Business Information Systems I

Christian Rossi

Academic Year 2024-2025

Abstract

This course offers a methodology to align IT design decisions with business goals. It introduces the concept of IT architecture, classifies key IT design choices, and examines how these choices impact IT architecture from both a software and infrastructure perspective. The course explores IT architecture within the manufacturing, utilities, and financial services sectors, focusing on both internal and external organizational processes along the industry value chain (e-business). It also equips students with the tools to analyze organizational requirements, with a particular emphasis on executive information systems, including the use of Key Performance Indicators.

Building on the concept of IT architecture, the course outlines a functional map of Enterprise Resource Planning systems, distinguishing between core and extended functionalities. It traces the evolution of information systems over time and highlights how ERPs have emerged through an ongoing process of functional integration. The course begins with a review of organizational theory from an information perspective, providing a framework to understand the organizational changes driven by ERP implementations. It then delves into the core functional areas of ERP systems, such as accounting and finance, operations, and management and control.

Contents

CHAPTER 1

Information processing

1.1 Introduction

Definition (*Technology*)**.** A technology represents a process that a given organization can perform, together with all the resources needed to perform the process.

Definition (*Techincal system*)**.** A technical system represents a set of machines supporting a given technology.

Definition (*Information system*)**.** An information system is a set of coordinated processes producing an information output and executing information processing activities.

Definition (*Information Technology architecture*)**.** An Information Technology (IT) architecture is a technical system supporting a given information system.

For a long time, there has been an ongoing debate about how technical innovation influences organizations. A well-established set of beliefs links technological advancements to organizational change, shaping how companies adapt and evolve:

1. *Efficiency over effectiveness*: technological innovation primarily enhances efficiency rather than improving overall effectiveness. It streamlines processes but doesn't necessarily guarantee better decision-making or outcomes.

2. *Economies of scale*: as technology advances, businesses can scale operations more efficiently, reducing costs per unit as production increases.

3. *Larger optimal size*: the minimum viable size of an organization tends to grow with technological progress, as larger entities can better leverage new systems.

4. *Increased specialization*: automation and sophisticated systems often lead to a workforce that is more specialized, with employees focusing on narrower, highly technical roles.

5. *Tayloristic perspective*: the traditional view, inspired by Taylorism, assumes that an optimal organizational structure exists.

6. *Limited focus on group work*: early studies largely ignored the impact of technology on teamwork and collaboration, focusing instead on individual efficiency.

7. *Greater bureaucracy and formalization*: as technical systems evolve, so do organizational rules, procedures, and levels of bureaucracy, making work more structured but also more rigid.

8. *More complex management*: with increased technology comes greater managerial complexity, requiring leaders to navigate intricate systems, regulations, and workflows.

1.1.1 Information processing

Emerging in the 1970s, the information processing perspective transformed how organizations viewed technology. As IT became widespread within businesses, it led to a fundamental shift in traditional beliefs about the impact of technical innovation. A radical shift in management principles, as technology was no longer just a tool for efficiency but a driver of decision-making and strategy. When information systems were well-integrated, they improved decision-making, coordination, and adaptability. However, poor implementation or information overload could lead to inefficiencies, miscommunication, and bureaucratic bottlenecks. As organizations embraced IT and information processing became central to management, three major theoretical approaches emerged: decision theory, transaction cost economics, and agency theory.

1.2 Decision theory

Galbraith (1973-1977) introduced the decision theory which is based on the idea that organizations function as open systems, constantly interacting with their environment. A key challenge they face is uncertainty, which defines the conditions in which they operate and reflects their ability to predict market demand. Several factors contribute to uncertainty, including market dynamism, the number of suppliers, variations in market requirements, and the level of innovation.

1.2.1 Bounded rationality

Bounded rationality refers to the cognitive limitations of individuals in processing information. Since no single person can handle all the necessary data for decision-making, cooperation becomes essential. Through cooperation, individuals and organizational units develop specialized roles, which, in turn, create interdependencies in information flow. To function effectively, organizations must manage these interdependencies, as coordination is crucial for overcoming individual cognitive constraints. This need for coordination is the fundamental reason organizations exist. IT plays a vital role in this process, serving as a tool for organizing and managing information beyond individual capabilities.

1.2.2 Hierarchy

Hierarchy is a coordination mechanism based on command and control, where decision-making authority is centralized rather than delegated. It forms the foundation of many companies and institutions, ensuring the structured flow of information within an organization. To try to reduce uncertainty effectively, hierarchies rely on two main types of information systems:

- *Vertical information systems*: manage the flow of information along hierarchical lines, reinforcing structured decision-making. However, they have limitations when dealing with environmental uncertainty. As uncertainty increases, exceptions arise, creating the need for more planning and control mechanisms. These exceptions lead to additional information processing demands, often requiring information to flow upward toward higher hierarchical levels for resolution.

- *Horizontal information systems*: facilitate direct communication between units at the same hierarchical level. These systems improve coordination by enabling decision-making at lower levels, reducing the reliance on top-down control. With a higher degree of delegation, horizontal systems enhance flexibility and responsiveness in dynamic environments.

