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PHASE 1 – SYSTEM PLANNING

3 Methods:

- **Structured analysis** (based on concept of SDLC *Systems development life cycle*)
- **Object – orientated analysis**
- **Agile methods**

IT combination of hardware, software and services people use to manage, communicate and share info.

Information system combines information technology, people and data to support business requirements.

System analysts plan, develop and maintain information systems

Information systems developed by company itself = **in-house applications**, or purchased = **software packages**.

Mission-critical system is one that is vital to a company's operations.

IS 5 x Main Components:

Hardware – everything in physical layer

Software – programs that control the hardware and produce the desired info or results.
- <u>System Software</u> = manage hardware components (OS, drivers…) Controls flow of data and provide system security and manage network operations.
- <u>Application Software</u> = support day-to-day business functions and provide users with required info. Company-wide apps is called ***enterprise apps*** and include order processing systems, payroll…
  Incl both **horizontal** and **vertical** systems:
  horizontal – can be adapted for use in many different types of companies
  vertical – meet unique requirements of a specific business or industry

Data – raw material, saved in tables.

Processes – tasks and business functions that users, managers and IT staff members perform to achieve specific results. Represent actual day-to-day business operations.

People – People with interest in IS are called **stakeholders.** Include management group, users and IT staff members.

When planning an IS system a company must consider how a new system will interface with older systems which are called **legacy systems**.

UDERSTAND THE BUSINESS!

System analysts use a process called **business process modeling** to represent company operations and info needs and requires a business profile and a series of models that document business processes.

Business Profile is an overview of a company's mission, functions, organization, products, services, customers, suppliers, competitors, constraints and future direction. Starting point of modeling process.

Business Process is specific set of transactions, events, and results that can be described and documented.

(**BPM) Business Process Model** graphically displays one or more business process. For complex operations computer-based modeling tools that use standard language **(BPMN) Business process modeling notation is used** (include various shapes and symbols)

Internet-dependent firm – Amazon
Brick-and-mortar – physical locations

e-Commerce (*electronic commerce***)** or **I-Commerce (***Internet commerce***),** 2 x Main Sectors:

B2C (Business-to-Consumer)

B2B (Business-to-Business) – used **EDI** (Electronic data interchange), enabling computer-to-computer data transfer, plan production etc based on another companies data. **XML** (Extensible markup language) offer std protocols, universal availability and low communication costs… allowing web-based communication between different hardware and software environments.

Popular form of B2B interaction is called (**SCM**) Supply Chain Management or (**SRM**) Supplier relationship management.

Enterprise Computing
IS that support company-wide operations and data management requirements, referred to as (**ERP**) Enterprise resource planning.

Transaction Processing (TP)

Process data generated by day-to-day business operations.

Series of tasks performed by processing a sales order: (processed as one group)
- Verify Cus Data
- Check Credit status
- Post to AR
- Check stock availability
- Adjust Invent Data
- Update Sales Activity File

Business Support

Business Support Systems provide job-related info support to users at all levels of a company. Analyze transactional data, generate info needed to manage and control business processes and provide info that leads to better decision-making. Calles (**MIS**) **Management information systems**.

RFID (radio frequency identification) – Newest development in data acquisition, uses high-frequency radio waves to track physical objects and can track parcels constantly.

Knowledge Management

Also called **expert systems** because they stimulate human reasoning by combining a knowledge base and inference rules that determine how the knowledge is applied.

Knowledge base consist of large database allowing users to find info by entering keywords or question in normal English phrases.

Knowledge management system uses **inference rules** which are logical rules that identify data patterns and relationships. Do not use strict logical rules but a technique called **Fuzzy logic** that allow inferences to be drawn from imprecise relationships. Not black and white like binary logic but shades of gray… Results from fuzzy logic search will display in priority order.

User Productivity

User productivity systems include e-mail, fax, word processing etc. and include **Groupware** (programs run on a company intranet and enable users to share data, collaborate on projects and work in teams.)

Information Systems Integration

Most companies require systems that combine TP, Business Support, Knowledge management and user productivity features.

What information do users need…

Organizational Levels:

- **Top Managers** (develop long-range plans, **strategic plans**, defining company's overall mission and goals.)

- **Middle Managers and knowledge workers** (Provide direction, necessary resources and performance feedback to supervisors and team leaders. Focus is shorter time frame and need more detailed info than top managers.)
  Knowledge workers include professional staff members such as system analysts, programmers, accountants, researchers etc.

- **Supervisors and Team Leaders** (oversee operational employees and carry out day-to-day functions, they coordinate operational tasks and people.)

- **Operational Employees** (include users who rely on TP systems to enter and receive data they need to perform their jobs.

SYSTEM DEVELOPMENT TOOLS consist out of:

Modeling	Prototyping	Computer-Aided System Engineering (CASE)

Modeling

Graphical representation of a concept or process that systems developers can analyze, test and modify.
Business model, or **Requirements model** describes info system must provide.
Data model describes data structures and design
Object model describes object which combine data and processes
Network model describes the design and protocols of telecommunications links
Process model describes the logic that programmers use to write code modules

Prototyping

Test system concepts and provides an opportunity to examine input, output and user interfaces before final decisions are made. Prototype is an early working version of an information system.

CASE

Uses powerful software, called case tools to help systems analyst develop and maintain IS. Provide overall framework for systems development and support wide variety of design methodologies incl structured analysis and object-oriented analysis.

