IT4350 - INFORMATION SYSTEMS ARCHITECTURE AND APPLICATIONS

LECTURE 1 - INTRODUCTION TO INFORMATION SYSTEMS

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KEY TERMS

We begin with definition of some basic concepts

- Information Technology
- Business Process
- Information Systems
- Organization
- Integration
- Enterprise Systems (ES)
- IS/ES architecture

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INFORMATION TECHNOLOGY

Computers (maybe…): hardware and software

Resources: computer hardware, software, networks, databases

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BUSINESS PROCESS

A specific ordering of work activities across time and place, with a beginning, an end, and clearly identified inputs and outputs.

Davenport, 1993

A way of work is organized, coordinated, and focused to produce a valuable product or service

Concrete workflows of material, information, and knowledge - sets of activities

Sequence, purpose, interaction

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BUSINESS PROCESS EXAMPLES

- Manufacturing and production: Assembling product, checking quality, producing bills of materials
- Sales and marketing: Identifying customers, creating customer awareness, selling
- Finance and accounting: Paying creditors, creating financial statements, managing cash accounts
- Human Resources: Hiring employees, evaluating performance, enrolling employees in benefits plans

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BUSINESS PROCESS EXAMPLES

Cross-Functional Business Processes

Transcend boundary between sales, marketing, manufacturing, and research and development

Group employees from different functional specialties to a complete piece of work

Example: Order Fulfillment Process

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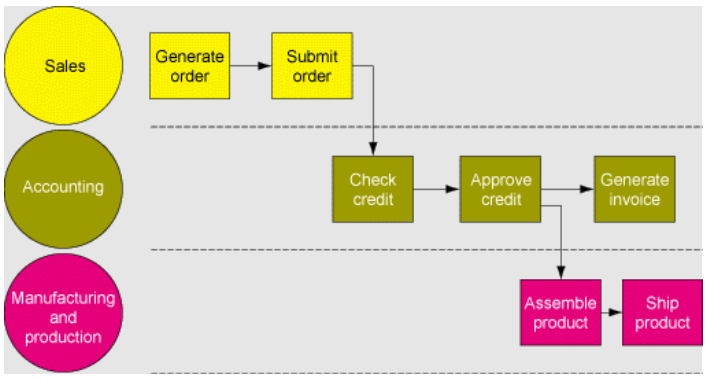
BUSINESS PROCESS EXAMPLES

The Order Fulfillment Process



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INFORMATION SYSTEM

An **information system** is a unique **configuration** of **IT resources** and **organizational processes** whereby the IT resources (and the information they provide) are applied to **support** specific organizational processes.

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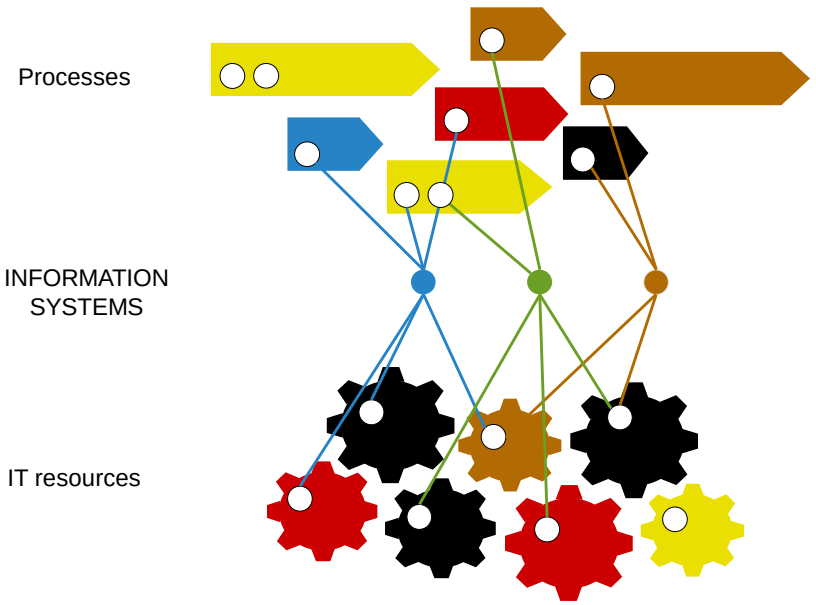