1.2.3 Summary

Organizations can address environmental uncertainty in two main ways:

1. They can increase their information processing capacity by implementing vertical and horizontal information systems.

2. They can increase slack resources, such as maintaining warehouses or creating independent organizational units.

However, it assumes that hierarchies are the only coordination mechanism, overlooking market-based coordination as a viable alternative when hierarchies become inefficient. Additionally, it considers environmental uncertainty as the primary challenge, ignoring behavioral uncertainty caused by opportunistic individual behavior, which can also undermine hierarchical effectiveness.

1.3 Transaction cost economics

Williamson (1975) introduced the concept of transaction cost economics, which examines the costs associated with coordinating economic exchanges. A transaction occurs when a customer receives a product or service from a supplier in exchange for payment. Transactions represent one of the oldest and most fundamental ways for individuals and organizations to cooperate, as they enable objectives that go beyond individual or organizational rationality.

1.3.1 Market systems

A key function of transactions is to reduce behavioral uncertainty by mitigating opportunism. In market systems, individuals produce goods and services for themselves and maximize the benefits of their own efficiency. However, achieving coordination often requires executing transactions, which come with an associated transaction cost.

The total cost of a coordination mechanism is the sum of production costs and transaction costs. Market systems tend to have low production costs because individuals and firms operate efficiently. However, transaction costs remain low only under conditions of perfect competition.

Transaction An economic transaction typically unfolds in four key phases:

1. *Matchmaking*: this stage involves identifying potential suppliers based on initial requirements. The outcome is a list of candidates that meet the specified criteria.

2. *Negotiation*: from the set of potential suppliers, one is selected through discussions that refine the requirements. The result is a formal agreement, often documented in a contract with defined Service-Level Agreement (SLA).

3. *Execution*: the transaction is carried out according to the contract. The expected output includes the delivery of the product or service, along with any deviations or exceptions from the agreed SLA.

4. *Post settlement*: if exceptions or issues arise, this phase involves managing them through established procedures to resolve disputes, enforce agreements, or make necessary adjustments.

Price system The price system serves as the market's primary coordination mechanism, conveying crucial information about supply and demand. Prices are influenced not only by production costs but also by market dynamics. When the market functions efficiently, prices remain close to production costs and serve as a reliable indicator of product quality.

Perfect market Several factors can disrupt market efficiency:

1. *Shortages*: when supply fails to meet demand.

2. *Complexity*: when goods or services are too intricate for standard pricing.

3. *Customization*: when products require personalization, limiting standardization.

4. *Uncertainty and information asymmetry*: when buyers and sellers have unequal access to relevant information.

5. *Negotiation power imbalance*: when either buyers or sellers dominate price-setting.

6. *Transaction frequency*: when repeated transactions influence cost-efficiency.

When markets fail, businesses often resort to hierarchical coordination rather than relying on external suppliers. The decision between market-based transactions and hierarchical structures is primarily driven by cost considerations. IT acts as an organizational tool that reduces coordination costs. By improving information flow and transaction efficiency, IT strengthens market systems, leading to smaller, more numerous companies and reducing reliance on hierarchical structures.

1.3.2 Summary

Viewing markets and hierarchies as mutually exclusive coordination mechanisms overlooks hybrid models. Traditional theories ignore behavioral uncertainty within organizations.

1.4 Agency theory

Agency theory challenges the traditional view that markets and hierarchies are entirely separate coordination mechanisms. Instead, it suggests a continuum between the two, recognizing that market-like coordination mechanisms exist even within organizations. By applying these mechanisms effectively, organizations can improve efficiency.

Organizations function as networks of contracts between individuals. Internal coordination is not solely based on command and control but also involves transactional exchanges. Just like external markets, organizations incur transaction costs, referred to as agency costs. Agency costs arise whenever decision-making responsibilities are delegated to lower levels of the hierarchy.

1.4.1 Agency cost

Delegation within an organization mirrors market transactions, creating an internal market with its own coordination expenses, known as agency costs. These costs include:

- *Control costs*: expenses related to monitoring and ensuring compliance.
- *Warranty costs*: costs associated with guaranteeing performance.
- *Residual loss*: inefficiencies that arise despite control measures.

1.4.2 Hierarchy

In a perfectly competitive market, customers have no direct control over their suppliers (transactions are based entirely on trust and delegation). However, in imperfect markets, customers (or suppliers) may have some level of control over their counterparts. This control can take the form of visibility into production processes or even hierarchical oversight, where suppliers operate under certain constraints imposed by their customers. As a result, the distinction between internal markets and hierarchical coordination is not always perfect.

1.4.3 Summary

The main limitations of agency theory are:

1. Hierarchical mechanisms exist within market transactions, blurring the boundaries between markets and organizations.
2. Agency theory overlooks task-related uncertainty, which affects the efficiency of coordination mechanisms.
3. The role of technology is task-dependent: technical innovation influences organizational structures and can shift the cost balance between market-based and hierarchical coordination.

To address these gaps, information systems theory explores how technology can enhance coordination and reshape organizational structures.

1.5 Enterprise Resource Planning

Enterprise Resource Planning (ERP) systems often feature vertical solutions specifically designed to meet the needs of different industries. These solutions are tailored to be highly specialized. However, we can make a broader distinction between manufacturing and service companies:

- Manufacturing companies produce tangible products.