System Development Methods

Structured Analysis	Object-Oriented Analysis	Agile/Adaptive Methods
System in terms of data and the processes that act upon that data. Dev is organized into phases with deliverables and milestones to measure progress. SDLC waterfall model (with phases) Data flow diagrams (DFDs) & process descriptions & Business Process modeling	Views system in terms of objects that combine data and processes. Objects represent actual people, things, transactions and events. More interactive, use waterfall or model with more iteration Various object-orientated diagrams, actors, methods and messages & Business modeling	Intense team-based effort. Dev cycle broken into cycles or iterations that add functionality. Each iteration is designed, built and tested in ongoing process. Spiral model Tools that enhance communications, collaborative software, brainstorming & white boards & Business modeling.
Iteration (repetition) possible between **5 phases**: **1 Systems Planning** (Preliminary Investigation) **2 Systems Analysis** (Sys requirement doc) **3 Systems Design** (Sys Design Specification) **4 Systems Implementation** (Complete Functioning IS) **5 Systems Support and Security** (Operational IS)	Usually follows series of analysis and design phases similar to the SDLC. Phases tend to be more interactive. **Interactive model** that can accurately depict real-world business processes.	**Phases and Tasks *(spiral)*** **Planning** (Define objectives, constraints and deliverables) **Risk Analysis** (Identify risks and develop acceptable resolutions) **Engineering** (Develop prototype that incl all deliverables **Education** (Perform assessment and testing to develop objectives for next iteration)
PRO: Traditional method. Relies on written documentation. Frequent phase iteration can provide flexibility compared to other methods. Well-suited to project management tools.	**PRO:** Integrates easily with O-O programming languages. Code is modular and reusable reducing cost and development time. Easy to maintain and expand as new objects can be cloned using inherited properties	**PRO:** Flexible and efficient in dealing with change. Stresses team interaction and reflects a set of community-based values. Frequent deliverables constantly validate the project and reduce risk.
CON: Changes can be costly. Requirement defined early and can change during development. Users might only be able to describe their needs until they see examples of features and functions.	**CON:** newer so less familiar to Dev team members. Interaction of objects and class can be complex in larger systems.	**CON:** Team members need high level of tech and communication skills. Lack of structure and documentation can introduce risk factors. Overall project might be subject to scope changes as user requirements change.

Project Management is process of planning, scheduling, monitoring, controlling and reporting upon the Dev of an IS.

STRUCTURED ANALYSIS		
Based on overall plan similar to a blueprint for constructing a building, called the **predictive** approach. Technique = **process-centered** Process model shows data that flows in and out of system processes. Inside each process, input data is transformed by **business rules** that generate the output. (**DFD**) Data flow diagram uses various symbols and shapes to represent data flow, processing and storage. In the **waterfall model** the result of each phase is called a **deliverable** or **end product** flowing into next phase.		
1	**Sys Planning**	Usually begins with formal request to the IT department, called a **system request**, describing problems or desired changes in an IS or business process. Purpose of this phase is to perform a **preliminary investigation** to evaluate an IT-related business opportunity or problem. Key part of preliminary investigation is a **feasibility study** that reviews anticipated costs and benefits and recommends a course of actions based on operational, technical, economic and time factors.
2	**Sys Analysis**	Purpose is to build a logical model of the new system. Step 1 is **requirement modeling** where you investigate business processes and document what the new system must do to satisfy users. Perform fact-finding using techniques such as interviews, surveys, doc review, observation and sampling. Results are used to build business models, data and process models, and object models. Deliverable = **system requirements document** (describes management and user requirements, costs and benefits and outlines alternative Dev strategies.
3	**Sys Design**	Purpose is to create a physical model that will satisfy all documented requirements for the system. Design user interface and identify necessary outputs, inputs and processes. Also design internal and external controls, incl computer-based and manual features guaranteeing reliable, accurate, maintainable and secure sys. Deliverable = **system design specification**
4	**Sys Implementation**	New sys is constructed. Programs are written, tested and documented and system is installed. Objective = Deliver complete functioning and documented IS. Final Preparation = converting data to new system's files, training and performing actual transition to new sys. Includes assessment called **systems evaluation** (determine whether sys operates properly and if costs and benefits are within expectations.
5	**Sys Support & Security**	IT staff maintains, enhances and protects the system. Maintenance changes correct errors and adapt to changes in the environment. Enhancements provide new features and benefits. Objective = maximize ROI Well-designed sys must be secure, reliable, maintainable and scalable. **Scalable =** design can expand to meet new business requirements and volumes.

OBJECT-ORIENTED ANALYSIS

Combines data and the processes that act on data into things called **objects**. (Real-world business processes and operations.

And object is a member of a **class** (collection of similar objects).
Objects possess characteristics called **properties** which is inherited from the class or possesses on it's own.

Instructor and Student fall under **person** class.
Person has property called "address" which is inherited by the instructor and student.
Student has property called "major" which is not shared.

Built-in processes (**methods**) can change object's properties. (an ORDER may have property called "status" that can change.

One object can send info to another object using a **message** (request specific behavior or info from another object). ORDER requests address from CUSTOMER.

AGILE METHODS

Attempt to develop system incrementally by building series of prototypes and constantly adjusting them to user requirements.

Emphasizes continuous feedback and each incremental step is affected by what was learned in prior steps.

Iterative DEV boost productivity by using flexible manufacturing system where team-based effort and short-term milestones helped quality up and costs down

OTHER DEVELOPMENT METHODS

2 Popular Methodologies:
JAD (Joint application development) team-based fact-finding which is only one phase of the Dev process.

RAD (Rapid application development) compressed version of entire process.

SYSTEM DEV GUIDELINES

5 Basic systems Dev Guidelines	
Develop a Plan	Prepare plan and stick to it, logical sequence
Involve Users and carefully listen to them	Users must be involved in Dev process, especially when identifying and modeling system requirements
Use Project Management Tools and Techniques	Keep on track, avoid surprises. Reasonable nr of checkpoints
Develop Accurate Cost and Benefit Information	Managers need to be informed
Remain Flexible	Ability to react quickly

INFORMATION TECHNOLOGY DEPARTMENT

6 main Functions:

- **Application Development**
  Provides leadership and overall guidance but systems themselves are developed by teams consisting of users, managers and IT staff members. Popular model is a project-oriented team using RAD or JAD with IT professionals providing overall coordination, guidance and technical support.

- **Systems Support and Security**
  vital protection and maintenance services for hardware and software, incl enterprise computing systems, networks, TP systems & corporate IT infrastructure. Technical support to other groups in IT department, often includes **deployment team** (installs and configure workstations)

- **User Support**
  Provide users with technical info, training and productivity support (help desk or info center)

- **Database Administration**
  data design, management, security, backup and access.

- **Network Administration**
  hardware and software maintenance, support and security. Install, configure, manage, monitor and maintain network apps.

- **Web Support**
  design and construct Web pages, monitor traffic, manage hardware and software and link Web-based apps to company's info systems, important for companies engaged in e-commerce.
- **Quality Assurance (QA)**
  reviews and test all apps and system changes to verify specs and software quality standards.

SYSTEM ANALYST

Investigates, analyzes, designs, develops, installs, evaluates and maintains a company's IS.