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ORGANIZATION

People

Process

Structure

- coordination and control mechanisms

Organization and environment

- stakeholders, competitors, other influences

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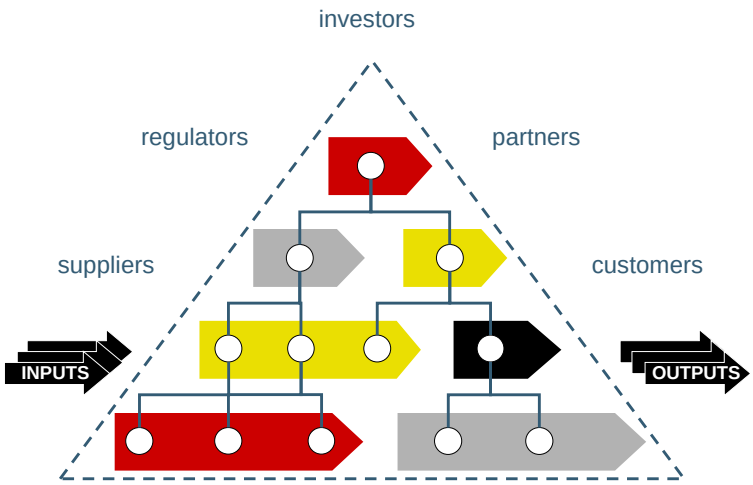
ORGANIZATION & ENVIRONMENT



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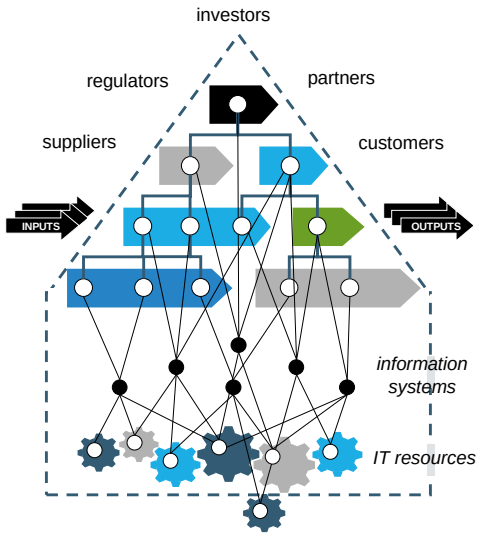
INFORMATION SYSTEMS IN ORGANIZATIONS



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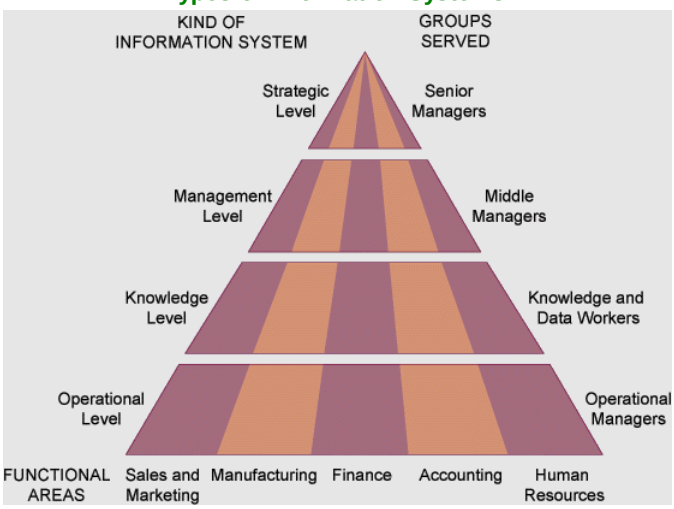
KEY SYSTEM APPLICATIONS IN THE ORGANIZATION

Types of Information Systems



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MAJOR TYPES OF SYSTEMS IN ORGANIZATIONS

- Executive Support Systems (ESS)
- Decision Support Systems (DSS)
- Management Information Systems (MIS)
- Office Systems
- Transaction Processing Systems (TPS)

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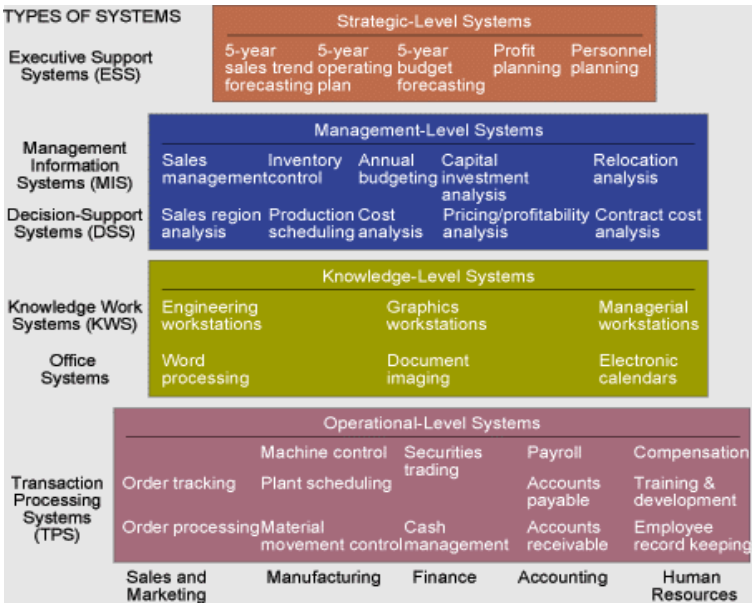
MAJOR TYPES OF SYSTEMS IN ORGANIZATIONS