- Service companies provide intangible products.

Companies typically rely on three main IT functional portfolios within their ERP systems: administrative, operational, and executive. These portfolios, while initially developed separately, are now integrated within modern ERP systems, forming the core functionalities of these systems.

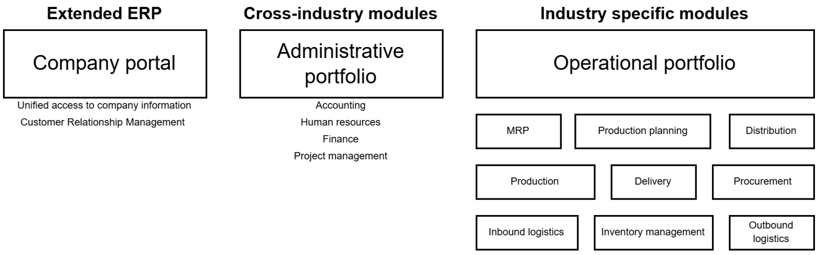


Figure 1.1: ERP architecture

CHAPTER 2

Administrative portfolio

2.1 Introduction

The administrative portfolio focuses on automating organizational activities that are often administrative and bureaucratic in nature, including: accounting and tax management, finance, human resources, project management (from an accounting perspective), and governmental procedures.

This portfolio is largely industry-agnostic, although it is country-specific. It represents an early stage of automation, alongside office automation, by streamlining tasks that involve number crunching. It typically involves minimal decision-making, as its processes are procedural and repetitive. Although traditionally viewed as stand-alone, it often links to other processes. Despite its simplicity in design, the administrative portfolio can be functionally complex.

CHAPTER 3

Operational portfolio

3.1 Manufacturing company

Definition (*Information intensity*)**.** Information intensity refers to the amount and complexity of information required in an organization's processes.

Generally, service industries require higher information intensity than manufacturing. IT Intensity measures how well IT systems meet an organization's information processing needs. However, IT intensity can sometimes be greater in manufacturing than in services, depending on automation and digital integration.

Definition (*Management inclination*)**.** Management inclination reflects how much a company's leadership views IT as a strategic asset.

This varies based on factors like digital literacy, organizational culture, and company history. Historically, manufacturing companies have adopted IT earlier, while service industries experienced a lag of around ten years.

Drivers Several factors determine how IT intensive a company or industry can be:

1. *Structure of information processes*: the more structured and rule-based an activity is, the easier it is to automate using IT.
2. *Data volume*: the sheer amount of information that needs to be processed influences IT requirements.
3. *Operational frequency*: tasks that are repeated frequently benefit more from IT automation.
4. *Computational complexity*: simpler processes are easier to digitize and automate efficiently.

3.1.1 Manufacturing value chain

Porter's value chain concept highlights how IT supports various business activities to create competitive advantages.

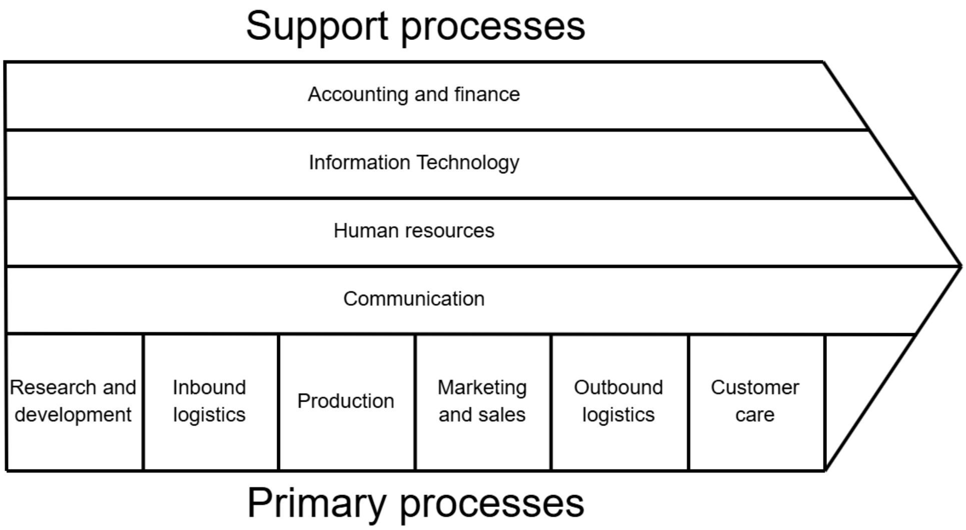


Figure 3.1: Porter value chain

Activity cycles Manufacturing involves continuous, iterative cycles that ensure efficiency and product quality. These cycles include:

1. *Development cycle*: focuses on designing and industrializing both products and production processes.

2. *Logistics cycle*: manages customer orders through:

   - *Procurement*: acquiring and handling materials, including reception, warehousing, and distribution to production plants.
   - *Production*: the physical transformation of raw materials into finished goods.
   - *Sales and distribution*: managing orders, external logistics, and post-sale services such as maintenance and customer support.

3.1.2 Inter-functional information processes

Inter-functional information processes play a key role in managing various aspects of production and operations within a company:

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.