Responsibilities = help translate business requirements into IT projects. Help document business profiles, review business processes, select hardware and software packages, design info systems, train users and plan e-commerce Web sites.
Plans projects, develops schedules, estimate costs, conducts meetings, delivers presentations and writes memos, reports and documentation.

KNOWLEDGE, SKILLS AND EDUCATION

Technical Knowledge: State-of-the-art knowledge (internet good resource) learn about technical developments, exchange experiences… attending training courses, on-site and online, Networking with colleagues.

Communication Skills: Strong oral and written and ability to interact with people at all levels.

Business skills: work closely with managers, supervisors and operational employees, must understand operations and processes. Curious, comfortable with financial tools and able to see the big picture.

Critical thinking Skills: include ability to compare, classify, evaluate, recognize patterns, analyze cause-and-effect and apply logic. Often use a what-if approach.

Education: College degree in IS, computer science or business and some IT experience.

Certification: verifies an individual demonstrated a certain level of knowledge and skill on standardized test.

GLOSSARY

brick-and-mortar	Companies conducting business primarily from physical locations
business process	A specific set of transactions, events, tasks, and results that can be described and documented
business process model	Graphically displays one or more business processes
business process modeling	Process used to represent company operations and information needs
business profile	Company overview; the starting point for the modeling process
business support systems	Provide job-related information support to users at all levels of a company
business-to-business	Business sector focused on selling to businesses
business-to-consumer	Business sector focused on selling to consumers
CASE tools	Powerful software used to help develop and maintain information systems
computer-aided systems engineering	Technique that uses CASE tools to help systems analysts develop and maintain information systems
data	Basic facts that are a system's raw material
data model	Describes data structures and design
deliverable	The result of each phase in the waterfall model
empowerment	Trend to give employees more responsibility and accountability
end product	Another term for deliverable
enterprise applications	Company-wide applications
enterprise computing	Information systems that support company-wide operations and date management requirements
expert systems	Systems that simulate human reasoning by combining a knowledge base and inference rules
extensible markup language	Language that allowed company-to-company traffic to migrate to the Internet
feasibility study	Reviews anticipated costs and benefits and recommends a course of action
horizontal system	System that can be adapted for use in many different types of companies
in-house applications	Information systems developed within a company
inference rules	Logical rules that identify data patterns and relationships
knowledge base	Large database that allows users to find information by entering keywords in normal English phrases
knowledge workers	Professional staff members who provide support for the organization's basic functions
mission-critical system	A system vital to a company's operations
modeling	Produces a graphical representation of a concept or process
Moore's Law	Prediction of Gordon Moore that the number of transistors in an integrated circuit would double about every 24 months
predictive	Approach based on an overall plan
process model	Describes the logic that programmers use to write code modules
product-oriented	Companies that manufacture and sell products
prototype	Early working version of an information system

radio frequency identification	High-frequency radio waves used to track physical objects
requirements model	Describes information that a system must provide
software	Programs that control the hardware and produce the desired information or results
software packages	Information systems purchased from outside vendors
strategic plans	Long-range plans that define the company's overall mission and goals
structured analysis	Traditional method of developing information systems that is still widely used
system requirements document	Deliverable of systems analysis phase
system software	Programs that manage system hardware components
systems analysis and design	Step-by-step process for developing high-quality information systems
systems design phase	Phase used to create a physical model that will satisfy all documented requirements for the system
systems evaluation	Assessment to determine whether the system operates properly and if costs and benefits are within expectations
systems planning phase	Beginning phase starting with a systems request
systems request	Describes problems or desired changes in an information system or a business process
systems support and security	Provides vital protection and maintenance services for system hardware and software
systems support and security phase	Phase during which IT staff maintain, enhance, and protect the system
user support	Provides users with technical information, training, and productivity support
Web support	Support function for a company's Internet operations

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PHASE 2 – BUSINESS JUSTIFICATION

OVERVIEW

Business case refers to the reasons, justification for a proposal. A strong business case suggests that the company should pursue the alternative, above other options because it would be in the firm's best interest to do so.

Strategic Plan is like a road map for the future. Plan starts with a missions statement which reflects our purpose, vision and values.

Strategic planning overview

Strategic planning is a dynamic process that identifies specific goals and objectives that support the company's mission.

SWOT analysis:

Strengths

Weaknesses

Opportunities

Threats

Critical success factors are vital objectives that must be achieved for the company to fulfill its mission.

Business Case

Should answer following questions:

- Why we doing the project
- What is the project about
- How does this solution address key business issues
- Cost and how long
- Will productivity loss incur during transition
- Return on investment?
- Risks of doing and not doing the projects
- How to measure success
- What alternatives exist?

Information system projects

Systems request is starting point for most projects – formal way of asking for IT support.

Main reasons for Systems Projects:

- Improved service
- Better performance
- Support for new products and services
- More info
- Stronger controls
- Reduced cost

Factors affecting system Projects:

Internal
External

- Economy
- Governments
- Existing systems and data
- IT Department
- User requests
- Top managers
- Strategic plan
- Technology
- Suppliers
- Customers
- Competitors

Evaluation of systems requests

Companies use **systems review committees** or a **computer resources committee** to evaluate systems projects.

Systems request forms are used by some companies to streamline request process and ensures consistency.

Feasibility

Feasibility tests:

- Operational feasibility
- Technical feasibility
- Economic feasibility
- Schedule feasibility

Operational feasibility

Proposed system will be used effectively after it has been developed.

Questions:

Does management, users support the project and see the need for change?
Will workforce be reduced?
Training needed, resources available?
Will users be involved in planning right from the start?
Will new demands be placed on users, operating changes?
Will customers experience adverse effects and for how long?
Risk to company’s image or goodwill?
Does development schedule conflict with other company priorities?
Legal or ethical issues?

Technical feasibility

Technical resources needed to develop, purchase, install or operate the system.

Questions:

Does company have necessary hardware, software and network resources, can it be acquired?
Needed technical expertise?
Does proposed platform have sufficient capacity for future needs, or can it be expanded?
Prototype required?
Hardware and software environment reliable, will it integrate with other company IS?

Economic feasibility

Projected benefits of proposed system outweigh the estimated costs **TCO** (Total cost of ownership), which include ongoing support and maintenance as well as acquisition costs?