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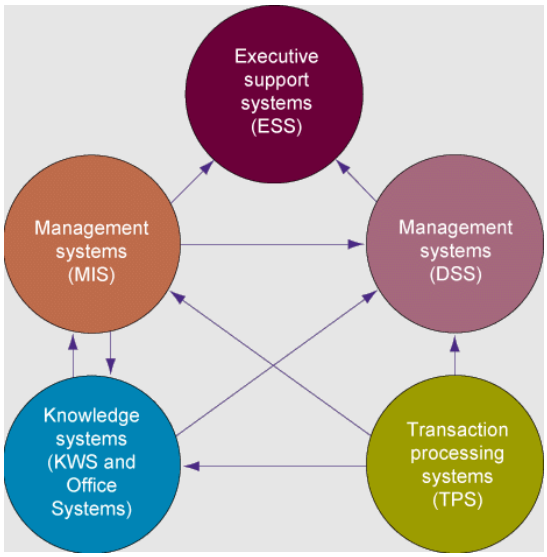
INTERRELATIONSHIPS AMONG SYSTEMS



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Traditional View of the Systems

Within the business: there are functions, each having its uses of information systems

Outside the organization's boundaries: There are customers and vendors

Functions tend to work in isolation

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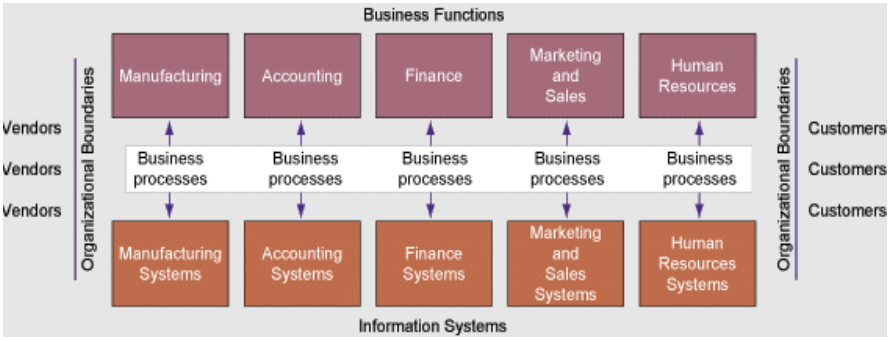
Traditional View of the Systems



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INTEGRATION

Making whole or complete

Overcoming isolation of information systems

Enterprise resource planning (ERP) systems

Enterprise systems

- Technical and organizational solution

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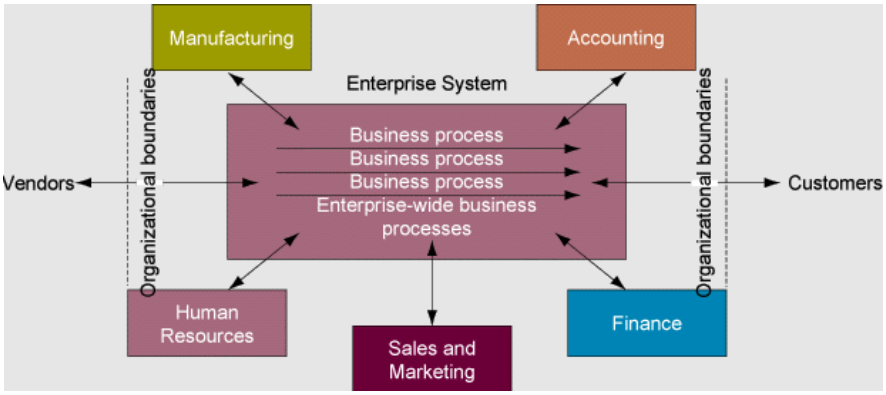
ENTERPRISE SYSTEMS



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ENTERPRISE SYSTEMS

Enterprise systems (ES) are large-scale application software packages that support business processes, information flows, reporting, and data analytics in complex organizations.

ES are generally packaged enterprise application software (PEAS) systems they can also be bespoke, custom developed systems created to support a specific organization's needs

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ENTERPRISE SYSTEMS

Examples are:

- Supply chain management systems
- Customer relationship management systems
- ERP

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EXAMPLE : ENTERPRISE RESOURCE PLANNING (ERP) SYSTEMS

- Enterprise Resource Planning Systems are the first generation of enterprise systems meant to integrate data and support all the major functions of organizations.
- ERP systems integrate various functional aspects of the organization as well as systems within the organization of its partners and suppliers.
- The goal of an ERP system is to make the information flow dynamic and immediate, therefore, increasing its usefulness and value.

