Lecture 1: Managing Organization:

- **Organization:**
  - social unit of people.
  - humans end to create, develop, and manage organization.
  - organizations influence the way the individuals contribute to its goals and vice versa.
  - an open system (affects the environment and affected by it).
  - individuals in organizations established systems, sub-systems, and processes.

- **Evolutions of organizations:**
  - In classic environment: economical consideration provided the organizations to adopt mass production strategies in order to maximize returns.
  - In post-modern era: organizations deal with more uncertain market, high entry barriers for production and services offered by organizations.

- **Managing life cycles in organizations:**

<table>
<thead>
<tr>
<th>Stage of life cycle</th>
<th>Organizational issues</th>
<th>Information imperatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inception</td>
<td>understanding the market.</td>
<td>market information, knowledge acquisition on product, processes, competition and uncertainty.</td>
</tr>
<tr>
<td></td>
<td>Providing structure.</td>
<td>establishment of standard operating procedures, performance measurements.</td>
</tr>
<tr>
<td>Growth</td>
<td>resource management, control over cost, margin and market share.</td>
<td>enterprise resource planning, decision modeling.</td>
</tr>
<tr>
<td>Maturity</td>
<td>formalizing of standard operating procedures, deliverables and benchmarking performance.</td>
<td>information management through coordination, collaboration; formalized information flow, lean structures and processes.</td>
</tr>
<tr>
<td>Decline</td>
<td>market behavior, adaptation to internal and external pressure, liability of complacency.</td>
<td>information on innovation, new markets, products and processes, business process re-engineering.</td>
</tr>
</tbody>
</table>

- **Product life cycles stages:**
  - Development
  - Introduction
  - Growth
  - Maturity
  - Decline

- **Organization layers:**

**Strategic layer**
- it focuses on planning and providing a roadmap for the organization.
- it includes tasks related to new processes, products and services through collaborative effort of all stakeholders.
- it also includes tasks related to taking up correct measures in the entire organizational life cycle.
- the role of strategic managers is to provide solutions to critical problems, continuously working for mitigating external pressures arising out of competition and technology changes.

**Tactical layer**
- it focuses on the enterprise level performance.
- it manages changes in the entire business that is driven by enterprise wide strategy.
- some of the systems oriented tools like enterprise resource planning (ERP), decision support support systems and business intelligence(BI) are chosen by this layers for continuous engagement with the environment and providing the right support to the strategic layer.

**Operational layer**
- it refers to actual implementations of strategies through predetermined processes.
- this layer takes care of repetitive transactions with utmost precision at all times.
- this layer also continuously support the knowledge repository and information warehouse through the established interface mechanisms across process, systems and structures in the organization.
- includes a critical mass of human resource that needs motivation to adapt to the changes due to technology induction, process improvement and portfolio management.
End-user of IT and Decision Making Process:
(سؤال رسم)

✓ Types of Decision Making:
(تعداد)
- Unstructured: are those in which the decision maker must provide judgment, evaluation, and insights into the problem.
- Semi-structured: those in which only part of the problem has a clear-cut answer provided by an accepted procedure.
- Structured: repetitive and routine, and decision makers can follow a definite procedure for handling them to be efficient.

Organization and Systems linkage:
- general system theory describes organization as a system.
- System: an association of some components which work together to meet the system’s objectives.
- technology perspective specially IT have direct relationship with organization perspectives and systems.

Managing organizational decisions & controls:
- effective management is dependent on organization’s set goals, established control and decision support structures at all levels in the organization.
- role of information management is quite critical.
- routine decision is more formal, preventive and predictive.
- ERP and BI tools are used to make decisions.

Styles of decision making:
(مقارنة)

<table>
<thead>
<tr>
<th>Reactive</th>
<th>decision-making style is the only style that is strategic.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>collaborative resolutions.</td>
</tr>
<tr>
<td></td>
<td>explicit and tacit knowledge based problem solving tools.</td>
</tr>
</tbody>
</table>

Preventive
- decision making process needs dynamic inputs from information management principles designed for the purpose.
- intelligence gathering through information retrieval techniques and searches for best practices.
- designed parametric evaluation mechanisms through benchmarking, structured approaches to problems.
- preparing choices and alternatives with explicit and tacit knowledge.

Proactive
- decision making process is based on probabilistic decision model and domain specific explicit knowledge.
- needs dynamic inputs.
- based on probabilistic decision model and domain specific explicit knowledge.
- intelligence gathering through information retrieval and searches for practices.
- infusing system thinking.
Lecture 2: Enterprise Architecture:

- **Enterprise**: organization or sub-activity whose boundary is defined by commonly held goals, processes, and resources.
- **Architect(person)**: is a high-level role responsible for the overall work effort of creating the architecture and design of the system such as enterprise architect and application architect.
- **Architecture**: structured framework for the analysis, planning, and development of all resources in that entity.
- **Architecture description**: defines the components that make up the overall information system.
- **Enterprise Architecture(EA)**: the analysis and documentation of an enterprise in its current and future states from an integrated strategy, business, and technology perspective.

- What is the purpose of EA? to create a map of IT assets and business processes.
- Enterprise Architecture Context:
  - The enterprise view: relationship between:

- Communicating about architecture: to bridge the ‘communication gap’ between architects and stakeholders.

> Most frameworks contain four basic domains:
1. **Business architecture**: documentation that outlines the company’s most important business processes.
2. **Information architecture**: identifies where important blocks of information, such as customer record, are kept and how one typically accesses them.
3. **Solution/Application system architecture**: map between relationships of SW applications.
4. **Infrastructure technology architecture**: blueprint for the gamut of HW, storage system, and networks.

- Enterprise in EA characteristics:
  ✓ consists of people, information, and technologies.
  ✓ performs business functions.
  ✓ defined organizational structure that is distributed in multiple locations.
  ✓ responds to internal and external events.
  ✓ has a purpose for its activities.
  ✓ provides specific services and products to its customers.

- Organizational contexts of EA:
  - few organizations create their own technologies; rather than importing them.
  - environment is the source of the inputs to be processed by the organization, just as it’s the “sink” to which all outputs are delivered.