TCO's estimated by:

- People, IT staff and users
- Hardware
- Software, including in-house development as well as purchases
- Formal and informal training
- Licenses and fees
- Consulting expenses
- Facility costs
- Estimated cost of not developing the system or postponing the project.

Tangible benefits
measured in monetary value… result from decrease in expenses, increase in revenue or both:

- New system reducing overtime
- Online package tracking system improving service and decreases the need for clerical staff
- Sophisticated inventory control system cutting excess invent and eliminates production delays.

Intangible benefits

Advantages that are difficult to measure in dollars but important:

- User-friendly system improving employee job satisfaction
- Sales tracking system, better info
- New Web site enhancing company's image.

Schedule feasibility

Project can be implemented in an acceptable time frame. Interaction between time and costs to be considered.

- Can company or IT control factors affection schedule feasibility
- Management established firm timetable for project?
- Conditions to be satisfied during the development of the system.
- Does accelerated schedule pose any risks and are the risks acceptable
- Project management techniques available to coordinate and control project
- Project manager appointed?

Evaluating Feasibility

First Step: Identify and weed out system requests that are not feasible. Ongoing task that must be performed throughout systems development process.

Setting priority

Highest priority goes to projects providing greatest benefit at lowest cost in shortest period of time. But influenced by many factors.

Factors affecting priority:

- Reducing costs? Where, when, how, how much?
- Revenue increase? Where, when, how, how much?
- More information, results measurable?
- System serve customer better?
- Serve organization better?
- Implantation in reasonable time period? How long results last?
- Necessary resources available?

Discretionary and nondiscretionary projects

Discretionary = project where management has a choice in implementing them.

Nondiscretionary = no choice exists.

Preliminary Investigation overview

Analyst to conduct study of systems request and recommend specific action. End result of preliminary investigation is a **report to management**.

Planning Preliminary Investigation – STEPS:

- **STEP 1**

  Understand problem or opportunity.

- **STEP 2**

  Define project scope and constraints

- **STEP 3**

  Perform fact-finding
  - Analyze organizational charts
  - Conduct interviews
  - Review documentation
  - Observe operations
  - Conduct user survey

- **STEP 4**

  Analyze project usability, cost, benefit and schedule data.

- **STEP 5**

  Evaluate feasibility
  - Operational
  - Technical
  - Economic
  - Schedule

- **STEP 6**

  Present results and recommendations to management.

STEP 1 (Understanding problem):

Getting to real cause and not just symptom, popular technique is called **fishbone diagram** or **Ishikawa diagram.**

Main bone is problem with sub-bones representing possible cause of problem. And then ask questions around these.

STEP 2 (Define the project Scope and constraints)

Determining **project scope** means defining the specific boundaries or extent of the project. Projects with a very general (not specific) scope are at risk of expanding gradually without specific authorization, this is called **project creep**. To avoid this the project scope must be as clearly as possible. Also need to identify **constraints** (a requirement of condition that system must satisfy or an outcome that the system must achieve – can be hardware, software, time, policy, law or cost.)

When examining constraints the following characteristics must be identified:

- **Present versus Future**
  now or at future time

- **Internal versus External**
  due to requirement within organization or external force such as government regulation.

- **Mandatory versus Desirable**
  Absolutely essential or merely desirable?

STEP 3 (Fact Finding)

Gather data about project usability, costs, benefits and schedules. Involves various techniques.

- **Analyze organization charts**
  layout of people and position, try and acquire from HR.

- **Conduct interviews**
  Steps:
  1. Determine people to interview
  2. Establish objectives
  3. Develop interview questions
  4. Prepare
  5. Conduct interview
  6. Document interview
  7. Evaluate

- **Review Documentation**
  current system documentation, make sure accurate and up to date.

- **Observe operations**
  Follow and trace actual paths taken by input source documents or output reports. Observe outputs and inputs.

- **Conduct a user survey**
  Design form… larger group, quicker than interviews.

- **Analyze the data**
  Pareto chart widely used tool for visualizing issues needing attention. Drawn as a vertical bar graph… representing various causes of problem.

  XY chart also called the **scatter diagram** is another problem-solving tool.

STEP 4 (Analyze Project usability, cost, benefit and Schedule Data).

- What info you must obtain and how you will gather and analyze it
- Will you conduct interviews, how many people and how much time
- Conduct a survey, who, time?
- How much it will cost to analyze info and prepare report with findings and recommendations?

STEP 5 (Evaluate feasibility)

Analyzed problem/opportunity, now evaluating Projects feasibility.

Operational = included review of user needs, requirements and expectation

Technical = hardware, software and network resources needed.

Economic = Financial analysis tools to assess, cost-benefit data and cost estimate.

Schedule = stakeholder expectations regarding acceptable timing and completion dates.

STEP 6 (Present results and recommendations to management)

Report might consist out of following sections:

- Introduction (overview)
- Systems Request Summary (basis of systems request)
- Findings (results and description of scope, constraints and feasibility)
- Case for Action (summary of case and recommendation.)
- Projects Roles (people who will participate and their roles)
- Time and Cost Estimates (cost acquiring and installing system, and TCO)
- Expected Benefits (tangible and intangible)
- Appendix (supporting info)

Glossary:

biometric devices	Can identify a person by a retina scan or by mapping a facial pattern
business case	Reasons, or justifications, for a proposal
case for action	Summary of project request and a specific recommendation
computer resources committee	Key managers and users that evaluate systems requests
constraint	Requirement or condition that the system must satisfy or an outcome that it must achieve
critical success factors	Vital objectives that must be achieved for a company to fulfill its mission
customer relationship management	Systems that integrate customer-related events and transactions
discretionary projects	Projects where management has a choice in implementing them
economic feasibility	Means the projected benefits outweigh estimated costs
electronic product code	Technology that uses RFID tags to identify and monitor the movement of each individual product
electronic proof of delivery	Customer scans incoming products against a digital shipping list
encryption	Coding of data to keep it safe from unauthorized users
fishbone diagram	An analysis tool that represents the possible causes of a problem as a graphical outline
intangible benefits	Advantages that are difficult to measure in dollars but are important to the company
Ishikawa diagram	Another term for a fishbone diagram
just-in-time inventory systems	Rely on computer-to-computer data exchange to minimize unnecessary inventory
mission statement	Reflects a company's purpose, vision, and values
nondiscretionary projects	Projects where no choice exists
operational feasibility	Means a proposed system will be used effectively after it has been developed
Pareto chart	Vertical bar graph used for visualizing issues that need attention

preliminary investigation	Investigation done to study the systems request and recommend specific action
project creep	Process where scope expands gradually without specific authorization
project scope	Specific boundaries, or extent, of the project
scatter diagram	Another term for an XY chart
schedule feasibility	Means that a project can be implemented in an acceptable time frame
strategic planning	The process of identifying long-term organizational goals, strategies, and resources
SWOT analysis	A management review that looks at strengths, weaknesses, opportunities, and threats
systems request	Formal way of asking for IT support
systems review committee	Another term for computer resources committee
tangible benefits	Benefits that can be measured in dollars
technical feasibility	Refers to technical resources needed to develop, purchase, install, or operate the system
total cost of ownership	Costs of the system, including ongoing support and maintenance costs
XY chart	Shows correlation between two variables

