - ECC to any DB - BW on Hana - BW/4HANA. This means that through the SLT application it is possible to replicate any DB or a SAP ECC on my compatible DB or on a SAP BW on Hana or SAP BW/4HANA platform at the application level, or replication in real time information on BW physical structures

- **Data Services**: Versatile and comprehensive data provisioning tool, it allows to connect to countless data sources, transform information and materialize information on any target. As source systems, it offers full compatibility with most databases and also with ABAP systems; as target systems, it is compatible with most existing databases

9.6 Extraction from SAP ERP system

- Extraction from ERP System is the activity that allows to **export Data** from ERP System, in order to import them into another environment (such as SAP Business Warehouse)
- The structure used to extract data from ERP is called Extractor (or Datasource) and it's a **cross component between source and destination system**

There are two main categories of extractors:

- **Application Specific**
- **Cross-Application**

Extractors can be:

- **Standard**
- **Custom**

9.7 Release Management

When working with SAP BW, there are (generally) three different environments:

- **Development System**: used to develop new objects or enrich existing ones
- **Quality System**: used to test developments with more consistent data
- **Production System**: where users view data and actively work on the system
- The presence of three different systems, and their use, applies **both on ERP and BW systems**
- Generally, there is a **connection one-to-one** between the same environments of ERP and BW system
- Structures and dataflow, developed in BW development system, are imported in quality system through **transports between environments**

9.8 User Profiling

Users in a BI system generally have different roles in terms of:

- **What to do**
  - Developers: create the data model and reports
  - Business Users: view reports
- **What to see**
  - CFO: all reports
  - Sales users: only reports of sales area
- **Which portion of data**
  - Group sales manager: sales data of all companies of the group
  - Local sales manager: only sales data of his company

9.9 Back-end vs Front-end

Data are only useful when available for **analysis**
Data visualization is the technology enabling corporate users to "see" data, to support them to better understand the information and using them in a business objectives perspective

9.9.1 Data Navigation and Visualization

Front-end web development is the practice of navigating data as well as converting them to **graphical interface for user to view and interact with data**

9.9.2 Data access layer

So what makes the front end possible? Where is all the data stored?

This is where the back end comes in. **It handles business logic and data storage**. It consist of servers, applications and databases.

9.10 Data Visualization

- It makes it easy to **recognize patterns and find exceptions** while interpreting the data at a faster pace
- It allows access to challenging data sets, it allows **exploration**, can be fun and provides useful information in an efficient way
  - Analysis: **support reasoning about information**
  - Communication: **Inform and persuade others**
- **Know Your Purpose**
- **Know Your Audience**
- **Choose the right tools**

10 Production Analytics

SIcad Group belongs to the manufacturing industry and it's a company which produces adhesive tapes

10.1 Production Analytics Project

The purpose of this project was to give the production management the instruments to have a clear view of the productivity of the Group, giving them the opportunity to analyzing in detail where and why there are problems or conducts to be improved

10.2 Project Phases

- **Plan**
  - Meeting to collect **user requirements**
  - Delivery to the customer of the **BI proposal** in terms of solution to be deployed, project plan and budget
- **Analysis**
  - Meetings with business users and **detailed definition of requirements**
  - Production and approval of **Business Blueprint**
- **Design**
  - Meetings with IT users to identify the correct source tables
  - Production and approval of **Design Document**
- **Build**
  - Developers test check to the correctness of implementations
  - Business: **user acceptance test** and approval of the solution
- **Deploy**
  - After the approval of the solution, we deployed it to the production system, giving access to all users
- **Training**
  - Training to all users enabled to use the BI application, to allow them to use the new instruments correctly

10.3 User Requirements

During the **pre functional analysis phase**, in order to design a first high level architecture and propose our offer, the following information have been collected:

- Final output of the project
- Perimeter of analysis
- Main dimensions and KPI
- Macro requirements of the BI solution

The aim of this project was the development of **three different reports**, to allow users to analyze data related to the following areas:

- **OEE**: indicator of productivity (%) which include: quality, efficiency and availability
- **Downtime**: moments while machines are not working due to different reasons
- **Scraps**: when producing a material, different components are withdrawn from the warehouse to be uses. There might be some scraps due to cuts or bad quality of the product