Why do I need an EA?
1. primary reason: to get an overview(map) of processes.
2. to provide a strategic context.
3. to achieve competitive advantages.
Why is IT critical? (سؤال مقالي)
- because business required to support a service economy rely deeply on having real-time market.
- additionally consumers want to check product offerings, status... in real-time and literally from anywhere.

• The enterprise Architecture Approach: (الترتيب مهم)

<table>
<thead>
<tr>
<th>Governance</th>
<th>Methodology</th>
<th>Framework</th>
<th>Artifacts</th>
<th>Standards</th>
<th>Best practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st core element</td>
<td>2nd core element</td>
<td>3rd core element</td>
<td>4th core element</td>
<td>5th core element</td>
<td>6th core element</td>
</tr>
<tr>
<td>identifies the planning, decision making, and oversight processes.</td>
<td>specific steps to establish and maintain an EA program.</td>
<td>the scope of overall architecture, the type, and relationship.</td>
<td>identifies the types of methods of documentation.</td>
<td>identifies business &amp; technology standard for enterprise in each domain.</td>
<td>proven ways to implement parts of the overall/sub-architectures.</td>
</tr>
</tbody>
</table>

• EA: ongoing management program that provide a strategic, integrated approach to capability and resource planning/decision-making.
- EA is a part of an overall governance process.
- EA can help identify gaps in the performance of line of business.
- **EA provides:**

<table>
<thead>
<tr>
<th>Strategic alignment</th>
<th>Standardized policy</th>
<th>Decision support</th>
<th>Resource oversight</th>
</tr>
</thead>
<tbody>
<tr>
<td>connects goals.</td>
<td>resources governance and implementation.</td>
<td>financial control &amp; configuration management.</td>
<td>lifecycle approach to development/management.</td>
</tr>
<tr>
<td>connects activities.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>contacts resources.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EA provides support for IT resource decision-making at the:

<table>
<thead>
<tr>
<th>executive level</th>
<th>management level</th>
<th>staff level</th>
</tr>
</thead>
<tbody>
<tr>
<td>provides visibility for large IT initiative and supports the determination of strategic alignment.</td>
<td>supports design and configuration decisions.</td>
<td>supports decisions regarding operations.</td>
</tr>
</tbody>
</table>
Lecture 3: Enterprise Architecture Standards & Frameworks:

- Selected EA standards & frameworks:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE</td>
<td>It provides definitions and a meta-model for the description of architecture. It states that an architecture should address a system's stakeholders concerns. It asserts that architecture descriptions are inherently multi-view, no single view adequately captures all stakeholder concerns.</td>
</tr>
</tbody>
</table>

**Zachman Framework**

- It is a widely used approach for developing or documenting an enterprise-wide architecture.

**Views of Rows:**
- Planner’s View (Scope)
- Owner’s View (Enterprise Model)
- Designer’s View (System Model)
- Builder’s View (Technology Model)
- Subcontractor View (Detailed Representation/Specifications)
- Actual System View (The Functioning of Enterprise)

- Usually we use the term “business process model” if we model the process from the business perspective. “Workflow model” or “process implementation” represents the process from the IT perspective.

- The framework rows therefore indicate different views.
- Last row, “the functioning enterprise,” is not normally counted.
- Framework columns also address different primitive questions.

**TOGAF (The Open Group Architecture Framework)**

- It is a comprehensive approach for an enterprise information architecture, which addresses:
  - TOGAF is a high level and holistic approach to design, planning, implementing, and governing.
  - It is a Registered trademark of The Open Group in the United States.

- TOGAF has the following main components:
  - An Architecture Capability Framework: Addresses the organization, processes, skills, roles and responsibilities required to establish and operate an architecture function within an enterprise.
  - The Architecture Development Method (ADM): Provides a “way of working” for architects.
  - The Architecture Content Framework: Considers an overall enterprise architecture as composed of four closely interrelated architectures:
    - Business Architecture
    - Data Architecture
    - Application Architecture
    - Technology (IT) Architecture
  - The Enterprise Continuum: It views the process of creating a specific enterprise architecture as moving from the generic to the specific, which comprises various reference models:
    - Technical Reference Model
    - The Open Group’s Standards Information Base (SIB)
    - Building Blocks Information Base (BBIB)

**Model Driven Architecture (MDA)**

- Model Driven Architecture is an architectural framework by OMG (Object Management Group).

  Three abstraction levels are:
  - Computation-Independent Model (CIM) describing the situation in which the system will be used.
  - The Platform-Independent Model (PIM) describes the operation of a system while hiding the details necessary for a particular platform.
  - A Platform-Specific Model (PSM) combines the specifications in the PIM with the details that specify how that system uses a particular type of platform.
Lecture 4: IT acquisition:
- **IT Acquisition**: a process by which its various components are selected, obtained and used for achieving the business objectives.
  - normally key decision makers and in some situations business environment influences the it acquisition process.
  - the scenarios of IT acquisition process provide insights to various stages involved in IT acquisition that an organization may adopt.
- **Some of IT acquisition scenarios are:**
1. **CEO-Led scenario:**
   - it suggests that the chief executive officer (CEO) is focused on acquisition of IT in the organization and there is a close coordination between him/her and the Chief Information Officer (CIO).
   - decisions on IT acquisition are taken for new system development, procuring application software, upgrading existing network, hardware, and communication setup.
2. **CIO-Led scenario:**
   - the CEO accepts the technology proposal without any active involvement in the process. The technology as recommended by the CIO is acquired. Involvement of the business process owners is elicited at a later stage of the project execution schedule.
3. **Process technology led scenario:**
   - suggests that business process owners at times initiate a proposal in order to automate their processes either due to induction of a technology for the process improvement and/or proofing better services throughout IT alignment.
4. **Competitor/External force led scenario:**
   - competitor's proven competence in providing better service encourages the organization to upgrade with IT interventions in the similar way. the organization also benchmark before embarking on such project.
5. **User-Driven scenario:**
   - in certain situations, existing users demand upgradation go the infrastructure because of the expected success in leveraging the IT infrastructure. this is normally CIO-driven but mostly it is initiated by the users.