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CHAPTER 4 – DETERMINING REQUIREMENTS

OVERVIEW

Overall objective is to understand proposed project, ensure that it will support business requirements and build solid foundation for system development.

System analysis Activities

Interaction between 3 x modeling.

- **Requirements modeling**

  Fact-finding to describe current system and requirement for new… outputs, inputs, processes, performance and security.

- **Data and process modeling**

  presentations graphical system data and structured analysis, data flowing into a process, business rules and output data flow.

- **Object modeling**

  combines data and processes into objects, represent actual people, things, transactions and events that affect the system.

- **Development strategies**

  Consider various Dev options and prepare for transition to systems design phase. Deliverable = **system requirements document.**

System analysis skills

Analytical skills enable to identify problem, evaluate elements and develop solution.
Interpersonal skills working with people at all organizational levels.

Team-Based techniques = JAD, RAD, Agile Methods.

JAD – Joint Application Development

Users have vital stake in IS and participate fully in Dev process. Users meet at off-site location for period of time to be insulated from the distraction of day-to-day operations. Analyse existing system, obtain user input and expectations and document user requirements. Normally have project leader.

Participants and roles:

JAD Participant	Role
JAD project leader	Develop agenda, facilitator and leads
Top Management	Provides enterprise-level auth and support for project
Managers	Provide department-level support for project and understanding of how project must support business functions and requirements
Users	Operational-level input on current operations, desired changes, input and output requirements, user interface issues
Systems analysts and other IT staff members	Provide technical assistance, security, backup, HW, SW and network capacity.
Recorder	Documents results and work to build system models and develop CASE tool documentation.

Advantages:

Key-users participate effectively and then feel greater sense of ownership in results and support for new system. Accurate statement of requirements and better understanding of goals.

Disadvantages:

Expensive and cumbersome if group is too large.

RAD – Rapid Application Development

Team-based technique, end product is new info system. Rad is complete methodology with 4-phase life cycle. Used to reduce cost and dev time. Relies on prototyping and user involvement.

RAD phases and Activities:

- **Requirement Planning**
  Users, managers and IT staff discuss and agree on needs/scope/constraints and requirements, obtains management auth and continue.

- **User design**
  Build models and prototypes
  Conduct intensive JAD-type sessions.

- **Construction**
  Program and app dev
  Coding
  Unit, integration and system testing

- **Cutover**
  Data conversion
  Full-scale testing
  System changeover
  User training

Objectives:

Cut dev time and expense. Continuous process.

Advantages:

Quickly with cost saving

Disadvantages:

Stresses mechanics of system itself and doesn’t emphasize company’s strategic business needs. Accelerated time cycle allow less time for quality, consistency and design standards.

Agile Methods

Incremental development by building series of prototypes and constantly adjusting them to user requirements.

Scrum is another agile approach. (team members to lunge at each other to achieve their objectives). Mental intense interaction. Scrum sessions have specific guidelines that emphasize time blocks, interaction and team-based activities (pic and chicken (ham and egg restaurant)).

Advantages:

Flexible and efficient in dealing with change. Reflect a set of community-based values. Frequent deliverable constantly validate project and reduce risk.

Disadvantages:

Team member require high level of technical and interpersonal skills. Lack of structure and documentation can introduce risk factors. Subject to significant change in scope as user requirements continue to evolve during the project.

Modeling Tools and Techniques

Help understand design of a system. www.cengagebrain.com navigate to Video Learning Sessions and look at FDD modelling.

Following is used by analysts building models after fact-finding, studying them and determine whether more fact finding is required:

Functional decomposition Diagram

Top-down representation of function or process by breaking them down into lower-level functions and processes. Is like drawing an organization chart. These processes translate into program modules during application development.

Business Process Modeling

Describes one or more business process. Filling a product order, updating cus account. Analysts often create models using a standard language **business process modeling notation (BPMN)** which includes various shapes and symbols to present events, processes and workflows. CASE tools can be used. Overall diagram is called a **pool** and designated customer areas are called **swim lanes**.

ADVANGATE: faster results, fewer errors and reduced cost.

Data Flow Diagrams

Show how system stores, processes and transforms data.

Unified Modeling Language (UML)

Visualizing and documenting software systems design. Object-oriented design concepts. Various graphical tools to represent information system from a user's viewpoint.

Case Diagrams

Visually represents interaction between users and information system. User becomes an **actor** with specific role describing how he interacts with system.

Sequence Diagrams

Shows timing of interactions between objects as they occur. Systems analyst might use sequence diagrams to show all possible outcomes or focus on single scenario.

System Requirements checklist

System requirement is a characteristic or feature that must be included in an info system to satisfy business requirements and be acceptable to users. Serve as benchmarks to measure overall acceptability of finished system.

5 General categories:

- **Outputs**
  Invent system produce daily report with SOH etc.
  Contact Management system generate daily reminder list for all reps.
  Cus analysis system produce quarterly reports comparing to previous quarters.

- **Inputs**
  Manufacturing employees swipe ID cards in online data collection terminals recording labor costs etc.
  Each input form must include certain info (forced)
  Data entry screens must be in uniform.

- **Processes**
  HR system interface properly with existing payroll system
  prescription system must automatically generate insurance claim form
  Video rental system must not execute new rental transaction for cus who have overdue videos.

- **Performance**
  System must support 25 user online simultaneously
  Response time
  Operational 7 days a week

- **Controls**
  Employee record only editable by HR member
  Transactions must have audit trails
  Must not exceed credit limit.