These processes are interconnected across different products and divisions within the organization, making the information systems closely tied to the organizational structure. All production processes rely on the exchange of information across different functions. The use of inter-functional information extends beyond production and operations into planning and control processes. It also plays a vital role in administrative tasks.

3.1.3 Production

Companies may produce two types of goods:

- *Standard production*: products have a finite set of predetermined features that can be changed to accommodate customer preferences. In this case, companies produce according to a sales plan, before actual orders are received.
- *Custom production*: products are designed according to customer requirements and then produced on demand.

While custom and standard production represent opposite ends of the production spectrum, there is a continuum between the two. Custom production is often seen in complex products, while standard production is associated with simpler goods. IT supports all production types, although its functionalities vary depending on the degree of customization or standardization in the production process.

Product structure The product structure defines the hierarchical arrangement of components that make up a finished product. It ranges from individual components to larger product parts, outlining the relationships and dependencies between them.

3.1.4 Information taxonomy

Operational databases are organized to store various types of information that support the flow of activities within an organization. These can be categorized into three primary types:

- *Transaction information*: describes the flow of operational activities, focusing on exchanges between different organizational units and external parties. It is the largest in terms of volumes.
- *Operation information*: details the objectives and expected results of operational activities.
- *Catalog information*: basic, static knowledge that exists independently of the flow of production activities. It is quite complex and requires continuous updates and maintenance. This information plays a key role in organizational learning.

Operations planning information is a key link between the operational and the executive portfolios. Therefore, the level of detail of operational information is a driver of the efficiency of coordination inside an organization. Operational information has intrinsic value as an organizational asset. Its usefulness extends beyond internal operations, as it can sometimes be monetized or sold.

3.1.5 Information Technology integration

Initially, IT functionalities were developed independently for each organizational function, without a comprehensive view of processes. The focus was on automating existing activities rather than supporting or re-engineering them to improve performance. Each function operated with separate data, and objectives were often misaligned, resulting in inefficiencies.

The traditional approach involved information being created at the start of a cycle and used later. However, to truly optimize organizational performance, a more proactive approach is needed. This involves using information at the executive level and integrating the various functions within an organization to create a unified view that enhances decision-making and operations. There are two key approaches to IT integration:

- *Horizontal integration*: this refers to the integration of systems along the operating processes of an organization, specifically those that align with Porter's primary processes. This is done by the Computer Integrated Manufacturing (CIM), which is a system that supports the integration of manufacturing processes.
- *Vertical integration*: this focuses on connecting the operational portfolio with the executive portfolio. This is done by the Material Requirements Planning (MRP), which ensures materials are available for production at the right time, helping optimize the production process and minimize waste.

Computer Integrated Manufacturing CIM integrates various manufacturing processes. with the main objective of achieving an optimal scheduling and production resource management, which results in production efficiency. The main functionalities are: activities, workforce, plant, materials and quality management.

Materials Requirements Planning MRP is a production planning and inventory control system designed to manage manufacturing processes and ensure the availability of materials for production. It emerged in the 1970s and 1980s with the aim of achieving flexibility and economies of scale through optimal planning. This is achieved with concurrent engineering (design and produce in parallel) and inside-out production processes (streamline production processes). MRP helps organizations achieve greater effectiveness by allowing them to respond more quickly to market demands while simultaneously benefiting from scale economies.

3.2 Service company

In service industries, IT plays a dual role: it's both a tool for creating services and a channel for delivering them. Unlike in manufacturing, services are typically produced at the same time they are delivered to the customer.

3.2.1 Service value chain

The concept of the value chain, originally introduced by Porter, can also be applied to service businesses. However, in services, the boundaries between production and delivery are often blurred.

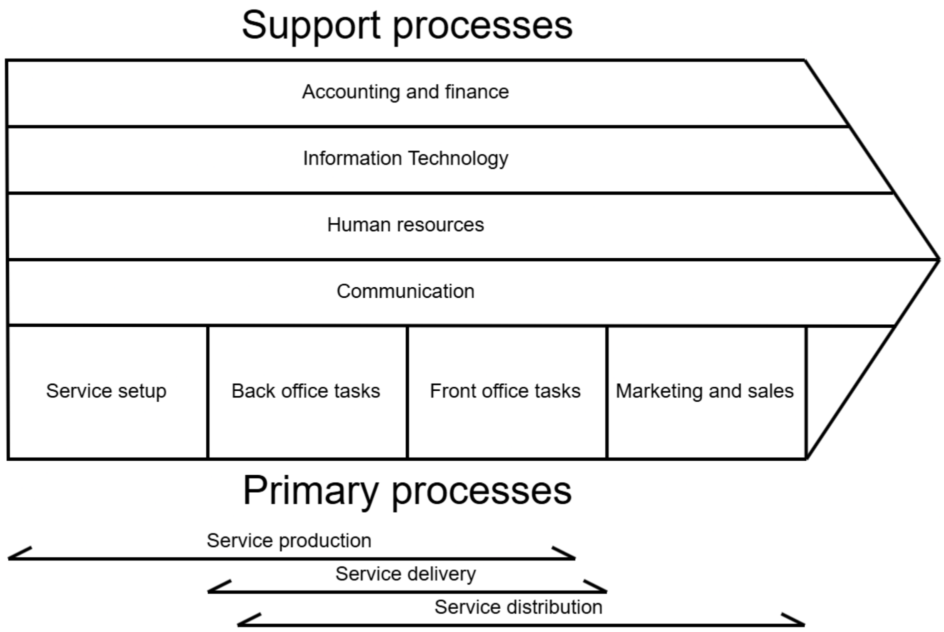


Figure 3.2: Service value chain

Definition (*Service set-up*)**.** Service set-up is the set of tasks required to prepare the company's production capacity.

