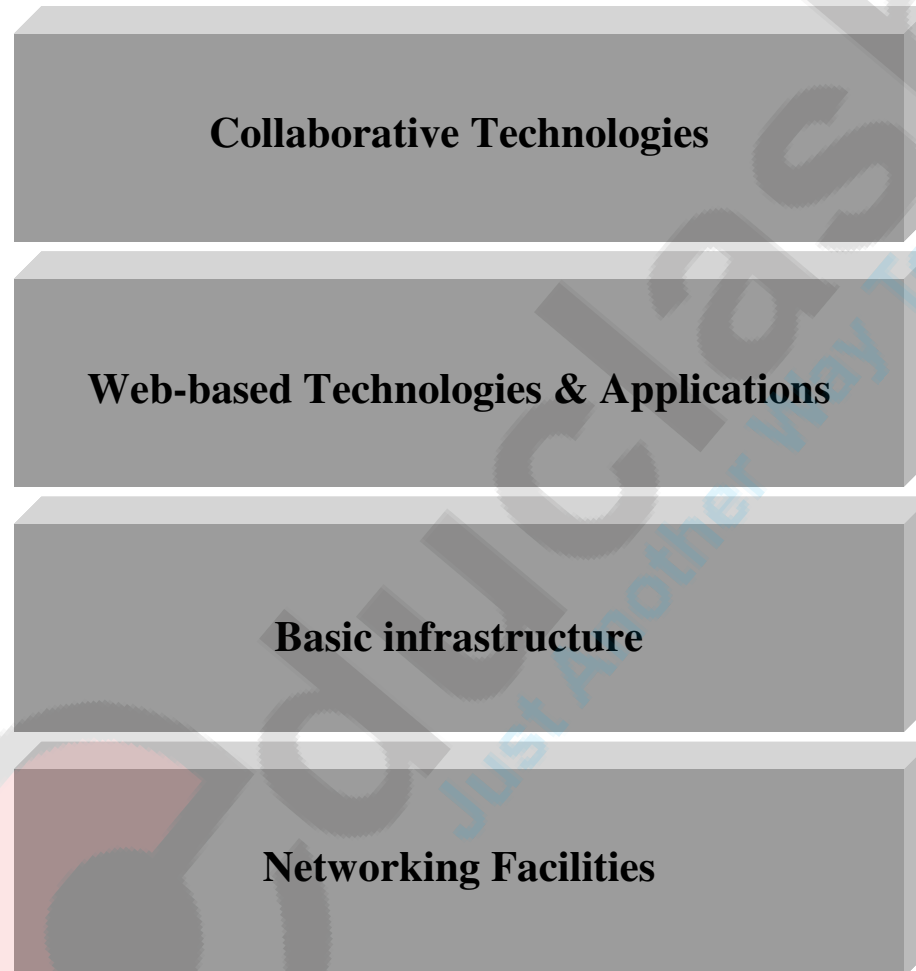# Chapter 6
e-Business Technological Infrastructure

e-Business Technical Infrastructure

- The infrastructure for e-Business comprises technologies that can be seen as different layers that built upon each other:
  - The bottom layer includes networking topologies, the Internet, and protocols such as TCP/IP.
  - The layer above is the basic infrastructure layer that contains such as client/server and tiered architectures.
  - The layer above this contains the technologies that are required to develop web-based applications.
  - Finally, the top layer contains collaborative technologies such as workflow systems and EDI
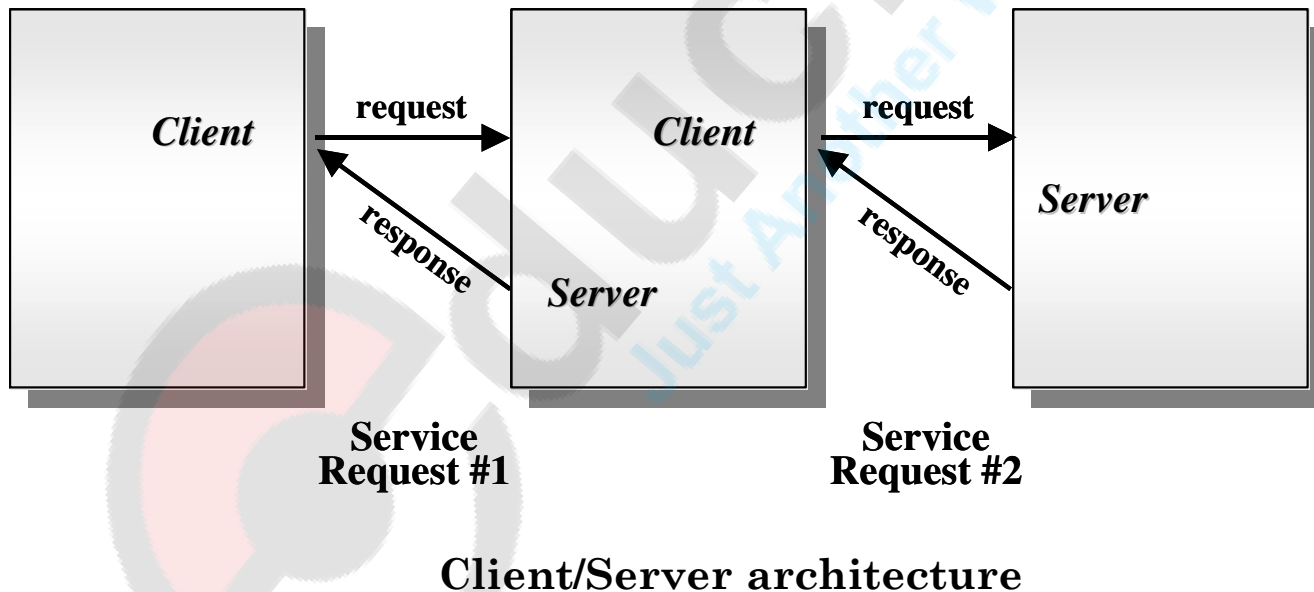
Collaborative Technologies