Future Growth, Costs and benefits

Must consider **Scalability** (how system will handle future growth and demands) and **Total Cost of Ownership** (includes all future operational and support costs).

Microsoft have method for measuring total costs and benefits called **Rapid Economic Justification (REJ).**

Fact-Finding

First determine info needed. Ask questions like:

- What business functions are supported by current system
- What strategic objectives and business requirements must be supported by new system?
- What are the benefits and TCO of proposed system
- What transaction will the system process?
- What info needed by users?
- Must system interface with legacy systems?
- What security issues exist?

To get these answers must have Fact-Finding Plan. (who, what, where, when, how and then more importantly, WHY?) or more structured as the Zachman Framework.

Difference between asking what IS being done and what COULD or SHOULD be done.
Who does this? (current system)
Why does this person do it? (current system)
Who should do it? (future system)

Zachman International

Model asking traditional fact-finding questions in system development context. Viewing project from different perspectives.

Interviews

Important fact-finding tool. Planned meeting during which you obtain information from another person.

7 Steps of an Interview:

- **Determine people**
  Right people. During analysis phase speak to people in all levels of organization. In an **informal structure** some people have more influence or knowledge than appears on organization's chart. Your knowledge about formal and informal structures helps determining correct people to interview. Group interviews saves time but foresee problems as well.

- **Establish objectives for interview**
  Determine general areas to be discussed and list facts you want to gather. Try to solicit ideas, suggestions and opinions during interview.

- **Develop interview questions**
  Helps keep track, standard list allows to compare answers from people in same roles. (avoid **leading questions** suggesting or favor a particular reply). Interview should include different kind of Questions:

  Open-ended: Encourage spontaneous and unstructured responses. Determine opinions, attitudes etc. What are users saying about the new system? Is there anything else you can tell me about this topic?

  Closed-ended: limit or restrict the response. When you want specific info to verify facts. Do you review the reports before they are sent out? How many of hours does a clerk receive?

  Range-of-Response: Closed-ended when asking person to evaluate something by providing limited answers to specific responses or on a numeric scale. On a scale of 1-to-10 how effective was your training? Low, medium or high etc.

- **Prepare for the interview**
  Meeting request, keep managers informed when meeting with their staff, follow up the day prior. Send list of topic days before especially when detailed information is needed so person can prepare. Ask interviewer to have docs available if you have questions about them. Decide on location.

- **Conduct the interview**
  Introduce yourself, describe project and explain objectives. Ask questions in order you have prepared them and give interview enough time to answer. Establish good rapport. Concentrate on what is said and notice any nonverbal communication that takes placed, called **engaged listening**. Summarize main points covered and explain next course of action. Thank the person and encourage him to contact you with questions or additional comments. Ask whether they can suggest additional topics for discussion.

- **Document the interview**
  Note taking is acceptable but should be kept to a minimum. Distracts other person. Record info quickly after interview so don't schedule back-to-back interviews.

- **Evaluate the interview**
  try to identify any possible biases. Might try to protect their own area or function and give incomplete answers or they might distort facts.

Structured brainstorming small group of people and take turn to speak
Unstructured brainstorming anyone can speak at any time.

Other Fact-Finding Techniques

- **Document Review**
  but documents can sometimes be outdated. Obtain docs and forms currently in use.

- **Observation**
  of current operating procedures. Allows to verify statements made in interviews about how they really operate. Plan in advance with checklist of specific tasks you want to observe and questions you want to ask.
  - Ask sufficient questions, identify methods of handling situations that are not covered by standard operating procedures.
  - Observe all steps in a transaction and note documents, inputs, outputs and processes involved.
  - Examine each form, record and report
  - Consider each user working in the system. What they do, info they receive and from whom, how regularly interrupted.
  - Talk to people who receive reports and whether it discloses sufficient information.

  Hawthrone Effect: productivity improved during observation whether conditions were made better or worse.

- **Questionnaires and Surveys**
  Where need input from large amount of people. Must contain heading with general instruction.
  - Keep it user-friendly
  - Provide clear instructions
  - Logical order, simple to complex
  - simple terms and wording
  - Limit open-ended questions
  - Include section for general comments.
  - Test on small group of people before distributing it to a large group

- **Sampling**
  Collecting examples of actual documents.

  Example: 200 people have error on statement, you want to speak to 20:
  Systematic sample: every 10th customer would be selected.
  Stratified sample: select 5 from each of the 4 different zip codes.
  Random sample: and 20 customers.

  Must be fair representation.

- **Research**
  Internet, magazines, seminars…

Documentation

Keeping accurate records of interviews, facts, ideas and observations is essential.

Record info as soon as received
Use simplest recording method
Record finding that other can understand it
Organize documentation so related material is located easily.

Personal Information Managers to track of meeting interviews (PDA's)

The systems analysis phase includes 3 activities:
- requirement modeling
- Data and process modeling
- Consideration of development strategies.

Glossary

4G (fourth generation)	The latest wireless standard
actor	The user in a use case diagram, having a specific role that describes how he or she interacts with the system
analytical skills	Skills used to identify a problem, evaluate the key elements, and develop a useful solution
brainstorming	Small group discussion of a specific problem, opportunity, or issue
business process model	Describes one or more business processes
closed-ended questions	Questions that limit or restrict the response
construction phase	Focuses on program and application development tasks similar to the SDLC
cutover phase	Resembles the final tasks in the SDLC implementation phase
engaged listening	Concentrating on what is said and noticing any nonverbal communication that takes place
functional decomposition diagram	Top-down representation of a function or process
Hawthorne Effect	Productivity improves whenever workers know they are being observed
histogram	Vertical bar chart showing the distribution of questionnaire or sampling results
informal structure	Some people have more influence or knowledge than appears on an organizational chart
inputs	Necessary data that enters the system, either manually or in an automated manner
interpersonal skills	Skills used to work with people at all organizational levels, balance conflicting needs of users, and communicate effectively
interview	Planned meeting during which you obtain information from another person
mobile device platform	Operating system for wireless devices
observation	Seeing the current system in action to give additional perspective and a better understanding of system procedure
open-ended questions	Questions that encourage spontaneous and unstructured responses
outputs	Electronic or printed information produced by the system
performance	Refers to system characteristics such as speed, volume, capacity, availability, and reliability
personal digital assistants (PDAs)	Hand-held computers that can handle calendars, schedules, appointments, telephone lists, and calculations
personal information manager (PIM)	Program to keep track of meetings, interviews, appointments, and deadlines
pool	The overall diagram, using BPMN terminology
processes	The logical rules that are applied to transform the data into meaningful information
productivity software	Includes word processing, spreadsheet, database management, presentation graphics, and collaborative software programs
questionnaire	Document containing a number of standard questions that can be sent to many individuals
random sample	A sample selecting any customers
range-of-response questions	Closed-ended questions that ask the person to evaluate something providing limited answers to specific responses