10.4 BI Proposal

After a first phase of user requirements, an offer has been produced to customer including:

- Software selection and approach
- High Level Architecture
- Project Plan
- Deliverables

10.5 Functional Analysis

The first phase of a project is the Functional Analysis.
During different meetings with the customer we analyze:

- Business Process
- Requirements

10.6 Business flow

For each step, a **Production Order** is created.
The main information related to a production order are listed below:

- **Materials** to be produced
- **Quantity** to be produced and unit of measure
- **Bill of Materials** related to the order
- **Task List** related to the order

10.7 Technical Analysis and Design

The second phase of a project is the Technical Analysis.
During this phase, the main steps are:

- Analysis of Source Data
- Definition of:
  - Data Model
  - Data Processing

10.8 Developments

After the model design, developments can begin.
The main steps are:

- **Data Extraction**
- **Data Processing**
- **Reporting Structure**
- **Report Creation**

10.9 Go Live

Once everything has been developed, few steps finalize the project

- User Acceptance Test
- Deploy and Go Live
- End users training

11 Business Trends

11.1 Trend Areas for Business Intelligence

- User Experience
- Big Data Analytics
- Advanced Analytics
- Cloud Ecosystem

11.2 User Experience

- Strategic KPIs accessible designed with high user experience to Board Members and Managers for fast decision support
- Interactive access to data and KPIs for Commercial, Financial and Operative analysis
- Deployment of Interactive Dashboard & Reporting to analyze business areas at detailed level

Competitive Business Intelligence shall:

- Provide highly interactive and highly responsive Dashboards & Reports
- Support mobile display
- Easy sharing of contents
- Support the seamless Integration of BI analysis pages into business processes or business systems

11.2.1 High Interactive and Fast BI

- Filters, Drill-Down, Tooltips
- Dashboard navigability
- Non standard visualizations
- GIS data integration

11.2.2 High Performances Architectures

- Multilayer Architecture: allows to distribute computing
- Right choice of Technology: high performance database, ETL vs ELT tools
- Data Modelling Best Practices Adoption

A column-stored database is a DBMS that indexes each column of a table, is a DBMS that indexes each column of a table, storing the indexes in lieu of row data, unlike traditional relational DBMSs using a row-store. Most column-store. Most column-store DBMSs include additional store DBMSs include additional optimization techniques to further compress the data, using less storage and increasing input/output (I/O) performance

High Performance Databases based on Massive on Massive Parallel Processing (MPP) is a type of database is a type of database where the data and processing power are split up among several different nodes (servers), allowing to be spread across more machines and so improving execution time.

High Performance Databases based on in-memory process are databases that exploit in-memory processing to speed up execution time

Success factors of Discovery Analytics:

- Support mobile displays
- Easy sharing of contents
- Enable embedded analytics
- Self-Service BI

11.3 Big Data Analytics

What are Big Data?

- Data from machine level like activity on the server
- Unstructured contents coming from Social Media
- Data from sensors or smart devices or PLC
- Public data from private of government sources
- Scanned version of statements and forms
- Data from text files or HTML
- Digital files, pictures and videos
- Data from operational or analytic databases

Classification of Big Data:

- Veracity
- Value
- Variability
- Complexity

11.4 Advanced Analytics

The Advanced Analytics Framework

- Finding optimal set up, scheduling or resource allocations
- Deriving Information from long and heterogeneous text sources
- Predict event or trends from the analysis of the past
- Discovering meaningful correlations, patterns and trends
- Operating guided by lessons from existing information
- Inferring classes and classifications from data set

The main problem addressed

- **Description**: Advanced Analytics can support in understanding better phenomena, processes and socio-economical behaviors through clustering, monitoring..
- **Prevision**: Advanced Analytics can support in making previsions of events and trends thought Time Series, Simulations, Advanced Statistics..
- **Classification**: Predictive Analytics can be used to classify processes, customer behaviors, bad events for predictive maintenance
- **Optimization**: Optimization techniques can create optimal set up, resource allocations, scheduling for many different problems

Data Science needs in BI Architecture

- Allow for multiple points of access
- Quickly responding to fast software updates
- Open to DevOps paradigm