Web-based Technologies & Applications

Basic infrastructure

Networking Facilities

Technology stack for e-Business.

Basic Infrastructure: Client/Servers

- Distributed computing is the classical paradigm in support of e-Business processes & applications.

- A form of distributed processing is client server computing: it handles the need for both centralized data control and widespread data accessibility.

- Client/server is an architecture that involves client processes (service consumers) requesting service from server processes (service providers).

- Client/server computing does not emphasize hardware distinctions; it rather focuses on the applications themselves.

- The client/server model provides a typical way to interconnect programs that are distributed across different locations.

- There are different ways in which processing tasks can be divided between the client and the server. They range from:
  - Thin clients, with heavy servers
  - servers that only contain common data with all the processing executed at the level of the client.
- Solutions chosen depend on specific application requirements, e.g., local vs. central control, # of users, processing needs etc.
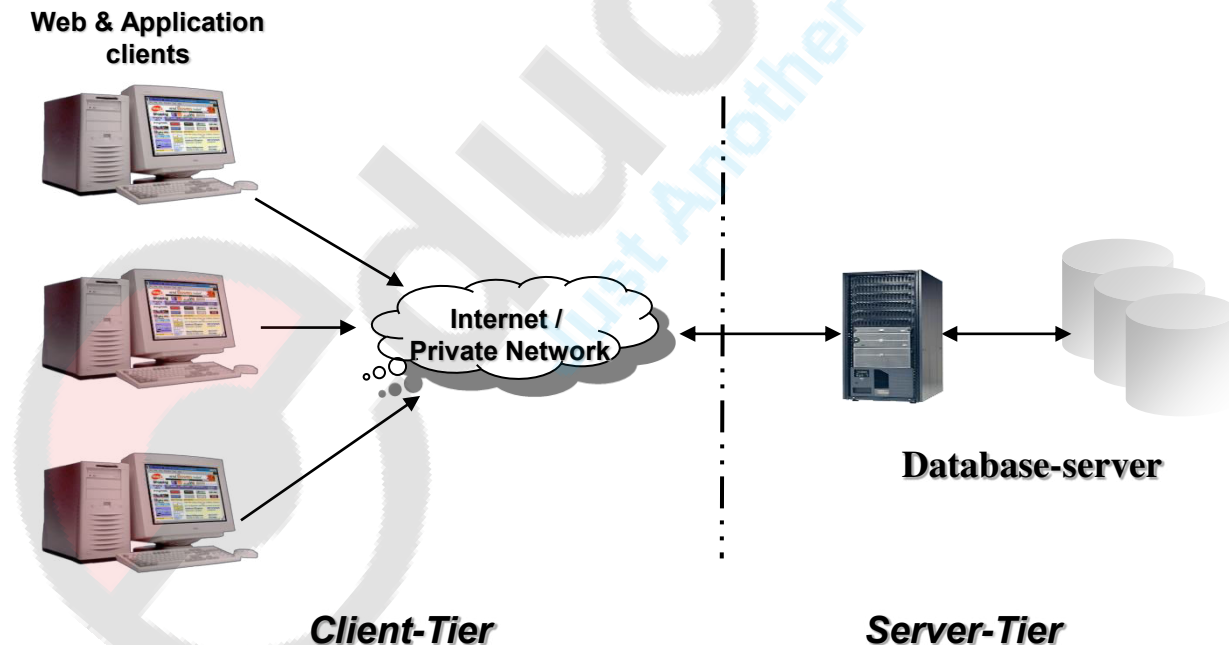