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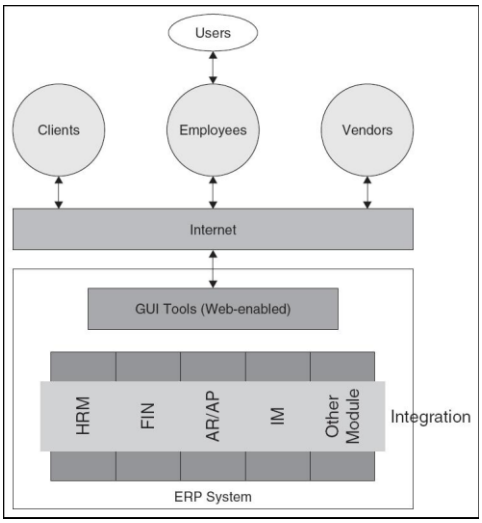
INTEGRATED SYSTEMS - ERP



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ENTERPRISE RESOURCE PLANNING (ERP) SYSTEMS (CONT'D)

- Another goal of ERP is to integrate departments and functions across an organization into a single infrastructure that serves the needs of each department.
- ERP systems replace an assortment of systems that typically existed in organizations. (Accounting, HR, Materials Planning, Transaction Processing, etc.).
- ERP solves the critical problem of integrating information from different sources and makes it available in real-time.

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EVOLUTION OF ERP

Timeline	System	Platform
1960s	Inventory Management & Control	Mainframe legacy systems using third generation software-(Cobol, Fortran)
1970s	Materials Requirements Planning (MRP)	Mainframe legacy systems using third generation software-(Cobol, Fortran)
1980s	Materials Requirements Planning (MRP-II)	Mainframe legacy systems using fourth generation database software and manufacturing applications.
1990s	Enterprise Resource Planning	Mainframe client-server systems using fourth generation database software and package software.
2000s	Extended ERP or ERP-II	Client-server systems using Web platform, open source with integration to fifth generation applications like SCM, CRM, SFA.

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BUSINESS PROCESSES AND ERP

- A crucial role of ERP in business is to better position the organization to change its business processes.
- ERP software have hundreds of business processes built into the logic of the system which may or may not agree with current processes of an organization.
- When implementing an ERP system, organizations have two choices:
  - Change business processes to match the software functionality.
  - Modify the ERP software to match the business processes.

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ERP SYSTEMS COMPONENTS

An ERP system consists of:

Hardware	Servers and peripherals
Software	Operating systems and database
Information	Organizational data from internal and external sources
Process	Business processes, procedures, and policies
People	End users and IT staff

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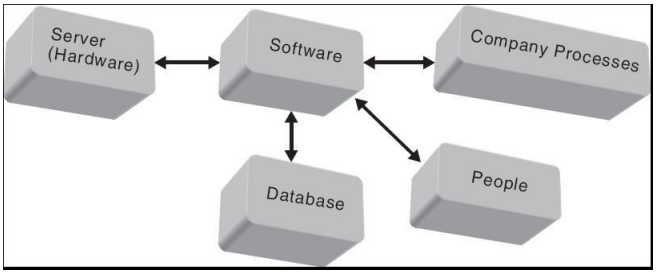
ERP COMPONENTS



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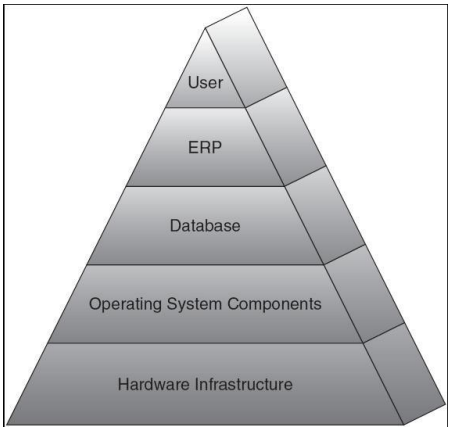
ERP COMPONENTS INTEGRATION



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ERP ARCHITECTURE

The architecture of an ERP system influences the cost, maintenance, and the use of the system.

A flexible architecture is best – it allows for scalability as needs change and grow.

A system's architecture is a blueprint of the actual ERP system and helps the implementation team build the ERP system.

If purchased, ERP architecture is often driven by the vendor, but other IT architectures are driven by organizational strategy and business processes.