rapid application development	A team-based technique that speeds up information systems development and produces a functioniong information system
Rapid Economic Justification	Microsoft framework to help IT professionals analyze and optimize IT investments
requirements planning phase	Combines elements of the systems planning and analysis phases of the SDLC
sampling	Collecting examples of actual documents when studying an information system
scalability	Refers to a system's ability to handle increased business volume and transactions in the future
scrum	Agile method that involves intense interaction
security	Hardware, software, and procedural controls that safeguard and protect the system and its data from internal or external threats
sequence diagram	Shows the timing of interactions between objects as they occur
site visit	Observing a system in use at another location
smart phone	Merger of various technologies resulting from the rapid growth of wireless communications, eg, the Apple iPhone
stratified sample	A sample broken into categories
survey	Another term for questionnaire
swim lanes	Designated customer areas, using BPMN terminology
system requirement	Characteristic or feature that must be included in an information system to satisfy business requirements and be acceptable to users
system requirements document	End product of systems analysis phase; An overall design for the new system
systematic sample	A sample where every 10th person is chosen, for example
Unified Modeling Language	Widely used method of visualizing and documenting software systems design
unstructured brainstorming	Brainstorming where anyone can speak at any time
use case diagram	Visually represents the interaction between users and the information system
user design phase	Users interact with systems analysts to develop models and prototypes that represent all system processes, outputs, and inputs
Zachman Framework for Enterprise Architecture	Model that asks the traditional fact-finding questions in a systems development context

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PHASE 2 – DATA AND PROCESS ANALYSIS

Data and process Modeling Tools

Graphical techniques to describe an IS, Popular Method is the DFD:

DFD's (DATA FLOW DIAGRAMS)

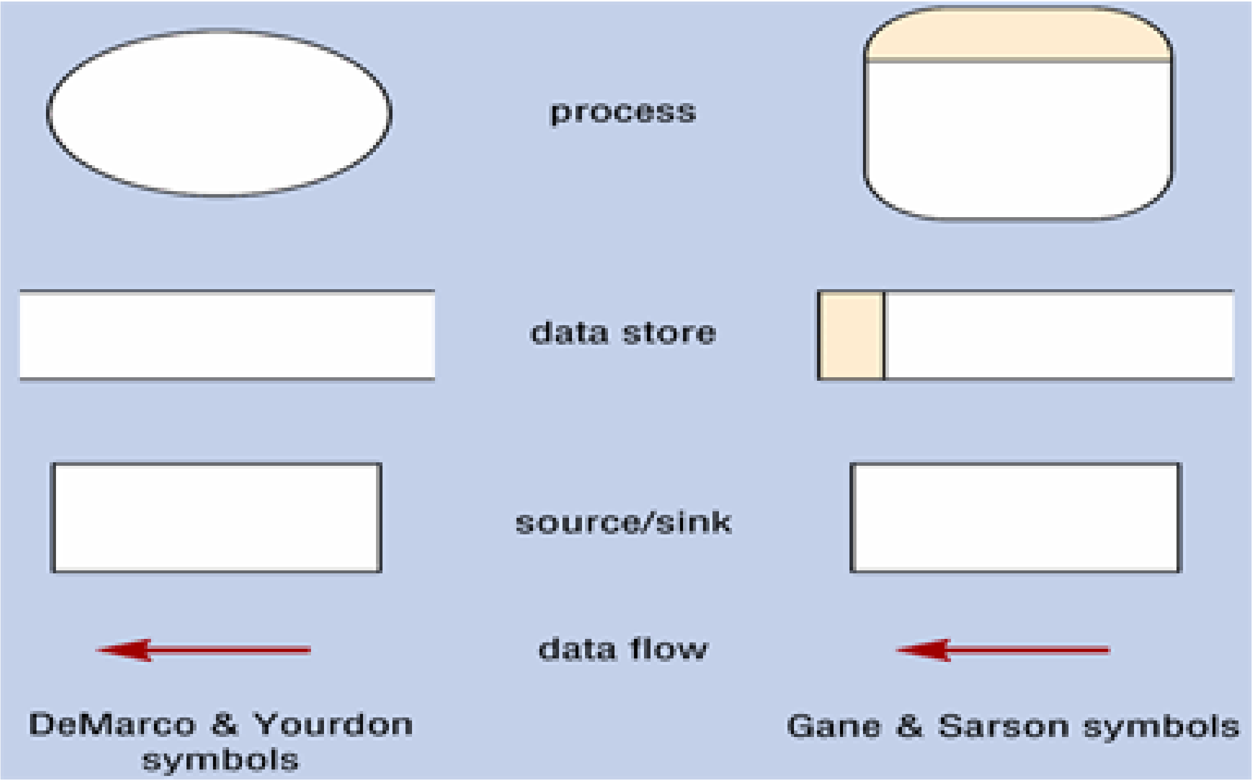
Shows how data moves through an IS but does not show program logic or processing steps. Set of DFD's provides logical model that shows what system does and how.

DFD Symbols:

4 Basic symbols:

- Processes
- Data flows
- Data stores
- Entities

Popular symbol sets is **Gane and Sarson** and **Yourdan,** Symbols are reference by using**all capital letters:**



Process Symbol:

Receives input data and produces output that has different content, form or both.
Example = Calculating Pay (receive Hours and Rate, produces Total)

Processes contain the **business logic** also called **business rules** that transforms data and produce the required results.

Process identifies specific function, name is a verb (and sometime adjective) followed by **singular** noun and appears in the symbol in CAPITALS (Calculate commission, verify order).

In DFD can be referred to as a **BLACK BOX** because inputs, outputs and general functions of process are known but underlying details and logic are hidden. This avoids unnecessary detail and clutter. Can zoom in on process if more detail is required.