- **IT Acquisition Process:**
  - the organization creates infrastructure related to IS and IT.
  - IS infrastructure creates information system and relates to businesses in the organization.
  - IT infrastructure provides hardware, software, networks middleware, firmware and applications etc. for the organizations.
  - in the whole acquisition process users interface with these infrastructures and IT service providers.

**Simple of software acquisition process:**

<table>
<thead>
<tr>
<th>Initiation stage</th>
<th>Planning stage</th>
<th>Research stage</th>
<th>In evaluation and negotiation stages</th>
<th>In implementation and operation stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>begins with the business needs. this need could be part of the large business plan formulated in the organization.</td>
<td>the project team is formed or the team takes over the planning process.</td>
<td>it involves the research in the market, benchmarking similar projects in order to assess vendor credibility, product suitability, cost, time efficiency and effectiveness of the project at hand.</td>
<td>include tendering process and vendor evaluation for the product and/or process takes place.</td>
<td>are last stages of the acquisition process where delivered product is assessed, evaluated and implemented with the help of users.</td>
</tr>
</tbody>
</table>

**Simple of IT acquisition process:**
• IT Acquiring organization’s issues:
  - in an acquisition process it is the responsibility of the IT service provider to display its credibility on providing required services to the acquiring organization as demanded.
  - the acquisition model most often employed is similar to “waterfall” development model in which well defined increments of capability/technology are assigned, developed and implemented in pre-specified order.

• IT Acquiring Life Cycle:
  1. Establish a planning useful life:
     - organization should consider the acquisition cost, the cost to support and maintain the equipment, and the impact of new labor cost saving configuration and management features.
     - organizations should factor these features into the life-cycle plan.
  2. Incorporate maintenance and support experience:
     - most organizations capture support, maintenance, and upgrade information within the support centre.
     - they should factor this information into evaluation and technology migration planning and including disposition of end-of-life products planning.
     - virtually every IT operations team needs to prepare a list of equipment for excessive maintenance and support.
     - organization should factor this information into an annual life-cycle management review.
  3. Flexibility with rapid technology cycle:
     - leasing and financing is used by many organizations to achieve a three to four-year IT equipment refresh life-cycle instead instead of being locked into five-year depreciation schedule that is longer than the equipment’s useful life.
  4. Scheduled review cycle and asset update:
     - with a lease in place, network and communication technology planners are better equipped to perform systematic reviews of their technology planners are better equipped to perform systematic reviews of their technology portfolios and plan for migrations and replacements.
  5. Additional IT capital management options:
     - with increasing demand in expanding infrastructure and communication needs and constrained budgets IT managers are often burdened on exploring options for acquisition.
     - many IT professionals embrace financing as a means to systematically renew their technology assets and maintain predictable budgets.
  6. Define threshold:
     - the opportunity for organizations is to fairly and fully explore the thresholds for adopting strategies to own or outsource infrastructure and services. it needs analytical framework to justify acquisition and use of business.
Phases in the IT acquisition process:

<table>
<thead>
<tr>
<th>Pre-acquisition phase:</th>
<th>Acquisition phase:</th>
<th>Post Acquisition phase:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The phase consists of:</strong></td>
<td><strong>This phase consists of:</strong></td>
<td><strong>this phase some influencers which can be used for assessment these influencers are:</strong></td>
</tr>
<tr>
<td>- Preparedness of users:</td>
<td>- IT acquisition management capacity:</td>
<td>- Life cycle:</td>
</tr>
<tr>
<td>- user involvement is quite important.</td>
<td>- mostly user's in this phase is to prepare for outlining requirement specific to the project taken up by the IT department.</td>
<td>- determines the system usability for a time period and it's a major area concern for any organization.</td>
</tr>
<tr>
<td>- preparedness of strategic, tactical, operational users depends on process awareness.</td>
<td>- at the same time it's the capacity of the IT department that enables identification of proper vendor assuming the rule of “partner” and organizing the project well.</td>
<td>- Successful acquisition:</td>
</tr>
<tr>
<td>- users in strategic level need to have desired skill in strategy formulation, tactical users in functional planning and operation users in transaction awareness.</td>
<td>- determine the delivery as well as requirements for the project is a major challenge for IT cell.</td>
<td>- IT acquisition involves hard components as well as soft components.</td>
</tr>
<tr>
<td>- Preparedness of IS:</td>
<td>- quality assurance on the part of acquirer is major indicator for successfully predicting a project success.</td>
<td>- success of IT acquisition also depends on how successfully the components are planned, acquired, and used.</td>
</tr>
<tr>
<td>- IS is an important component for building interfaces, and integration.</td>
<td>- vendor needs to be seriously evaluated during acquisition process.</td>
<td>- User satisfaction:</td>
</tr>
<tr>
<td>- it's experienced that strong orientation of IS toward business processes rather than becoming IT centric would provide better results and better use of artifacts.</td>
<td>- vendor supplying a product as a component/developing an application.</td>
<td>- end user through this model are divided into two categories:</td>
</tr>
<tr>
<td>- Preparedness of IT:</td>
<td>- display quality certification from the vendors does not necessary lead to procedure quality product.</td>
<td>1. users who are ignorant of IT infrastructure, but use the technology for business purposes.</td>
</tr>
<tr>
<td>- this component in the model would assess organization's strategy to organize IT.</td>
<td>- SW-CMM and ISO family provide enough scope for the vends to practice and adopt quality assurance methods.</td>
<td>2. core-IT professionals who use the IT infrastructures to render services to the business-centric users.</td>
</tr>
<tr>
<td>- it comes with relevant components(networks, databases, apps…) and a strategy must be formulated.</td>
<td>- for example: Oracle &amp; SYBASE supplying DBs technology wouldn't require any debate for its quality.</td>
<td>- IS-IT alignment:</td>
</tr>
<tr>
<td></td>
<td>- user must have a methodology to understand the fit between the product being chosen and requirement of the organization.</td>
<td>- IT when acquired, doesn’t only bring in technology at component level, it spreads across the entire organization having effect on its culture and process.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- it can’t be viewed with perspective of technology used for process-improvement tool, but it need strategy to determine the fit between the business and IT acquired.</td>
</tr>
</tbody>
</table>
Lecture 5: Business Process Modeling (BPM):

- **Characteristics of a process:**
  - **A process is a systematic set of activities:**
    - which manipulate/transport material/information.
    - in order to accomplish a specific purpose/objective.
    - creating value for a customer (internal/external).
  - **Most processes:**
    - require some sort of input.
    - use and/or consume resources.
    - produce some sort of output—a service/product.