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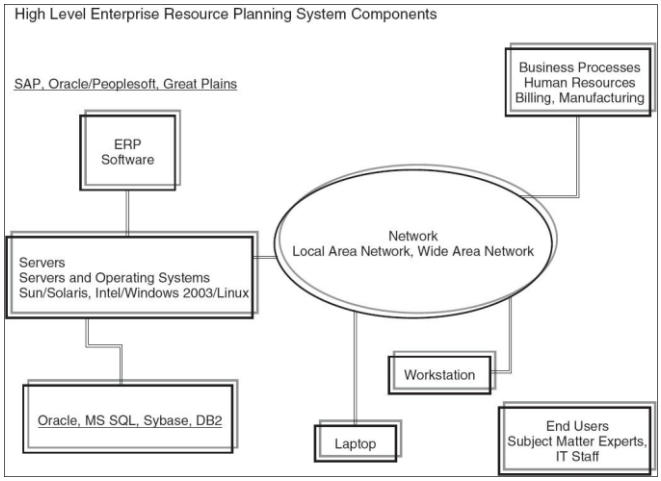
EXAMPLE OF ARCHITECTURE OF ERP AT LARGE UNIVERSITY



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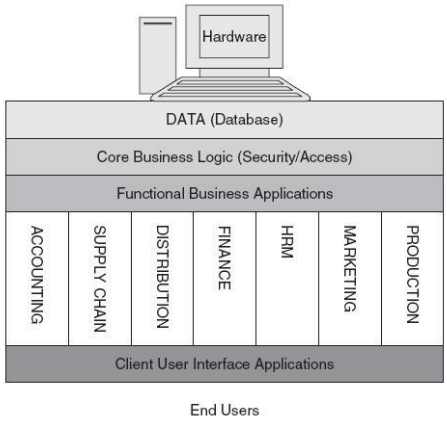
LOGICAL ARCHITECTURE OF AN ERP SYSTEM



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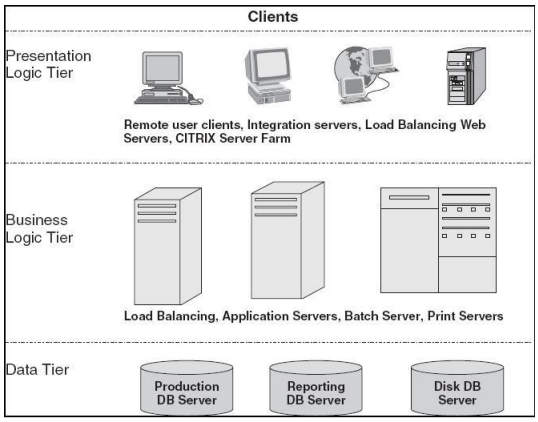
TIERED ARCHITECTURE EXAMPLE OF ERP SYSTEM



CHARACTERISTICS OF ENTERPRISE SYSTEMS

They are some of the most complex systems in use today

They are typically:

- N-tier systems made up of clients, an application layer, and a data layer
- Many are now employing a service-oriented architecture
  - SaaS, PaaS, SOA, Web services

WHY ENTERPRISE SYSTEMS

IT departments in every organization continue to be challenged on too many fronts:

- Cost pressures
- Data growth
- Security and privacy breaches

In this environment, transforming the management of critical information and processes is vital to generating new business value, delivering new client services and capturing new markets.

To deliver this transformation, forward-thinking businesses rely on **ENTERPRISE SYSTEMS**

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BENEFITS OF ENTERPRISE SYSTEMS

Firm structure and organization: One organization

Management: Firm-wide knowledge-based management processes

Technology: Unified platform

Business: More efficient operations and customer-driven business processes

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CHALLENGES OF ENTERPRISE SYSTEMS

Difficult to build: Require fundamental changes in the way the business operates

Technology: Require complex pieces of software and large investments of time, money, and expertise

Centralized organizational coordination and decision making: Not the best way for the firms to operate

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WHAT IS ENTERPRISE ARCHITECTURE?

- **Enterprise architecture** (EA) can be defined as a collection of special documents (artifacts) describing various aspects of an organization from an integrated business and IT perspective intended to bridge the communication gap between business and IT stakeholders, facilitate information systems planning and thereby improve business and IT alignment
- Enterprise architecture typically describes business, applications, data, infrastructure and sometimes other domains relevant from the perspective of business and IT, e.g. integration or security

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THE ESSENCE OF ENTERPRISE ARCHITECTURE

- Enterprise architecture provides effective instruments facilitating communication, collaboration and mutual understanding between different groups of actors
- Using EA documents for supporting discussions helps alleviate communication problems resulting from disparate knowledge, interests and goals of various involved actors
- Essentially, enterprise architecture can be considered as a *communication medium* between diverse business and IT stakeholders in organizations