Client/Server architecture

Features of Client/Server Architecture

- The basic features of the client/server model are:
  - Clients and servers are functional modules with well defined interfaces. The functions of a client and a server can be implemented by a set of software modules, hardware components, or any combination thereof.
  - Each client/server relationship is established between two functional modules, where one module, the client, initiates service requests and the other module, the server, responds to these requests.
  - Information exchange between clients and servers, i.e., requests and responses, are strictly through messages.
  - Message exchange is typically interactive.
  - Clients and servers may run on separate dedicated machines connected through a network.

Two-tier Client/Server Architecture

- Client/server introduces a two-tier client/server architecture.
- The tiers in a client/server application refer to the # of elements into which the application is partitioned, not the # of platforms where the executables are deployed.
- The tiers into which an application is partitioned is known as the logical partitioning of an application as opposed to physical partitioning (# of platforms where the application executables are deployed).
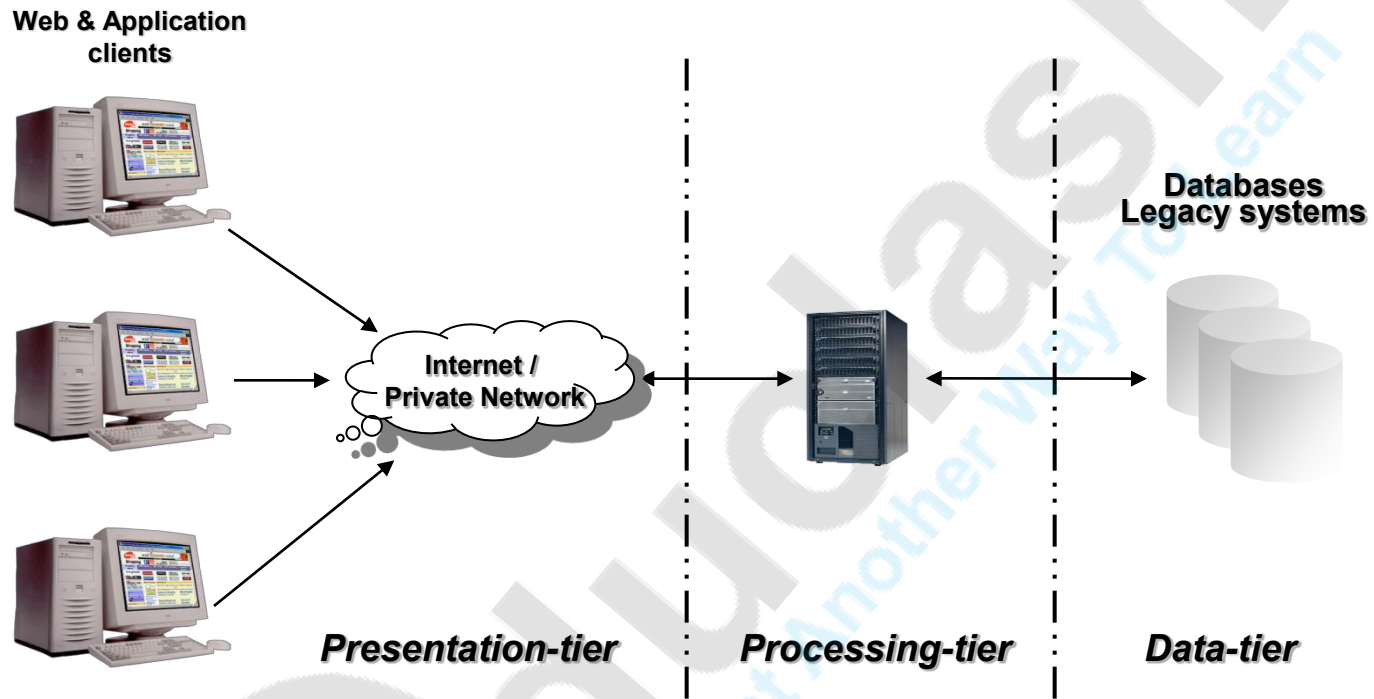
Web & Application clients

Internet / Private Network

Database-server

Client-Tier   *Server-Tier*

Drawbacks of the Two-tier Client/Server Architecture

- The client in such a two-tier system is known as "fat client" while the server is commonly referred to as the database server. Conversations occur at the level of the server's database language.