- **Modeling:** the process of architecting and structurally designing a SW application before starting the coding phase.
  - it can be expressed with: symbols, math types, words, and represents the description of entities, processes/attributes and their relations.

- **BPM:** means of representing the business activities, the information flow and decision logic in business processes.
  - with the power of visualization, it’s used to communicate info regarding a process and the interaction it includes within/between organizations either among the persons reading a model.
  - it achieves a common understanding of business knowledge between an organization and IT experts and thus drives the design and implementation of SW systems.
  - it works through modeling notations such as: UML or BPMN, which is: easily understandable by non-IT experts + sufficient to model complex business environment.

**BPMN:**
- originally defined by the Object Management Group (OMG), provided an easily conceivable notation by all users:
  - business analysts.
  - technical developers.
  - business people.
- supports XML based language such as: Business Process Execution Language (BPEL).

**Why BPMN needed?**
- provide a standard where there hasn’t been a standard.
- BPMN helps with process, design, deployment…
- BPMN is a core enabler for BPM which is concerned with managing change to improve business processes.

**Types of sub-models within BPMN:**

<table>
<thead>
<tr>
<th>Private (internal)</th>
<th>Abstract (public)</th>
<th>Collaboration (global)</th>
</tr>
</thead>
<tbody>
<tr>
<td>processes that are internal to specific organization and called workflow processes.</td>
<td>focuses on representing the communication &amp; interactions between an integral process of an organization and other processes executed by other organizations.</td>
<td>depicts all interactions among all the organizations that are involved in a business process.</td>
</tr>
<tr>
<td>departments that assume responsibility for each task.</td>
<td>only those processes that communicate outside the private business process are included in the abstract process.</td>
<td>it may contain within a pool and the different participant business interactions are shown as Lanes within the pool.</td>
</tr>
<tr>
<td>documents are exchanged.</td>
<td>doesn’t provide any insights regarding the organization structure, business/legal aspects or info systems.</td>
<td>doesn’t dive into any details regarding the process execution that happens internally in each organization.</td>
</tr>
<tr>
<td>business &amp; legal rules that regulate the process and its steps.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Modelling Concepts in BPMN:

**Artifacts:**
- **Activity:** is a generic term for work that company performs.
- **Types of activities:**
  - Atomic activity.
  - It can be performed more than once.
  - It is used when the work can't be broken down.
  - Compound activity.
  - Can be broken down into finer level.
- **Event:** is something that "happens" during the course of a business process.
  - It affects the flow of the process and usually have a cause(trigger)/impact(result).
- **Types of events:**
  - Indicates where a particular process will start.
  - Occur between a Start & End event.
  - It affects the flow of process, but won't directly start/terminate the process.
  - Where the process ends.
- **Gateway:** is used to control the sequence flow.
  - Determine decisions/forking/merging/joining of paths.

**Swim-lanes:** a mechanism to organize activities into separate visual categories in order to illustrate different functions capabilities. Types of Business Process Diagram (BPD) simian objects are:
- **Pool:** represents a participant in a process, it also acts as a graphical container for partitioning a set of activities from the pools.
- **Lane:** a sub-partition within a pool and will extend the entire length of the pool, either vertically/horizontally.
  - Used to organize and categorize activities.

**Modelling Concepts in BPMN:**

- **Data object:** a mechanism to show how data is required or produced by activities.
  - They’re connected to activities associations.
- **Group:** used for documentation/analysis purposes, but doesn’t affect the sequence flow.
- **Annotation:** mechanism for a modeler to provide additional text additional text information for the reader of a BPMN Diagram.

**Artifacts:** a segment of a process with:
Lecture 6: Unified Modeling Language (UML):

- UML is OMG’s most used modeling specification.
- UML is a visual language for specifying, constructing and documenting the artifacts of systems.

<table>
<thead>
<tr>
<th>Use case diagram</th>
<th>describes the functional behavior of the system as seen by the user.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class diagram</td>
<td>describe the static structure of the system: objects, attributes, associations.</td>
</tr>
<tr>
<td>Activity diagram</td>
<td>describe the dynamic behavior of a system (the workflow).</td>
</tr>
</tbody>
</table>

- **UML diagrams**: (رسوم)
  - the way of drawing these diagrams has been fully described in SWE(CS385) course-

- **BPMN vs. UML**: (مقارنة)

<table>
<thead>
<tr>
<th>UML</th>
<th>BPMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Process-Oriented approach.</td>
<td>- Object-Oriented approach.</td>
</tr>
<tr>
<td>- focuses on SW design.</td>
<td>- focuses on business processes.</td>
</tr>
<tr>
<td>- both are compatible with each other.</td>
<td></td>
</tr>
<tr>
<td>- business processes and participants can be mapped to construct such as use cases and behavioral models in UML.</td>
<td></td>
</tr>
</tbody>
</table>
Lecture 7: Software Architecture for enterprise applications:

- **SW Architecture:**
  - It’s about software design.
  - goes beyond the algorithms and data structures of the computation; designing and specifying the overall system structure emerges as a new kind of problem.
  - **Structural issues** include gross organization and global control structure; protocols for communication, synchronization, and data access; assignment of functionality to design elements; physical distribution; composition of design elements; scaling and performance; and selection among design alternatives.

- **Architecture drives (servers as the blueprint):**
  - Team structure
  - Documentation organization
  - Work breakdown structure
  - Scheduling, planning, budgeting
  - Unit testing, integration

**Architecture establishes the communication and coordination mechanisms among components.**

- **Decomposition of system architecture defines:**
  - **Component interfaces** (What a component can do).
  - **Component communications and dependencies** (How components communicate).
  - **Component responsibilities** (Precisely what a component will do when you ask it).