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EA DOCUMENTS AND ORGANIZATIONAL ACTORS

- To business executives EA documents explain the implications of planning decisions for the business strategy
- To IT executives EA documents explain the implications of planning decisions for the IT strategy
- To business unit managers EA documents explain the impact of planning decisions on their business processes
- To IT project teams EA documents explain the implications of planning decisions for specific IT projects
- To third parties EA documents explain the implications of planning decisions for the structure of specific contracts

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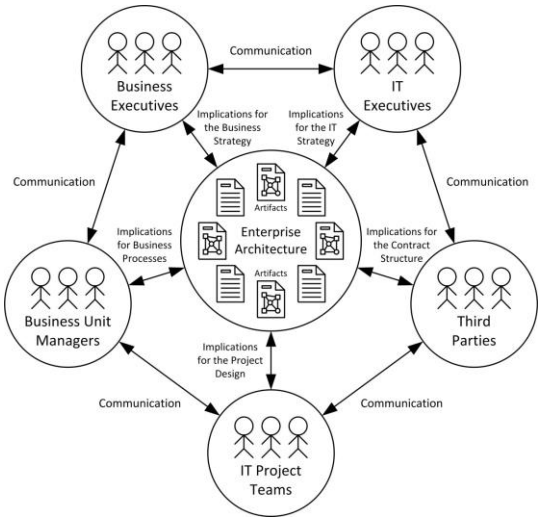
EA AS AN INSTRUMENT FOR COMMUNICATION



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SPECIFICS OF ENTERPRISE ARCHITECTURE

- Enterprise architecture has not much in common with building architecture
- Organizations as dynamic socio-technical systems cannot be designed or engineered and then built
- Organizations are extremely complex, organic and living entities that gradually evolve over time
- Enterprise architecture is a pragmatic set of descriptions useful for managing the evolution of organizations
- The term “enterprise architecture” is purely metaphorical and is only an umbrella term for multiple diverse documents used for information systems planning

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DOMAINS OF ENTERPRISE ARCHITECTURE

- The informational contents of enterprise architecture typically encompass the following common **EA domains**:
  - **Business domain** – covers customers, capabilities, processes, roles, etc.
  - **Applications domain** – covers programs, systems, custom software, vendor products, etc.
  - **Data domain** – covers data entities, structures, sources, etc.
  - **Integration domain** – covers interfaces, connections, interaction protocols, integration platforms, etc.
  - **Infrastructure domain** – covers hardware, servers, operating systems, networks, etc.
  - **Security domain** – covers firewalls, authentication mechanisms, identity and access management systems, encryption, etc.

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EA DOMAINS AS A STACK

- The set of common EA domains can be represented as a multilayered stack of domains, where lower layers underpin higher layers:
  - Applications automate business processes
  - Data is used by applications
  - Integration mechanisms link all applications and data together
  - Infrastructure hosts all applications, databases and integration platforms
  - Security mechanisms permeate all other EA domains
- The business domain is non-technical in nature, while all other EA domains are **technical domains** directly related to respective technologies

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ENABLING AND SUPPORTING EA DOMAINS

- All EA domains can be also separated into business-enabling domains and business-supporting domains

- **Business-enabling EA domains** occupy the top layers of the stack and represent functional domains
- These domains are relevant to business stakeholders and define the core business functionality of IT systems

- **Business-supporting EA domains** occupy the bottom layers of the stack and represent non-functional domains
- These domains are irrelevant to business stakeholders and unrelated to business functionality of IT systems

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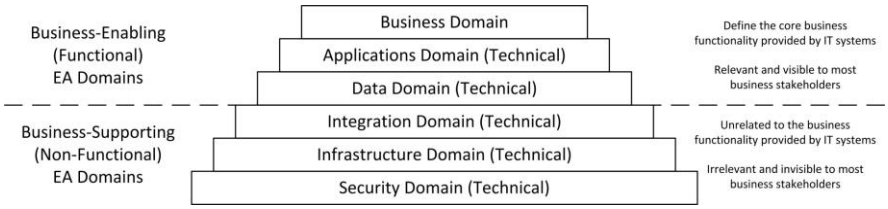
THE STACK OF EA DOMAINS



Generally, enterprise architecture can describe any domains considered as important from the perspective of the relationship between business and IT

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ENTERPRISE ARCHITECTURE ARTIFACTS

- Separate documents constituting enterprise architecture are typically called as **EA artifacts**
- EA artifacts provide descriptions of an organization from different perspectives important for the various actors involved in strategic decision-making and implementation of IT systems
- An EA practice implies using specific sets of EA artifacts for improving communication between different actors
- EA artifacts can be very diverse and differ in their informational contents, general meanings and lifecycles