- The two-tier architecture has several drawbacks, which are especially problematic for large and distributed applications:
  - Scalability problems
  - Poor business logic sharing
  - Client reliance on the database structure
  - Limited interoperability
  - High-maintenance costs

Three-tier Architecture

- The three-tier architecture overcomes the limitations of the two-tier architecture. A middle tier is introduced between the user system interface client environment and the database management server environment.

- The application is partitioned into 3 logical tiers:
  - presentation tier: responsible for the graphical user interface (GUI) layer usually in the form of a web-browser
  - processing tier (or middle-tier): contains the business logic & is responsible for the processing associated applications supported.
  - data tier: holds the permanent data associated with the applications supported e.g., modern and legacy application databases, and transaction management applications. It interprets requests from a client and routes them to a suitable data resource.

- The processing tier enables developers to isolate the main part of an application that can change over time: data & relationships inherent in the data.
- This tier has the effect of logically and physically decoupling business logic from the presentation and database functions. Here we can find business objects that correspond to entities in the business domain, e.g., sales orders, invoices, products ..
- There are a variety of ways of implementing this middle tier, such as transaction processing monitors, message servers, or application servers.

Web & Application clients

Databases Legacy systems

Internet / Private Network

Presentation-tier | *Processing-tier* | *Data-tier*

Three-tier client/server architecture.

Web Technologies and Applications

- The WWW can be viewed as a vast information system consisting of software applications or processes that exchange info. & that act on behalf of a user or another application. The WWW architecture consists of:
  - Identifiers. A single specification to identify objects in the system: the Uniform Resource Identifier (URI).
  - Formats. A nonexclusive set of data format specifications designed for interchange between agents in the system. e.g., HTML, XML schemas, etc.
  - Protocols. A small and non-exclusive set of protocol specifications for interchanging information between agents, e.g., HTTP.

Resources and URLs

- The Web is a universe of resources (anything that has identity). Examples include documents, files, menu items, machines, and services, as well as people, organizations, & concepts.
- The Uniform Resource Identifier helps locate WWW resources:
  - A URI consists of a string of characters that uniquely identifies a network resources.
  - URIs include URLs, which use traditional addressing schemes such as http and ftp, and Uniform Resource Names (URNs), which is a newer Internet addressing scheme.
- The Web organises inter-linked pages of information residing on sites throughout the world.
- Web pages rely on markup languages to tag text files for display at Web browsers.

Web-Based Applications

- Web sites provide the content that is accessed by Web users. A Web site is a catalogue of info. for each content provider over the Web:

    1. Web server,

    2. content files (Web pages), and/or

    3. gateways (programs that access non-Web content, e.g., databases).

- A Web server is an application (technically a server process) that receives calls from Web clients and retrieves Web pages and/or receives information from gateways.

- Web browsers are the clients that typically use graphical user interfaces to wander through the Web sites.

- Major elements involved in a Web application:

  – Web clients (browsers but also Web applications) through which users communicate with Web application servers.

  – Web application servers that administer the entire info. content intended for publication on the Web and dispense files that contain Web pages, images, sound and video clips and other media.

  – Infrastructure services, e.g., caching, directory & security.