- **Architecture components communication:**
  - Data passing mechanisms, for example:
    - Function call
    - Remote method invocation
    - Asynchronous message
  - **Control flow**
    - Flow of messages between components to achieve required functionality.
    - Sequential
    - Concurrent/parallel
    - Synchronization

- **Architecture components communication:**

  ★ **Patterns catalogue successfully used structures that facilitate certain kinds of component communication.**
  - Client-server
  - Message broker
  - Pipeline

  ★ **Patterns have well-known characteristics appropriate for particular types of requirements.**

- **Architecture addresses NFRs:**
  ★ **Non-functional requirements (NFRs) define how a system works.**
  ★ **NFRs rarely captured** in functional requirements
  ★ **Must be elicited** by architect
  - **NFRs include:**
    - Technical constraints
    - Business constraints
    - Quality attributes

- **Architecture = Abstraction:**
  - Architecture provides an abstract view of a design.
  - hides the complexity of design.
  - **may/may not** be a direct mapping between elements.
  - Example: Marketecture: informal deception of system/s structure and interaction.

  **Advantages:**
  + easy to understand
  + helps discussion during design build review…
- **Architecture Views:**
  - **Logical view:** describes architecturally significant elements of the architecture and the relationships between them.
  - **Process view:** describes the concurrency and communications elements of an architecture.
  - **Physical view:** depicts how the major processes and components are mapped on to the applications hardware.
  - **Development view:** captures the internal organization of the software components as held in e.g. a configuration management tool.
  - **Architecture use cases:** capture the requirements for the architecture; related to more than one particular view.

- **SW Architect responsibilities:**
  - Liaison with stakeholders
  - Technology knowledge
  - Software engineering
  - Risk managements

- **Architecture and Technologies:**
  - Architects must take design decisions.
  - Software vendors have created commercial off the-shelf (COTS) technologies that explicitly support widely used patterns.

  **Advantages:**
  + Makes implementation of patterns easier.
  + Reduces risk if technology is well built.

- **Quality Attributes:**
  - Reliability
  - Availability
  - Portability
  - Scalability
  - Performance

<table>
<thead>
<tr>
<th>Performance</th>
<th>Could be described as:</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>- Metric of amount of work performed in unit time.</td>
</tr>
<tr>
<td></td>
<td>- Deadline that must be met.</td>
</tr>
<tr>
<td>Measurements</td>
<td>- Throughput: amount of work an application must perform in unit time. Work is typically measured in: transactions per second (tps), or messages processed per second (mps).</td>
</tr>
<tr>
<td></td>
<td>- Response time: latency an application exhibits in processing a request (a business transaction). Usually measured in: (milli)seconds.</td>
</tr>
<tr>
<td></td>
<td>- Deadlines.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Scalability</th>
<th>Additional capacity may be deployed in two ways:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. adding more CPU, memory to the machine that’s running the app (scale up).</td>
</tr>
<tr>
<td></td>
<td>2. distributing the app on multiple machines (scale out).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Common Scalability Issues in IT systems:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Request load</td>
</tr>
<tr>
<td>- Connections</td>
</tr>
<tr>
<td>- Data size</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modifiability</th>
<th>Measure of how easy it may be to change an application to cater for new functional and non-functional requirements.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Predicting modifiability requires an estimate of effort and/or cost to make a change.</td>
</tr>
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<table>
<thead>
<tr>
<th>Security</th>
<th>Most common related requirements:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Authentication: Applications can verify the identity of their users.</td>
</tr>
<tr>
<td></td>
<td>- Authorization: Authorized users and applications have defined access rights to the resources of the system.</td>
</tr>
<tr>
<td></td>
<td>- Encryption: messages sent to/from the application are encrypted.</td>
</tr>
<tr>
<td></td>
<td>- Integrity: ensures the contents of a message are not altered in transit.</td>
</tr>
<tr>
<td></td>
<td>- Non-reputation: The sender of a message has proof of delivery and the receiver is assured of the sender’s identity.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Availability</th>
<th>Related to an application's reliability. If an application isn't available for use when needed, then it's unlikely to be fulfilling its functional requirements.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- easy to specify and measure.</td>
</tr>
<tr>
<td></td>
<td>- Period of loss of availability determined by: Time to: detect failure, correct failure, restart application.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Strategies for high availability:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Eliminate single points of failure.</td>
</tr>
<tr>
<td>- Replication and failover.</td>
</tr>
<tr>
<td>- Automatic detection and restart.</td>
</tr>
<tr>
<td><strong>Recoverability</strong> (e.g. a database) the capability to reestablish performance levels and recover affected data after an application or system failure.</td>
</tr>
</tbody>
</table>
Lecture 8: Enterprise Integration & SOA:

- **Enterprise Integration Concept**: shows components, what do they do, how they interact with each other.

**Enterprise architecture (EA)** = Business architecture + application architecture + technology architecture (computer platform architecture + network architecture)

- Integrated enterprise architecture (IEA) = EA with focus on integration.
  - IEA promises many benefits that include:
    - Identifying what resources exist.
    - Improving integration among resources.
    - Facilitating business process improvement.
    - Creating speed and efficiency in meeting changing business needs through IT.

- Software Oriented Architecture (SOA) is an effective way to develop an IEA.
  - SOA provides a standards-based conceptual framework for flexible and adaptable enterprise wide systems.
  - The objective of an integrated enterprise architecture is to show how well all the business plus technical components work together to serve the enterprise needs.

- **Examples of enterprise-wide integrated systems are**: (فراغات/أكمل)
  - Procurement systems that link order processing with payment, inventory management and shipping.
  - Manufacturing systems that link suppliers, designers, product managers, and production planners in a uniform manner.
  - Customer support systems that link customer service with customer relationship management, marketing and sales.
  - Health information networks that link various hospitals, doctors, pharmacies and health insurance providers.
  - Supply chain management systems that link several suppliers with the material requirement planning (MRP) systems of consumers.

- **Enterprise Integration definition**: focuses on the concepts related to working together, sharing, interacting, and collaborating.

- **Integrated architectures of enterprise applications** is like designing mini-applications that need to interact with each other for corporate business goals.

How can an EA help in the enterprise integration efforts?

- **For enterprise integration**, the goal is to provide standardized high-quality customer service across the entire firm’s service channels. Multi-channel integration is critical because customers expect consistent service when they interact with a company, no matter which channel they use.

