Business Information Systems I

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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. The course will feature lectures and case study discussions to reinforce these concepts.

Contents

CHAPTER 1

Introduction

1.1 Definitions

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 system is a technology, an IT architecture is a techncial 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 1960s and 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. Key changes included:

- A radical shift in management principles, as technology was no longer just a tool for efficiency but a driver of decision-making and strategy.

- Unlike earlier views, IT wasn't just about automation (it processed information, the most critical resource for managerial processes). Since managerial processes shape decision, it processed information, the most critical resource for managerial processes.

- This shift created both virtuous and vicious cycles: 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's Decision Theory (1973-1977) 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. Information technology 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 manage uncertainty effectively, hierarchies rely on two main types of information systems: vertical and horizontal.

Vertical information systems Vertical 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 systems In contrast, horizontal (or lateral) 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 based on the divide et impera (divide and rule) approach, as seen in divisional structures.

However, the decision theory framework has its limitations. 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. Transaction cost economics seeks to address these shortcomings by providing a broader perspective on coordination and uncertainty management.

1.3 Transaction cost economics

Williamson (1975) introduced the concept of transaction cost economics, which examines the costs associated with coordinating economic exchanges. In its simplest form, 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.

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, where market frictions such as information asymmetry, bargaining difficulties, and enforcement issues are minimized.

Economic 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 agreements.
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 SLAs.
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.

1.3.1 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.

Market systems According to Williamson (1975), 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, such as in-house production, rather than relying on external suppliers. The decision between market-based transactions and hierarchical structures is primarily driven by cost considerations

1.3.2 Information technology role

Information technology (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.

1.3.3 Limitations

Viewing markets and hierarchies as mutually exclusive coordination mechanisms overlooks hybrid models. Traditional theories ignore behavioral uncertainty within organizations. Agency theory addresses these gaps by considering the complexities of decision-making and incentives within firms.

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.

The key concepts of agency theory are:

- 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 Hierarchical control

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 exert 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 clear-cut; instead, there is a spectrum of overlap between the two.

1.4.3 Limitations

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.

CHAPTER 2

Operational portfolio manufactoring

2.1 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.

2.1.1 Manufactoring companies

Manufacturing companies typically rely on three main functional portfolios within their ERP systems:

1. Administrative portfolio.
2. Operational portfolio.
3. Executive portfolio.

These portfolios, while initially developed separately, are now integrated within modern ERP systems, forming the core functionalities of these systems.

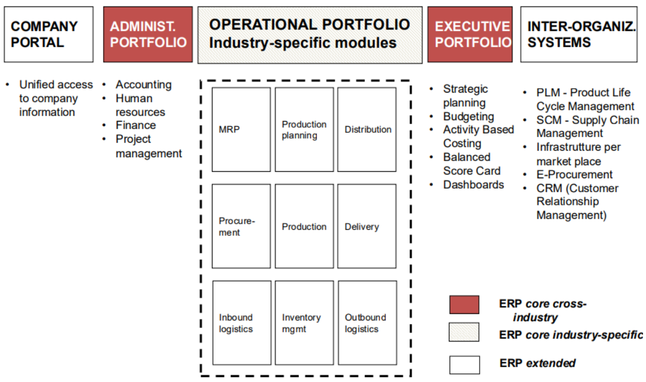


Figure 2.1: ERP functional architecture

2.1.2 Administrative portfolio

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, such as activity-based costing.

Despite its simplicity in design, the administrative portfolio can be functionally complex.

CHAPTER 3

Data and analytics in consulting

3.1 Introduction

Reply is a global network of over 150 specialized companies dedicated to helping organizations leverage cutting-edge technologies. Our mission is to drive innovation by enabling businesses to adapt to economic shifts and technological advancements, particularly those driven by the internet.

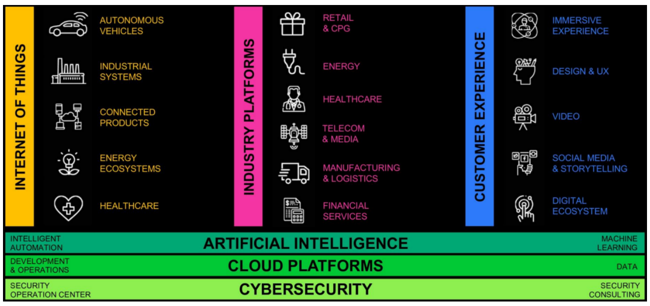
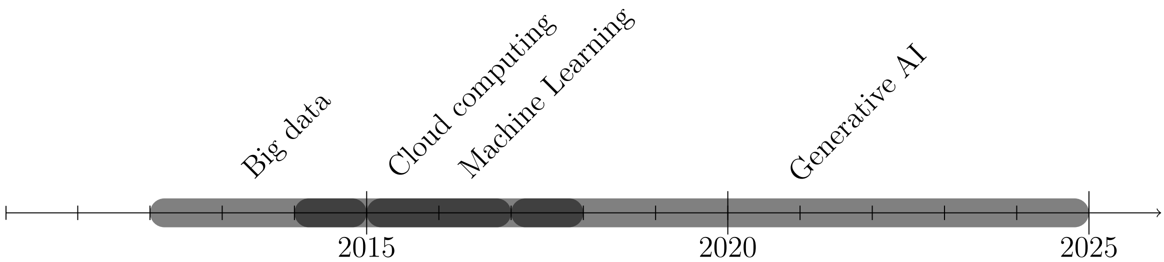


Figure 3.1: Reply services

Reply provides end-to-end solutions for businesses looking to transform raw data into valuable insights. From data collection to advanced analytics, our approach ensures that companies can harness the full potential of their data.

3.1.1 Data

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.

Technology	Hadoop, Hive, Impala, Cloudera
Key impact	Data-driven decision-making, process optimization, competitive advantage

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.

Technology	Neural Networks, Deep Learning, Reinforcement Learning, Clustering
Key impact	Advanced automation, improved predictions, enhanced decision-making

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.

Technology	AWS, Google Cloud Platform, Microsoft Azure
Key impact	Scalability, cost reduction, innovation acceleration

Generative Artificial Intteligence 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.

Technology	Large Language Models, synthetic data, Retrieval-Augmented Generation
Key impact	Creative automation, enhanced productivity, AI-driven decision making

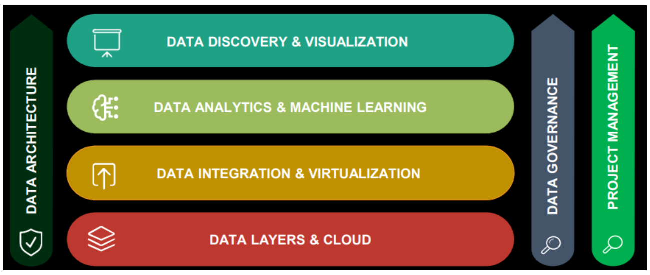


Figure 3.2: Data framework

3.1.2 Data job roles

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 Data engineers 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 Data analysts 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 Data privacy officers ensure compliance with data protection regulations (e.g., GDPR), while security officers implement safeguards to protect organizational data from cyber threats and breaches.