  – External services: (non-Web) mission critical applications & data internal to an enterprise & external partner services, e.g., financial, payment, information services, etc.
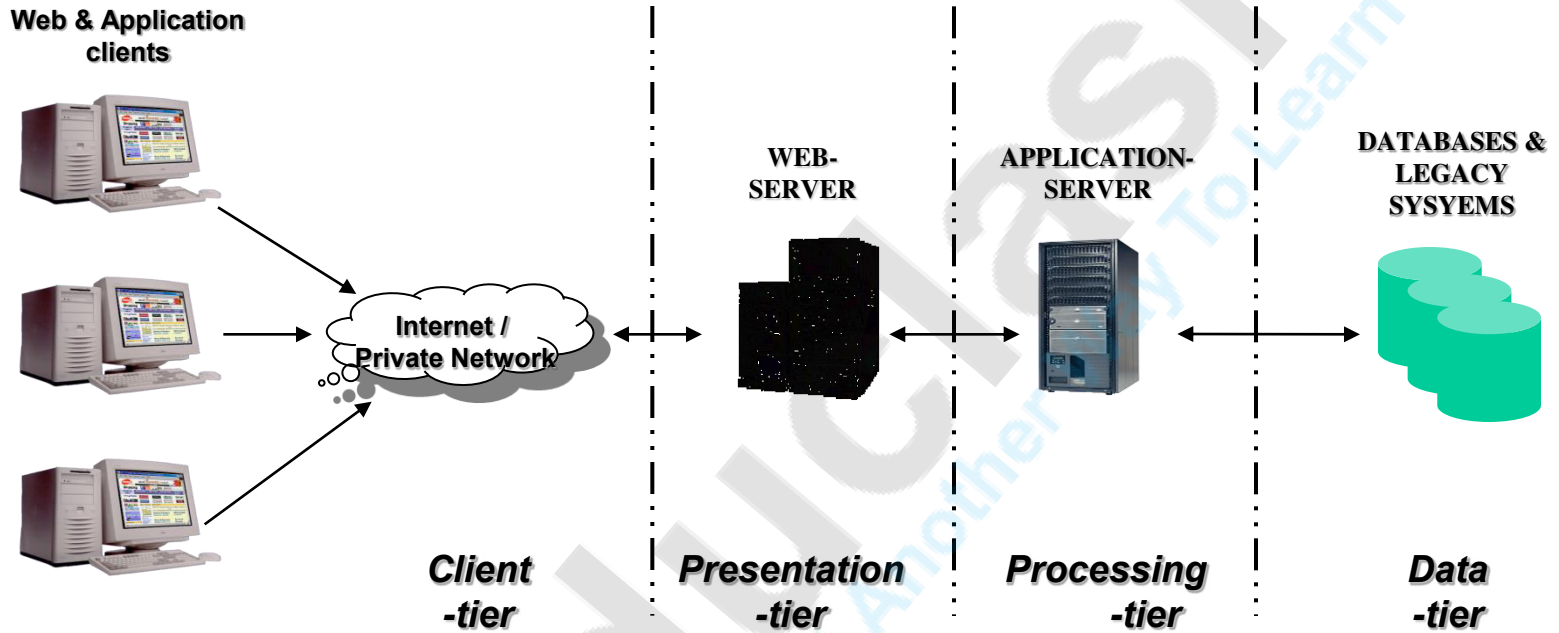
Types of Web Applications

Web applications distinguish between:

- Static documents delivered from the file system of the Web server.

- Dynamic documents that have an interactive and usually time-sensitive nature. These require the server to generate the document on the fly.

- Static documents can be read from an existing file, while dynamic documents may not exist on a disk at all, e.g., can be generated from databases, video capture systems and from scientific instruments such as whether monitoring systems.

Architectural Features of Web-based Applications

- Web-enabled applications are a special case of client-server applications where the client is a standard Web browser,e.g., Netscape /Internet Explorer.

- Modern Web-enabled applications leverage the three-tier architecture. The presentation tier of the three-tier architecture is subdivided into a client-tier and a new presentation-tier. The needs of this new presentation-tier is addressed by an infrastructure known as a Web-server.

- The presentation-tier receives requests from client apps & generates HTML using the services provided by the business (processing) tier. This tier provides further isolation between the application layout and the application logic.

- The client-tier is implemented as a web browser running on the user's client machine. It displays data & lets users & client applications enter/update data.

- The presentation-tier generates Web pages in which it includes dynamic content. It supports different types of clients, e.g., HTML & Java capable clients. A Web-server also finds the client application or user-entered data in Web pages coming back from the client & forwards it to the business logic-tier.

- Application logic is written in the processing or business logic-tier. This includes performing calculations and validations, managing workflow & all data access for the presentation-tier. An application-server supports the functions of business logic-tier.