**Enterprise integration can be at several layers** (e.g., business process integration, application integration, platform integration).

- **Enterprise application integration (EAI)** receives most attention due to the following main reasons:
  - Lack of integration between enterprise applications is very visible to the customers and business partners.
  - Many of the enterprise applications can be "legacy" applications that are old, unstructured, and monolithic. Dealing with legacy applications has been a dominant concern of IT management.

The integration process concentrates on the interactions and the interfaces between the enterprise structural components, at the following layers>>
Definitions of enterprise architectures:

Definition 1. Enterprise Architecture = architecture of architectures.


Definition 3. Integrated Enterprise Architecture = Horizontally Integrated Enterprise Architecture + Vertically Integrated Enterprise Architecture

- The integration process concentrates on the interactions and the interfaces between the enterprise structural components, at the following layers:
  - Business architecture that basically describes the business processes and how they interact/interface with each other.
  - Application architecture that shows the various application software packages and how they interact/interface with each other through messages and data flows.
  - Computing platform architecture with interactions and interdependencies between different operating systems, system software packages and middleware services located on various desktops, servers, and mainframes.
  - Network architecture with Intranet, Extranet, Public Internet and network devices interconnected through various connectivity devices and gateways.

- An previous EA diagram serves as a very effective framework for enterprise wide integration:
  1. Vertical integrations show a business architecture that is integrated with technology architecture (enterprise applications, platforms and networks) of a company or a division of a company. **It combines business, applications and IT infrastructure components into a solution for a particular situation.**
    - An example: supply chain management ERP system that automates all supply chain processes and operates on Linux platforms.
  2. Horizontal integrations show how processes and technologies at the same layer are integrated.
    - For example, the integration of business processes in sales with business processes in supply chain represent a horizontal integration at business process level.
    - As another example, smooth transition between wired and wireless networks (e.g., roaming support between a cellular phone, a Wi-Fi LAN and a wired corporate Intranet) represents a horizontal network integration.
  3. Mixtures represent an integrated architecture that is a combination of vertical architectures that interconnect different layers as well as the horizontal architectures at the same layers of an enterprise.
    - In many practical cases, mergers and acquisitions lead to these integration scenarios because many organizations have vertically integrated systems but when two or more organizations merge, multiple vertical architectures need to be integrated horizontally.

- Enterprise Architectures and Integration Through SOA:
  - SOA (Service Oriented Architecture) provides an elegant framework for representing and implementing an integrated EA. **SOA provides a loosely coupled architecture** which allows business services to discover and communicate with each other over a standards-based infrastructure and thus leads to enterprise-wide flexibility and adaptability.
    - All businesses provide a set of services. Some services are provided to the customers (B2C), some to other businesses (B2B) and some to the employees (B2E).
  - Service-oriented architectures (SOAs) rely on services and the components that provide the services as the fundamental elements for developing applications.
  - The main idea of service oriented architectures is that the applications should be thought of in terms of the services they provide and the individual components that actually deliver the services.
  - The services can be combined into aggregate services and similar components can be combined into applications. Thus a bank, for example, provides a set of services (e.g., deposits, withdrawals, fund transfers) and these services are provided through components that can be combined into banking applications.
SOA can be used in developing and building an integrated enterprise architecture. Specifically:

- Business architecture can be represented in terms of business services (BSs).
- Application architecture can be represented in terms of a set of business components (BCs) that automate business services (BSs).
- IT infrastructure can be represented in terms of the enterprise service bus (ESB) that shows how different infrastructure services support the business services and business components.

Service-oriented architecture is based on the following three fundamental features:

1. **Reusable Components**: It is important to decompose business applications into business components (BCs) in such a fashion so that as many components as possible are general purpose (i.e., reusable) and as few as possible are special purpose.

2. **Web-Services Enablement**: The components must have well defined service interfaces that can be stored in a directory so that service clients (SCs) can query an interface directory to discover and invoke the needed service providers (SPs).

3. **Enterprise Service Bus (ESB)**: a loosely coupled common middleware infrastructure must be used for communications, brokerage, security, directory and administration services needed throughout the enterprise.

---

- SOA oriented view of an enterprise architecture shows different application and an ESB as a collection of hubs that are interconnected to each other. In addition, each hub serves a subset of applications.
- In reality, a hub could be a server.
- In addition, each new acquisition can be assigned a hub. This allows a great deal of business flexibility and control.

The following figure shows a possible B2B integration architecture based on SOA. The key player in this scenario is the B2B integration bus that enables communications between the organizations.

---

**SOA for Cloud Computing:**

- becoming popular at present for flexible, robust and inexpensive computing services – mostly from service providers ("cloud vendors").
- The main idea of Cloud Computing is that all IT-related capabilities are provided “as a service” (e.g., software as a service (SaaS), platform as a service (PaaS), Infrastructure as a service (IaaS), etc.

**Importance of Metadata:**

- Enterprise integration is critically dependent on a clear definition of the metadata used in an enterprise.
- Metadata documents an organization’s terminology and meaning. It documents the enterprise language typically as an enterprise glossary of terminology.
- Consider also that different terms can mean the same thing in various parts of the business, such as “customer,” “client,” and “debtor.” These words are synonyms.
- Redundant data present no problem if their values do not change. But if data values are volatile and hence can change—such as an address—then every redundant version of the address in each database table must be changed to contain the latest correct data value.
- To communicate effectively, a common term must be agreed on and its exact meaning defined and documented so that all involved understand what that term means.
Lecture 9: Middleware for Enterprise Application Integration:

- **Application Integration**: Simple communication link between two applications.

  - If two companies want to trade over the internet, the three elements should be considered:
    1. **The dialogue or scenario process** for both buyer and seller.
    2. **The data model**: The exchanged data are, in fact, business documents (e.g., order forms) and not simple character strings.
    3. **The communication system**: It is a matter of the communication protocol used to exchange data. A large part of this work is about the different technologies implementing this exchange. Typically, in Internet contexts, the protocol used is HTTP (HyperText Transfer Protocol).