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INFORMATIONAL CONTENTS OF EA ARTIFACTS

- From the perspective of their informational contents, various EA artifacts can have different:
  - Representation formats - textual, graphical and tabular formats or a mix of these formats
  - Levels of detail - range in their granularity from very high-level abstractions to low-level details
  - Organizational scopes - range from entire organizations and lines of business to separate change initiatives and IT projects
  - EA domains - business, applications, data, integration, infrastructure and security domains as well as their combinations
  - Temporal states - current state (now), short-term future state (<1 year), mid-term future state (2-3 years), long-term future state (3-5 years), stateless and their combinations

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TWO MEANINGS OF EA ARTIFACTS

- From the perspective of their general meaning in an EA practice all EA artifacts can be separated into decisions EA artifacts and facts EA artifacts
- **Decisions EA artifacts** represent made planning decisions, i.e. achieved and formalized agreements between various stakeholders regarding the desired future course of action
- **Facts EA artifacts** represent documented objective facts, i.e. reflections of the actual current situation in an organization as it is

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DECISIONS EA ARTIFACTS

- Decisions EA artifacts may represent these decisions:
  - How an organization needs to work from the IT perspective
  - Where an organization should invest its IT dollars
  - How a particular IT solution should be implemented
- They always have certain implications for the future
- These EA artifacts are always developed or updated collaboratively by all relevant stakeholders
- After decisions EA artifacts are created and approved, all stakeholders should act according to these decisions
- All EA artifacts describing the future, and all stateless EA artifacts, can be considered as decisions EA artifacts

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FACTS EA ARTIFACTS

- Facts EA artifacts may document these facts:
  - What technologies the organizational IT landscape uses
  - What IT assets an organization possesses, runs and maintains
  - How the existing IT systems and databases are interconnected
- They have no implications for the future
- These EA artifacts may be developed or updated solely by specific actors
- After facts EA artifacts are created, they can be used by any actors as reference materials for planning purposes
- All EA artifacts describing only the current state can be considered as facts EA artifacts

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TWO LIFECYCLES OF EA ARTIFACTS

- From the perspective of their lifecycles in an EA practice all EA artifacts can be separated into permanent EA artifacts and temporary EA artifacts
- **Permanent EA artifacts** are long-lived EA artifacts often existing for many years
- **Temporary EA artifacts** are short-lived EA artifacts often existing for several months or even weeks

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PERMANENT EA ARTIFACTS

- Permanent EA artifacts live and evolve together with an organization
- They are created once and then updated when necessary according to the ongoing changes in an organization and its business environment
- After being developed these EA artifacts are constantly used, continuously maintained and occasionally discarded when become irrelevant
- Most EA artifacts covering wider scopes beyond specific IT initiatives or projects tend to be permanent EA artifacts

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TEMPORARY EA ARTIFACTS

- Temporary EA artifacts are transitory, single-purposed and disposable
- They are created at specific moments for particular purposes, used as intended and then immediately discarded or archived
- Due to their short lifespan, the very need to update or maintain temporary EA artifacts is usually absent
- All EA artifacts covering narrow scopes (e.g. separate IT initiatives or projects) tend to be temporary

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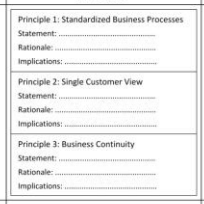
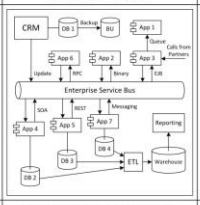
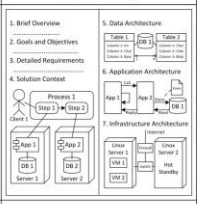
EXAMPLES OF EA ARTIFACTS

EA Artifact	Principles	Landscape Diagram	Solution Design
Example			
Description	General imperatives defining how the whole organization needs to work, updated on a yearly basis	A snapshot of the current IT landscape in a specific business function, maintained up-to-date	A detailed technical description of a specific IT project which is going to be implemented shortly
Analysis of EA Artifacts			
Format	Textual	Graphical	Textual and graphical
Detail	Very low level of detail	Low level of detail	High level of detail
Scope	Entire organization	Business function	Separate IT project
Domains	Business	Applications, data and integration	Business, applications, data and infrastructure
State	Stateless (no specific time focus)	Current state	Short-term future state
Dual	Yes	No	Yes
Meaning	Decisions	Facts	Decisions
Lifecycle	Permanent	Permanent	Temporary

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THE ROLE OF ARCHITECTS IN AN EA PRACTICE