Definition (*Back-office tasks*)**.** Back-office tasks are are production tasks carried out without the presence of the customer.

Definition (*Front-office tasks*)**.** Front-office tasks are tasks involve direct interaction with the customer and are also triggered by a specific customer request.

Definition (*Marketing and sales*)**.** Marketing and sales are activities focused on promoting the company's services, attracting potential clients, and closing service contracts with new customers.

3.2.2 Inter-functional information processes

Inter-functional information processes are essential for coordinating production and operations across different functions within a company. In service companies, two key processes stand out:

- *Order management*: this process handles all the information related to customer orders In service companies, order management plays a role similar to operations management in manufacturing firms.

- *Knowledge management*: this process deals with collecting and organizing new customer-related information acquired during service production and delivery. The goal is to transform this raw, often unstructured, data into structured knowledge that can be used to improve future services and enhance customer satisfaction. In the context of service companies, knowledge management effectively replaces traditional materials management.

Customizing services to individual customer needs is a key driver of customer satisfaction. To do this well, companies need detailed knowledge about each customer. This knowledge is typically gathered informally during interactions with customers. However, this information is often unstructured and difficult to act on directly. Knowledge management helps by converting these scattered insights into organized, actionable knowledge and linking them to specific service processes.

Knowledge management is not a one-time activity; it's a continuous learning cycle. As customer needs evolve and external environments change, companies must adapt their processes accordingly.

The knowledge management process involves three main stages:

1. Extracting customer knowledge from employees (often called knowledge workers) based on their direct service experiences.

2. Transforming that knowledge into structured, usable information, which is then stored in the company's systems.

3. Designing or updating procedures that use this information to enable greater service personalization and efficiency.

This process is far more complex than traditional planning systems like MRP, because it requires insight, interpretation, and innovation. That's why knowledge management is considered a hybrid of production planning and service innovation.

3.2.3 Information Technology integration

As in manufacturing, IT integration in service companies follows two main approaches:

- *Horizontal integration*: enabled by Personal Computers (PC).

- *Vertical integration*: enabled by client-server architectures.

Personal Computer PCs began to gain traction in the 1980s, marking a major shift in how work was done. Unlike manufacturing environments where robots automate production, service companies rely heavily on knowledge workers (individuals who create, process, and apply information to deliver services). PC aren't the equivalent of robots in service production. While robots automate tasks, studies on office work have shown that PCs serve more as support tools rather than automation technologies. This distinction sparked a wave of research into non-hierarchical, decentralized organizations, where individuals use PCs to make independent decisions and contribute more flexibly. PCs introduced: flexibility, variety and usability.

Client-server architectures Mainframes and data centers are powerful systems for managing and storing centralized data. But on their own, they don't empower individual users. Client-server architectures bridged this gap by connecting personal computers to centralized systems. This integration allowed knowledge workers not only to access shared data but also to communicate and collaborate across the organization. With client-server systems, information can flow between knowledge workers and higher management. The organization benefits from seamless, integrated management processes that support both autonomy and coordination.

3.2.4 Business Process Re-engineering

Definition (*Business Process Re-engineering*)**.** Business Process Re-engineering (BPR) refers to the transformational changes involved in integrating IT into service companies.

While it originated in manufacturing, by the 1990s it was clear that BPR had an even greater impact on the service sector. Several trends illustrate how BPR reshaped service delivery:

- *Increased delegation*: tasks were pushed downward in the organization, giving more responsibility and autonomy to frontline employees.
- *More complex sales roles*: sales staff evolved from simply selling services to guiding customers through service procedures.
- *Shift toward customer care*: he focus moved from one-time service sales to long-term customer relationships. This required storing detailed customer histories in centralized systems, enabling better support and personalization.

CHAPTER 4

Executive portfolio

4.1 Traditional control model

Anthony's Pyramid is a well-established framework for understanding how organizations manage control across different levels. It breaks down the process into three distinct types of control

1. *Strategic control*: setting and monitoring the organization's overall business objectives.
2. *Management control*: managing financial resources effectively.
3. *Operational control*: ensures daily operating activities are carried out efficiently and effectively.