- **Middleware: The Engine of EAI**
  - Middleware provides a mechanism that allows one entity (application or database) to communicate with another entity or entities.
  - Middleware is able to hide the complexities of the source and target systems, thereby freeing developers from focusing on low-level APIs and network protocols and allowing them to concentrate on sharing information.

- **Types of Middleware**: 
  1. Remote Procedure Calls (RPCs)
  2. Message-Oriented (MOM)
  3. Distributed objects

<table>
<thead>
<tr>
<th>1</th>
<th>Remote Procedure Calls (RPCs)</th>
<th>2</th>
<th>Message-Oriented (MOM)</th>
<th>3</th>
<th>Distributed objects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>are the oldest type of middleware. It is a client-server mechanism that allow the program to be distributed across multiple platforms.</td>
<td></td>
<td>products use an asynchronous paradigm. This model allows the application to continue processing after making a middleware service request.</td>
<td></td>
<td>are also considered middleware because they facilitate inter-application communications.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The asynchronous paradigm does not block the application from processing.</td>
<td></td>
<td>small application programs that use standard interfaces and protocols to communicate with one another.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The use of messages is an advantage as well. Because messages are little, byte-sized units of information that move between applications, developers find them easier to manage.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Database-oriented middleware

- is any middleware that facilitates communications with a database, whether from an application or between databases.

5. TP Monitors

- A transaction is a unit of work with a beginning and an end.
- The resources are integrated into the transactions and leveraged as part of the transaction.

6. Message brokers

- is the perfect match for EAI.
- can facilitate information movement between two or more resources (source or target applications) and can account for the differences in application semantics and platforms.
- Can join many applications using common rules and routing engines.
- Transform message schemas and alter the content of the messages.
**Middleware Models:**

- The **logical middleware** model depicts how the information moves throughout the enterprise **conceptually**.
- The **physical middleware** model depicts how the information **actually** moves and the technology it employs.

<table>
<thead>
<tr>
<th>Logical Middleware Models:</th>
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</thead>
<tbody>
<tr>
<td><strong>Point-to-point middleware</strong></td>
</tr>
<tr>
<td>- allows one application to link to one other application</td>
</tr>
<tr>
<td>- When application A desires to communicate with application B, they simply &quot;shout down&quot; the pipe using a <strong>procedure call or message</strong>.</td>
</tr>
</tbody>
</table>

**Disadvantages:**

- **Inability** to properly bind together more than two applications.
- **Lacks** any facility for **middle-tier** processing.

<table>
<thead>
<tr>
<th>Synchronous versus Asynchronous</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asynchronous</strong></td>
</tr>
<tr>
<td>- It is middleware that moves information between one or many applications in an asynchronous mode.</td>
</tr>
<tr>
<td>- The middleware software is able to <strong>decouple itself</strong> from the source or target applications, and the applications are not dependent on the other connected applications for processing.</td>
</tr>
<tr>
<td>- <strong>Placing a message in a queue</strong> and then going about their business, waiting for the responses at some after time from the other application(s).</td>
</tr>
<tr>
<td>- The middleware will <strong>not block</strong> the application for processing.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Queued communications</th>
<th>Publish/Subscribe</th>
</tr>
</thead>
<tbody>
<tr>
<td>- <strong>require a queue manager</strong> to place a message in a queue.</td>
<td>- The publisher is the provider of the information.</td>
</tr>
<tr>
<td>- The remote application then retrieves the message either shortly after it has been sent or at any time in the future (barring time-out restrictions).</td>
<td>- Publishers supply information about a topic, without needing to understand anything about the applications that are interested in the information.</td>
</tr>
<tr>
<td>- If the calling application requires a response (such as a verification message or data), the information flows back through the queuing mechanism.</td>
<td>- The <strong>subscriber is the recipient</strong>, or consumer, of the information.</td>
</tr>
<tr>
<td>- <strong>Most MOM products</strong> use queued communications.</td>
<td>- The subscriber specifies a topic that it’s interested in.</td>
</tr>
</tbody>
</table>
Lecture 10: XML and Enterprise portals:

- **Basic XML Concepts:** XML (Extensible Markup Language) messaging provides an effective method of enterprise integration for exchanging data in XML formats.
  - XML is text, in any written language. It is human-readable and machine-readable.
  - Each **start tag**, such as `<Name>`, is an XML element. It **must be followed** by an **end tag**, such as `</Name>`.
  - Both tags **surround** the **data content**.
  - A tag or XML element is a single word with no spaces, where the first character of the tag is a **letter or an underscore**: it **cannot be a number or any special character** other than an underscore.

<table>
<thead>
<tr>
<th>Elements must follow these naming rules</th>
<th>Naming Styles</th>
</tr>
</thead>
<tbody>
<tr>
<td>- are case-sensitive*</td>
<td>- Lower case <code>&lt;firstname&gt;</code> All letters lower case.</td>
</tr>
<tr>
<td>- must start with a letter or underscore</td>
<td>- Upper case <code>&lt;FIRSTNAME&gt;</code> All letters upper case.</td>
</tr>
<tr>
<td>- cannot start with the letters xml(or XML, or Xml, etc).</td>
<td>- Underscore <code>&lt;first_name&gt;</code> Underscore separates words -</td>
</tr>
<tr>
<td>- can contain letters, digits, hyphens, underscores, and periods.</td>
<td>- Pascal case <code>&lt;FirstName&gt;</code> Uppercase first letter in each word</td>
</tr>
<tr>
<td>- cannot contain spaces.</td>
<td>- Camel case <code>&lt;firstName&gt;</code> Uppercase first letter in each.</td>
</tr>
</tbody>
</table>

- **Distinct from HTML which is case-insensitive, XML is case- sensitive.**

- **Electronic XML Documents:** These electronic documents are **sent automatically** as XML messages between the relevant XYZ and ABC systems.
  - XML messaging allows these enterprise applications to be integrated, this is called **Enterprise Application Integration**.

- **Connecting Enterprises Together:** The enterprises are able to do business with other enterprises anywhere in the world using a variety of messaging formats and protocols. These formats include RosettaNet, BizTalk, EDI, ebXML and others as shown >>
- **OBI:** open buying on the internet.