- The key actors of an EA practice are **architects**
- Architects act as chief IT planners in organizations
- Ideal architects are effective communicators, team players, innovators and systems thinkers knowledgeable in both business and IT
- Architects are “T-shaped” professionals in connecting business and IT, i.e. specialists in finding optimal IT strategies and solutions satisfying business strategies and needs

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GENERAL RESPONSIBILITIES OF ARCHITECTS

- Communicating with various business and IT stakeholders and understanding their concerns
- Facilitating the dialog and conversation between different stakeholders
- Finding, proposing and discussing optimal planning decisions satisfying the concerns of stakeholders
- Developing and updating EA artifacts for supporting discussions and documenting the achieved agreements
- Establishing and maintaining a repository of EA artifacts
- Establishing, running and optimizing EA-related processes

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ARCHITECTS AS DEVELOPERS OF EA ARTIFACTS

- Architects are the key developers of all EA artifacts
- Architects are responsible for involving relevant stakeholders, collecting necessary data and completing all other activities required to develop EA artifacts
- However, the typical process of developing and updating EA artifacts differs significantly for decisions EA artifacts and facts EA artifacts

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DEVELOPING DECISIONS EA ARTIFACTS

- The development and update of decisions EA artifacts is a complex, creative and tricky process
- Decisions EA artifacts are always developed collaboratively by architects and their stakeholders
- Essentially, the collaborative development of decisions EA artifacts is the actual process of IT planning
- Even though architects usually act as facilitators or drivers of their development, fundamentally decisions EA artifacts are products of a collective teamwork
- Decisions EA artifacts are normally created in a proactive manner

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DEVELOPING FACTS EA ARTIFACTS

- The development and update of facts EA artifacts is a more simple, routine and straightforward process
- Unlike decisions EA artifacts, facts EA artifacts may be developed by individual architects alone or with only a minimal involvement of other actors
- Facts EA artifacts are often created in a reactive manner on an as-necessary basis

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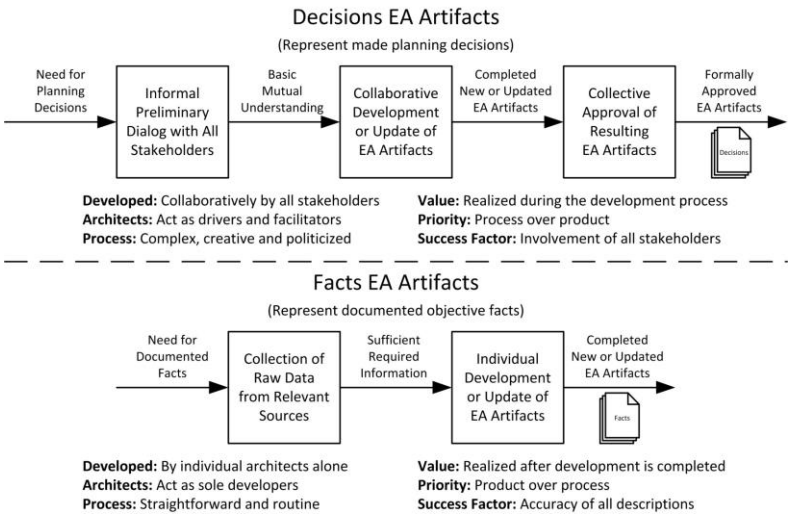
PROCESSES FOR DEVELOPING EA ARTIFACTS



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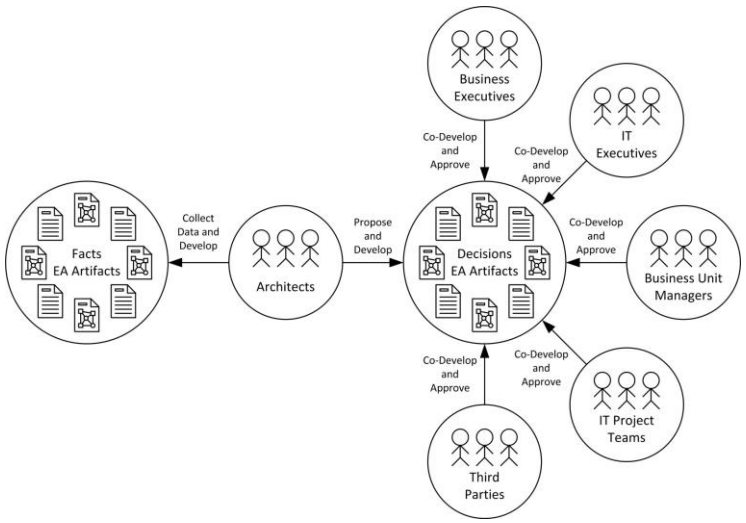
EA ARTIFACTS, ARCHITECTS AND OTHER ACTORS



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