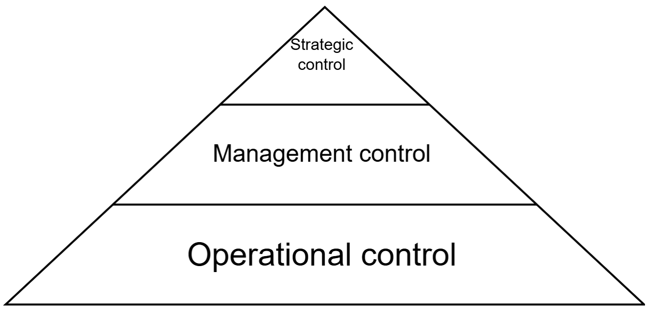


Figure 4.1: Anthony's pyramid

4.2 Executive information systems

Executive information systems are designed to provide senior leaders with the tools and insights they need to make informed, strategic decisions. These systems integrate data from various functional areas of an organization into a cohesive framework:

- *Financial performance*: monitor and optimize the financial health of the organization. Planning, budgeting and reporting with Activity Based Costing.

- *Process performance*: evaluate and enhance the efficiency of internal processes. Management dashboards with input-output process models
- *Clients and markets*: understand and engage with customers and markets effectively. Executive CRM with analytical CRM
- *Innovation and critical resources*: foster innovation and manage critical resources strategically. Strategic planning with strategic control (balanced scorecard).
- *Information to stakeholders*: communicate effectively with internal and external stakeholders. Communication through portals.

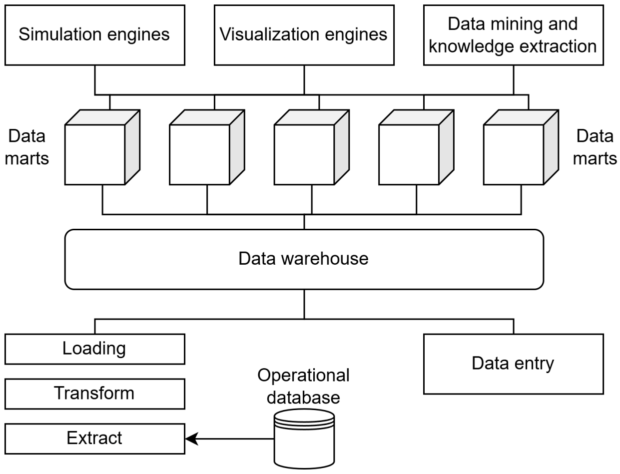


Figure 4.2: Executive information system

At the heart of an executive information systems are Key Performance Indicators (KPI): metrics that summarize the performance of specific activities or parameters. These indicators are defined by multiple dimensions, including: time, organizational unit, customer, product, process and activity, and other dimensions.

4.3 Design

The design of an executive information system involves a structured process to ensure that the system meets organizational needs and provides actionable insights for decision-makers. Below is a detailed breakdown of the key steps involved in designing an executive information system:

- *Define business requirements*: start by identifying the KPIs that align with the organization's strategic goals. These KPIs will serve as the foundation for the system, ensuring it provides relevant and meaningful insights to executives.
- *Identify information sources*: data required to populate the executive information system typically comes from various operational databases and systems. These data comes from ERP, CRM, operational information from legacy systems and customer, and administrative information.
- *Process the information*: once the data sources are identified, the next step is to process the data to ensure accuracy, consistency, and usability: selection, cleaning, integration, and aggregation.

- *Store the processed data*: efficient storage is crucial for maintaining performance and accessibility in warehouses and marts with a proper schema. Fact tables store the actual values of the KPIs, while key tables describe the dimensions that provide context to the facts.

- *Presentation and processing*: delivering insights to users through intuitive interfaces and advanced analytics tools.

4.3.1 Critical Success Factor

Critical Success Factor (CSF) refers to a business decision variable that is essential for the success of an organization. These factors serve as the backbone of the requirements analysis and specification process for designing an executive information system.

CSFs are high-level, abstract ideas that represent strategic priorities. Each CSF is not a single metric but rather a complex concept that corresponds to multiple KPIs. The steps needed for this approach are:

1. *Pre-definition*: conduct an initial analysis to identify potential CSFs based on industry standards, benchmarks, and existing documentation.

2. *Top managers interview*: engage in discussions with senior executives and decision-makers to pinpoint the CSFs most critical to the organization's success.

3. *Robustness analysis*: evaluate and select the appropriate KPIs that best represent each CSF. This involves assessing the relevance, reliability, and feasibility of potential KPIs. The KPis are chosen based on cost of information, significance, frequency and quantitatively.

4. *Refinement and documentation*: present the identified CSFs and KPIs to stakeholders for feedback and refinement. Finalize the documentation, ensuring it is clear, informal, and accessible to all relevant parties

CHAPTER 5

Enterprise Resource Planning

5.1 Introduction

Enterprise Resource Planning (ERP) systems have marked a transformative shift in the IT industry since the mid-1990s. This transformation is characterized by three key aspects:

1. It has become a global phenomenon.
2. It has shifted the focus from custom-built software solutions to packaged systems supported by consulting services.
3. It has unified and integrated three critical portfolios into a cohesive framework.