- **XML Messaging and Repository Standards:** (كتابة مصطلح)

<table>
<thead>
<tr>
<th>Electronic Business XML(ebXML)</th>
<th>BizTalk</th>
<th>RosettaNet</th>
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</thead>
<tbody>
<tr>
<td>- It defines the evolution of Electronic Data Interchange (EDI) applications and messages to XML.</td>
<td>- It defines an XML message envelope format for guaranteed message delivery.</td>
<td>- Used by the Information Technology and Electronic Components Industries.</td>
</tr>
<tr>
<td>- is a worldwide business standard XML specification to migrate EDI to XML.</td>
<td>- It includes a Repository of many XML document formats.</td>
<td>- defines XML message envelope standards and business document standards.</td>
</tr>
<tr>
<td>- It defines a technical framework that enables XML to be utilized in a consistent manner for the exchange of all electronic business data.</td>
<td>- Document Type Definition (DTD) files and XML Schema Definition (XSD) files are defining common XML business documents for use with BizTalk.</td>
<td>- The RosettaNet web site also includes a Repository of RosettaNet document formats freely available as Document Type Definition (DTD) files and XML Schema Definition (XSD) files.</td>
</tr>
</tbody>
</table>

- The ebXML Specifications were first released in May 2001; they document ebXML for use by EDI and middleware software vendors.
Redundant Data Integration using EAI: Considers that each redundant address version must be kept up-to-date if any one version of this data changes.

- The electronic XML Address Change Notification message is transmitted automatically in near real time. The result is inexpensive data maintenance synchronization for integration, with no errors introduced – a problem experienced with the previous manual data entry approach.

- Enterprise Portal: can appear in different forms, depending on the job responsibilities of each person accessing the portal.

  - An Enterprise Portal facilitates sharing and distribution of information, and permits virtual teams to operate in a distributed environment.

Enterprise Portal Configuration:

- Typical Portal configuration options include:
  - definition of access privileges; assignment of roles and privileges to individuals;
  - connection to available applications;
  - management of the desktop and screen areas; and the rule database behind the product.

- Many functions are implemented as servers:
  (1) Authentication Server: This is used to define user identify profiles in the Portal repository. It maps data, content, and people to a defined user.
  (2) Security Server: This provides support for single sign-on, encryption, and also for various security technologies, such as HTTP/SSL.
  (3) Search Engine: This server capability supports ad hoc searching across both structured and unstructured data sources: either within or outside the Portal.
  (4) Content Management Server: This scans, filters, and catalogs content from disparate data and resources. It often supports web crawlers on the Internet and Intranet.
  (5) Business Analysis Server: This is used for built-in decision support functions, such as ad hoc queries, reports, graphs, analysis and links to external BI tools.
  (6) Connections Server: This provides real-time connections to many source data systems, including legacy, ERP, DBMS, e-Commerce, e- Business etc.
  (7) Collaboration Server: This allows users to interact with individuals, groups, teams, and experts to share data and solve problems.
  (8) Events/Alerts Server: This controls notifications and alerts by time or database events, including a personal broadcaster.
  (9) Designer: This provides the capability to design the end-user interface so that the desktop can be managed effectively, with dynamic configuration of resources, and mode of interaction.
  (10) Administrator: The Administration Server supports management of role based content delivery to users, groups of users, or groups of groups.

Integration using an Enterprise Portal:

- An Enterprise Portal appears to deliver integration across many data sources presented in the separate windows. But this is deceptive; each window is typically independent of all others. The windows are not integrated. Furthermore, the redundant data versions also exist throughout the enterprise, at different levels of update. These data versions also are not integrated.
Abbreviations and terminologies:

**Lecture 1:**
- **DSS**: Decision support system
- **BI**: Business Intelligence
- **ERP**: Enterprise Resource Planning
- **OLTP**: Online Transaction Processing
- **OLAP**: Online Analytical Processing
- **Stakeholders**: Individuals that have key roles in, or concerns about the system, for example, as users, developers, or managers.
- **OLTP**: is operational computer system, which provides information to run day-to-day operations
- **OLAP**: is a technology that processes multidimensional data which allows for users to view data from multiple perspectives.
- **DSS**: is a computerized information system used to support decision-making in an organization.
- **BI**: refers to technologies, applications and practices for the collection, integration, analysis, and presentation of business information
- **ERP**: is the integrated management of core business processes, often in real-time and mediated by software and technology.
- **Dashboard**: is a tool used for information management and business intelligence. Dashboards organize, store, and display important information from multiple data sources into one, easy-to-access place
- **Balanced scorecard**: comes from the idea of looking at strategic measures in addition to traditional financial measures to get a more “balanced” view of performance.

**Lecture 2:**
- **Plan**: a detailed proposal (list of steps) for achieving a goal
- **Strategic planning** produces a high-level view of the direction that an enterprise sets for itself.
- **Business Process**: A business process is an activity or set of activities that can accomplish a specific organizational goal.
- **Models**: purposeful abstractions of reality.
- **Artifact**: is a documentation product, such as a text document, diagram, spreadsheet, briefing slides, or video clip.
- **Principles**: Principles are general rules and guidelines that are stable. Principles describe and support the way that an organization undertakes its mission.
- **CORBA**: The Common Object Request Broker Architecture (CORBA) is designed to facilitate the communication of systems that are deployed on diverse platforms.
- **SOA**: Software Oriented Architecture (SOA) is a component model that interrelates an application’s different functional units, called services, through well-defined interfaces and contracts
- **Web Services**: A software system designed to support interoperable machine-to-machine interaction over a network.
Lecture 4:
- **CEO**: Chief executive officer
- **CIO**: Chief information officer
- **MIS**: Management information systems
- **COTS**: Commercial off the shelf
- **ERP**: Enterprise Resource Planning
- **SW**: Software
- **ISO**: International Organization for Standardization
- **CMM**: Capability Maturity Model

Lecture 9:
- **The Common Object Request Broker Architecture (CORBA)**: is a standard defined by the Object Management Group (OMG) designed to facilitate the communication of systems that are deployed on diverse platforms.
- **OLE DB (Object Linking and Embedding, Database)**: an API designed by Microsoft, allows accessing data from a variety of sources in a uniform manner.