- The data-tier is responsible for managing the data. It provides the business logic-tier with required data when needed & store data when requested.
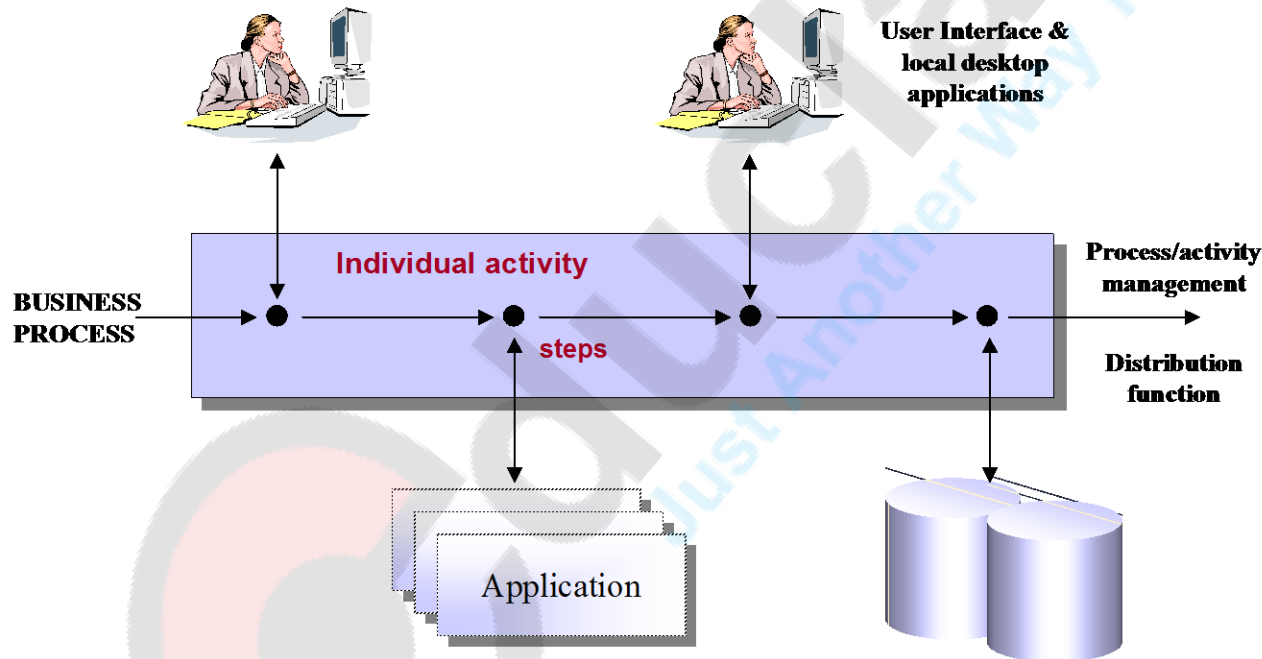
Multi-tiered architecture for developing web-based applications.
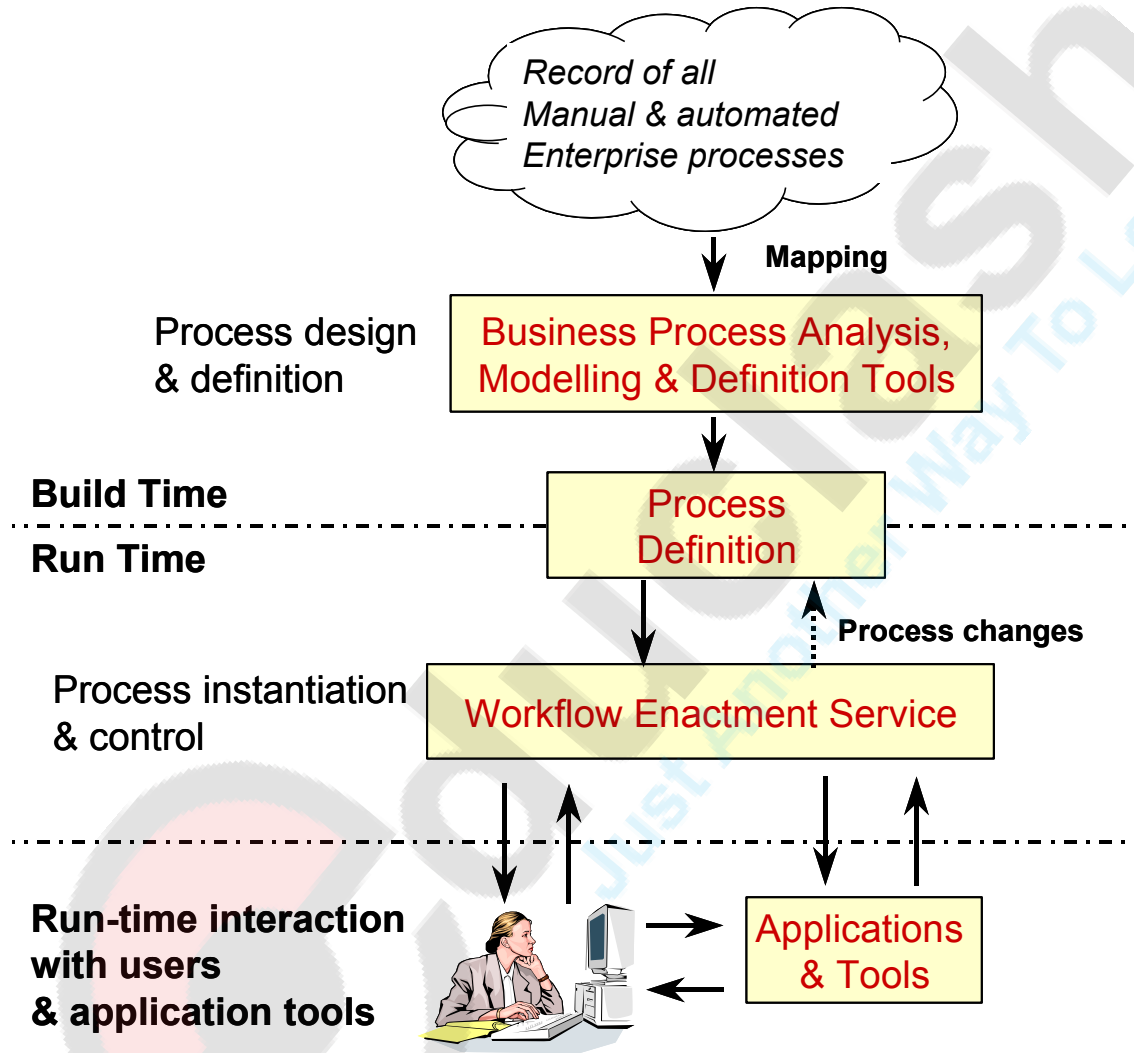
Collaborative technologies: workflows