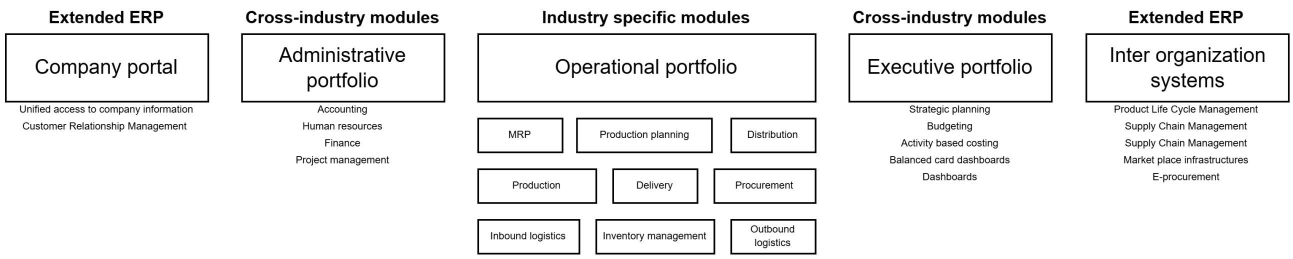


Figure 5.1: ERP architecture

A fundamental distinction exists between two types of ERP modules:

- *Core ERP*: these modules support internal processes within an organization. They encompass administrative functions, vertical operational tasks, and executive decision-making tools.
- *Extended ERP*: these modules facilitate interactions with external entities. They include Customer Relationship Management (CRM), Supply Chain Management (SCM), e-procurement platforms, and online marketplaces.

Principles ERP systems are built on three foundational principles:

1. *Information integration*: ERP systems aim to unify data across all levels of an organization. This includes vertical, horizontal and conceptual consistencies through a single, integrated data model that eliminates silos and promotes unified insights.

2. *Extension and modularity*: ERP systems are designed to be functionally comprehensive while offering flexibility through modular components:

   - *One-stop shopping*: a single supplier provides all modules, ensuring compatibility and streamlined implementation.
   - *Best-of-breed*: organizations can choose modules from multiple suppliers, allowing for tailored solutions but potentially increasing integration complexity.

3. *Process prescriptiveness*: ERP systems embed predefined process logic, which often necessitates organizational change. While this prescriptiveness offers advantages, it also presents challenges, including potential constraints on diversification and competitiveness.

No single ERP provider can deliver all functionalities required across every industry. Instead, niche players often specialize in offering industry-specific solutions tailored to unique business needs. This creates opportunities for system integration, allowing companies to combine software from multiple vendors to create a comprehensive and customized solution.

Small and medium-sized businesses typically opt for more flexible and cost-effective options, such as simplified ERP packages (often referred to as ERP Light), Software-as-a-Service (SaaS), or Cloud-based solutions.

5.2 Light ERP

Classic ERP systems are designed to cater to the complex needs of large enterprises. These solutions emphasize BPR to streamline and optimize workflows, ensuring alignment with organizational goals. They also provide industry-specific functionalities, often referred to as vertical solutions, tailored to meet the unique demands of sectors. System integration plays a critical role, allowing businesses to consolidate multiple software systems into a unified platform for seamless data flow. However, these systems come with high costs, not only in terms of licensing but also for customization and maintenance. Additionally, their implementation typically requires a significant time investment, often exceeding six months, due to the complexity and scale of deployment.

In contrast, small and medium-sized enterprises tend to adopt lighter, more cost-effective ERP solutions. These systems, often described as plug and play, are designed for quick and easy deployment without the need for extensive BPR. They focus on delivering simple administrative functionalities along with basic reporting tools for straightforward analytics. While these solutions are ideal for smaller businesses with limited budgets, they offer limited scalability.

5.3 Activity Based Costing

The complete integration of operational, executive, and administrative portfolios within an ERP system facilitates a real-time reconciliation of budgets, resource consumption, operational progress, and cash flows. This seamless integration is made possible through the implementation of Activity Based Costing (ABC).

ABC links operations directly to their associated costs, enabling organizations to better understand the financial impact of specific activities. By associating operations with an internal pricing system, businesses can allocate resources more effectively and gain deeper insights into cost drivers. This approach allows for a dual perspective on progress: it can be evaluated from both a project management standpoint and a financial standpoint, focusing on cost efficiency.

CHAPTER 6

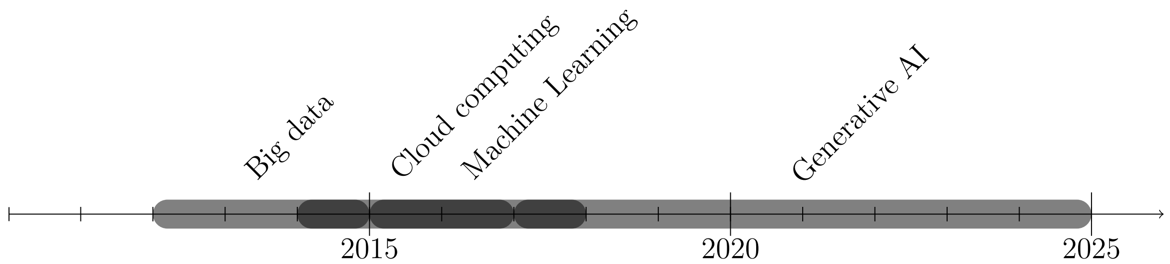
Customer Relationship Management

CHAPTER 7

Data analytics

7.1 Introduction

Data has become the foundation of decision-making, shaping industries and redefining business strategies. The journey of data-driven innovation can be divided into several key phases.