- A workflow system automates a business process, in whole or in part, during which documents, information, or tasks are passed from one participant to another for action, according to a set of rules.

- A workflow normally comprises a number of logical steps (activities).

- A workflow can depict various aspects of a business process including automated and manual activities, decision points and business rules, parallel and sequential work routes, and how to manage exceptions to the normal business process.

- Workflow technology enables developers to describe full intra- or inter-organisational business processes with dependencies, sequencing selection and iteration. It enables the developers to describe the complex rules for processing in a business process & allows people to be deployed more productively within an organisation.

User Interface &
local desktop
applications

Individual activity

BUSINESS
PROCESS

steps

Process/activity
management

Distribution
function

Application

Workflow characteristics

- Each workflow management system can be viewed at the highest level as providing support for the three functional areas:

    - Build time functions: these are concerned with defining, modeling and analyzing workflow processes and related activities.

    - Run-time process control functions: these are concerned with managing the sequencing and execution of workflow processes.

    - Run-time interactions: these are concerned with supporting interactions with human users and applications and tools for processing activity steps in workflow processes.

Record of all
Manual & automated
Enterprise processes

Mapping

Process design
& definition

Business Process Analysis,
Modelling & Definition Tools

Build Time

Run Time

Process
Definition

Process changes

Process instantiation
& control

Workflow Enactment Service

**Run-time interaction
with users
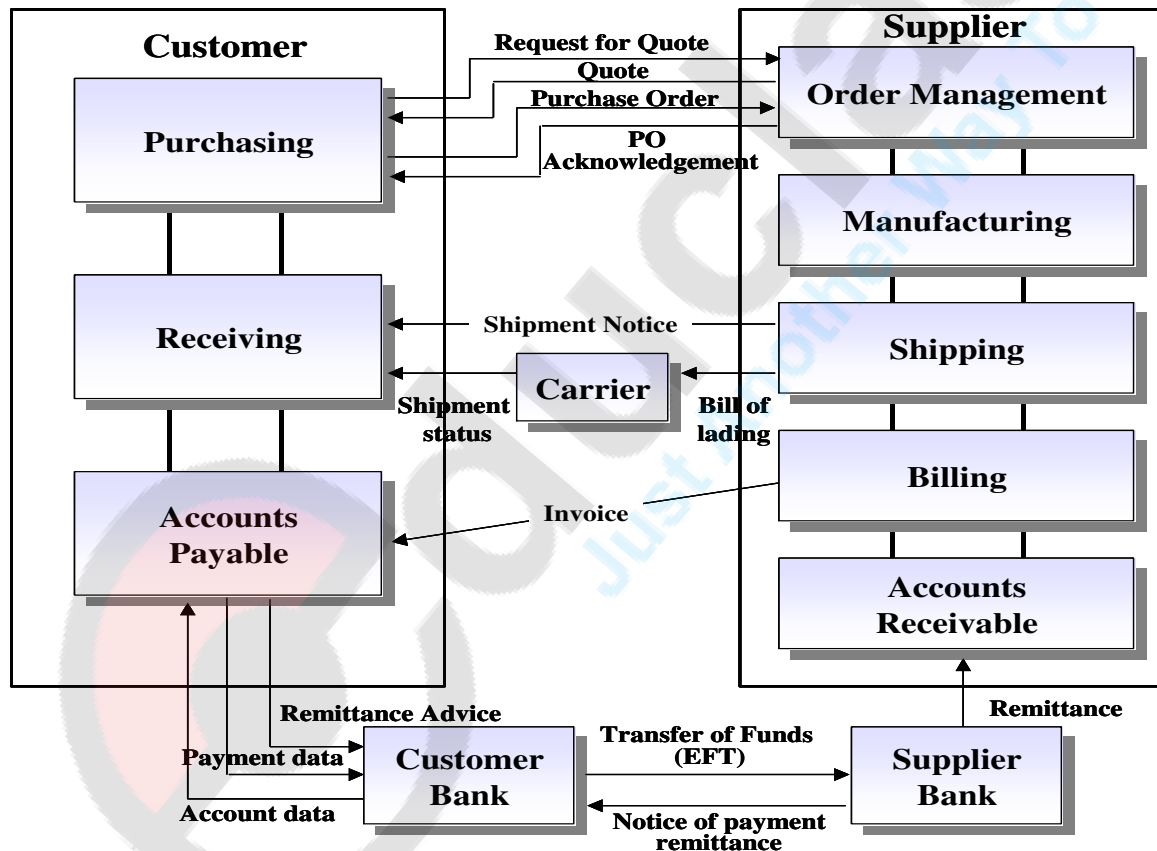& application tools**

Applications
& Tools

EDI – The Infrastructure for e-Business

- Electronic Data Interchange (EDI) is defined as the transfer of structured data by agreed message standards between computer applications.

- A network for transmitting standard transactions

- A paperless trading environment

- Routine documents; purchase order, billings, shipping manifests

- Documents translated into standard business language

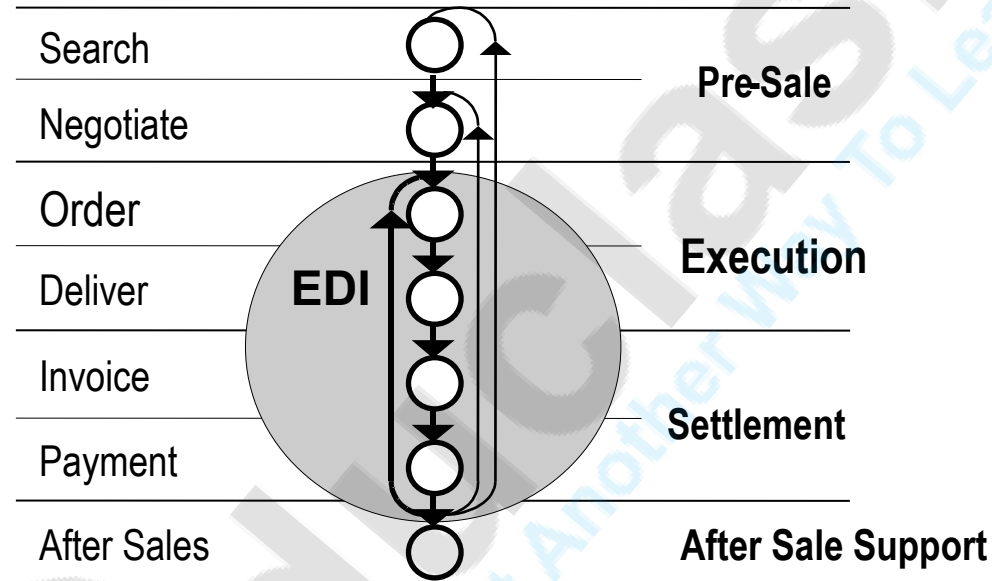- In use since the 1970s on private VANs.

EDI – The Infrastructure for e-Business

There are two key elements in basic EDI.

- Electronic documents replace their paper counterparts.
- The exchange of documents takes place in a standardized format.

EDI Trade Cycle

Search		**Pre-Sale**
Negotiate		
Order	**EDI**	**Execution**
Deliver		
Invoice		**Settlement**
Payment		
After Sales		**After Sale Support**

- Regular, repeat transactions between commercial trading partners
- Examples:
  - Supermarkets replenishing stocks
  - Vehicle assemblers purchasing components

Problems with EDI

- Fixed transaction sets
- Resilience to change
- Reliance on proprietary communications networks
- Encapsulation of business rules in transaction sets