Big data Big data refers to the exponential growth of structured and unstructured data generated daily. It brought new challenges in storage, management, and analysis but also unlocked vast opportunities for business intelligence.

Machine Learning Machine Learning marked the next stage of data evolution, enabling computers to learn patterns and make decisions without explicit programming. Machine Learning applications expanded rapidly, offering predictive insights and automation capabilities.

Cloud Computing Cloud computing revolutionized data storage and processing by providing scalable, cost-effective solutions over the internet. Businesses gained access to flexible computing power, reducing infrastructure constraints.

Generative Artificial Intelligence Generative AI represents the latest frontier, where AI systems exhibit human-like understanding, learning, and application of knowledge across diverse domains. Its potential is reshaping industries and redefining human-technology interaction.

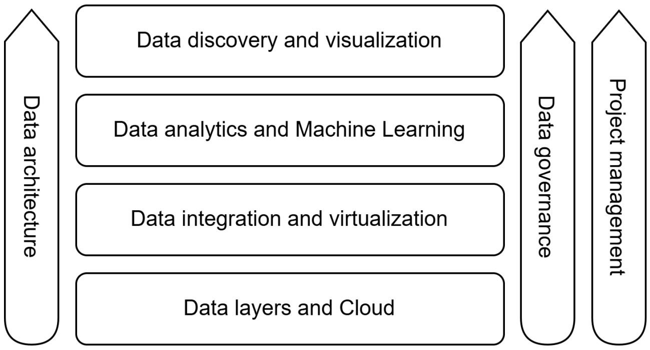


Figure 7.1: Data framework

The main jobs related with data are:

- *Data and Cloud architect*: data architects design comprehensive data infrastructures based on business objectives, ensuring seamless data integration and optimal storage solutions. Cloud Architects specialize in designing scalable, cloud-based architectures to support modern data needs.
- *Data engineer*: build and maintain the systems required for collecting, processing, and storing data. They design ETL pipelines, work with big data technologies, and ensure that raw data is transformed into a usable format.
- *Data analyst*: interpret and analyze data to provide actionable insights. They clean datasets, perform statistical analysis, and create visualizations to support business strategies and decision-making.
- *Data scientist*: data scientists develop machine learning models and apply advanced analytics to uncover patterns and predictions from complex datasets. They work with programming languages like Python and utilize AI-driven techniques for deeper insights.
- *Data privacy and security specialist*: ensure compliance with data protection regulations, while security officers implement safeguards to protect organizational data from cyber threats and breaches.

7.2 Project management

The main Key Performance Indictors (KPI) for a project are:

- *Revenue*: total income generated by the company from its consulting services before any expenses are deducted. It is a key indicator of overall sales performance and business growth. In a consulting firm, revenue typically comes from client contracts and project fees.
- *Earning before tax*: financial metric that measures a company's profitability before accounting for income tax expenses. Earning before tax reflects the profit generated from core operations and other activities, such as investments or interest income, before taxes are deducted.

- *Cost on revenues*: ratio of costs directly associated with generating revenue, expressed as a percentage of total revenue. This metric helps assess how much of the revenue is consumed by costs such as consultant salaries, software tools, and travel expenses. A high cost-to-revenue ratio may indicate inefficiencies in service delivery or pricing strategies.
- *Unallocation*: refers to staff who are not directly assigned to revenue-generating activities. Monitoring unallocated costs is crucial for identifying inefficiencies and ensuring that expenses are properly distributed across projects and services.

7.2.1 Project development

The two main approaches used in project development are waterfall and agile, each with its own strengths and limitations.

Waterfall The Waterfall model follows a sequential process, where each phase—analysis, design, development, testing, and implementation. Once a phase begins, changes to requirements are difficult to implement. This approach is best suited for projects with well-defined requirements from the start. In consulting, waterfall is ideal for projects with stable and predetermined requirements, particularly in industries where compliance, documentation, and structured processes are essential.

Advantages	
Clear requirements	A well-defined project scope ensures a structured development process
Predictability	Fixed timelines and structured phases make planning and resource allocation more manageable
Comprehensive documentation	Each phase includes detailed documentation, providing a thorough project record
Disadvantages	
Limited flexibility	Adapting to changes mid-project is challenging, making it less suitable for evolving requirements
Delayed feedback	Since testing happens at the end, user feedback may come too late, requiring costly revisions
Minimal client involvement	Limited collaboration during development can lead to misaligned expectations

Agile Agile follows an iterative and incremental approach, allowing for greater flexibility. Work is organized into sprints, each delivering a working product increment. Agile encourages continuous client collaboration and adapts easily to changing requirements. In consulting, agile is well-suited for projects where requirements may evolve, or when quick, tangible results are needed.

Advantages	
Adaptability	Changes can be accommodated at any stage, making Agile ideal for dynamic projects
Continuous feedback	Regular iterations ensure alignment with user needs and expectations
Client collaboration	Ongoing client involvement fosters a more interactive and responsive development process
Disadvantages	
Uncertain timeline	Iterative cycles can introduce unpredictability, making planning and resource management more complex
Minimal documentation	Agile prioritizes working software over documentation, which may be a drawback in highly regulated industries
Scope creep	Frequent changes and added features can lead to uncontrolled project expansion if not properly managed