Data Flow Symbol:

Path for data to move from one part of IS to another. Can be single data item (Student ID) or set of data (roster with all ID's, names etc.)

Names: (Deposit, Student Grade, Order, Grading).

Process changes data/form, always data flowing in and data flowing out!
one in and out, one in and 2 out, 2 in and 1 out etc…

Incorrect:
both out or both in and if input doesn't make sense with output received.

Spontaneous generation produces output but has no input data flow

Black hole process that has input but produces no output

Gray hole process that has at least one input and output but the input is insufficient to generate outcome shown.

Data Store Symbol:

Data stored because one or more process need to use the data at a later time.

Plural name (noun and adjectives), examples: Students, Products, Accounts Receivable, policies.

Each Data store has at least one in and one outflow of data connected to a process.
Tax Table is example where there will be no input because contains fixed reference data not updated by system.

Entity Symbol

Shows only external entities that provide data or receive output. (shows boundaries of system). (Customer, Patient, Bank).

DFD entities also called **terminators** because they are data origins or final destinations.
Source = Entity supplying data
Sink = Entity receiving data

Must be connected to a process!

Guidelines for drawing DFD's:

- Fit to one page
- Use name of IS as process name in context diagram (Process same as system name) **Grading System.** For processes at a lower level you would use verb followed by descriptive noun (Establish Gradebook)
- Unique names within each set of symbols
- Don't cross lines (no more than 9 process symbols) can make duplicate but make note not to confuse!
- Unique name and reference for each Process. Highest level contains process 0, represent entire IS but not internal workings. Create DFD named Diagram 0 which will show additional process which will be named and numbered as you do lower-level DFD's
- Obtain as much user input and feedback as possible. Model should be accurate, easy to understand and meet needs of users.

Steps to follow:

Step 1: Draw Context Diagram

Top-level view of an IS showing system's boundaries and scope. Single process symbol in middle of page and number it "**0**" This represent entire IS system (Black box). Then place entities and connect with data flow symbols. Data stores not shown yet.

Step 2: Draw a Diagram 0 DFD

To show detail of "0" Black box. Zooms in on system and shows major internal processes, data flows and data stores. It repeats the entities and data flows in the context diagram, retain all connections that flow into and of process 0.

Sub-processes labelled 1, 2… (Establish gradebook 1), (Assign final grade 2) etc.

These numbers are important as they identity a series of DFDs. Doesn't resemble sequential order.

A **diverging data flow** is dataflow in which the same data travels to two or more different locations.

When you explode a DFD the higher-level diagram is called the **parent diagram** and the lower-level diagram the **child diagram**.

When creating a set of DFDs you break the processing logic down into smaller units called **functional primitives** (process that consists of single function that is not exploded further which programmers will use to develop code). Document logic for functional primitive by writing process description in data dictionary.

Step 3: Draw lower-level Diagrams

When drawing lower-level Diagrams **leveling** and **balancing** must be used.

Leveling:
Process of drawing a series of increasingly detailed diagrams until all functional primitives are identified.

Analyst starts with overall view (Context Diagram), then created Diagram 0 which shows more detail, then continues to create lower-level DFD's until all processes are identified as functional primitives which represent single processing functions. Also called: **exploding, partitioning** or **decomposing.**

Processes are numbered using a decimal notation consisting of parent's reference number: 1.1, 1.2, when 1.2 is decomposed further it would be 1.2.1 and 1.2.2 and so forth making it easy to integrate and identify all DFD's.

Balancing:
Maintains consistency among a set of DFDs by ensuring the input and output data flows align properly.

Makes sure input and output data flows of the parent are maintained on the child DFD.
Example: Child still have 2 inputs and 3 outputs after exploded.

Data Dictionary

Detail within DFD's are documented separately in data dictionary which is the second component of structured analysis. A **Data Dictionary** or **Data repository** is a central storehouse of information about the system's data. Used to collect, document and organize specific facts about the system, incl contents of data flows, data stores, entities and processes.

Defines and describes all data elements and meaningful combinations of **data elements** (data item or field which is **smallest** piece of data that has meaning within an IS)
Example: Balance, Company name…
Record is meaningful combination of related data elements. (relationships)
Serves as a **central storehouse** of documentation for an IS

Documenting Data

Provide clear, comprehensive information about the data and processes making up the system.

Documenting Data Elements:

- **Data element name or label**
  standard name which should be meaningful to users.
- **Alias**
  Any name other than standard data element name
- **Type and length**
  numeric, alphabetic and max number of characters.
- **Default Value**
  Default value if not inserted. COD Terms
- **Acceptable Values**
  Set of values permitted. Specifically listed or referenced in a table or from range of values. Can have **validity rules**.
- **Source** can be specific form, department or outside organization
- **Security** Identification for certain users only to be able to update data
- **Responsible users** ID of user(s) responsible for entering or changing values of element.
- **Description and comments** Additional notes.

Documenting Data Flows:

- **Data flow name/label**
- **Description**
  Describe flow and purpose
- **Alternate name(s)**
  Aliases
- **Origin**
  beginning or source (process, data store or entity)
- **Destination**
  Ending point(s) (process, data store or entity)
- **Record**
  represents group of related data
- **Volume and frequency**
  expected number of occurrences for data flow per unit of time.
- **Description and comments** Additional notes.

Documenting Data Stores:

- **Name/label**
- **Description**
  Describe store and purpose
- **Alias**
- **Attributes**
  Standard DFD names that enter or leave the data store
- **Volume and frequency**
  estimated number of records in data store and how frequently updated.

Documenting Processes:

- **Name/label**
- **Description**
  Brief statement of purpose
- **Process number**
  reference number identifying process and indicates relationships among various levels in the system.
- **Process description**
  input and output data flows. For functional primitives the process description also documents the processing steps and business logic.

Documenting Entities

- **Name**
- **Description**
  Entity and its purpose
- **Alias**
- **Input data flows**
  input data flows to entity
- **Output data flows**
  Output data flows leaving the entity

Documenting Records

- **Record or data structure name**
  Record name as it appears in related data flow and data store entries in data dictionary
- **Definition and description**
  Brief definition
- **Alias**
- **Attributes**
  list of all data elements included in record, Data element names must match exactly what you entered in data dictionary,.

Data Dictionary Reports

- List element alphabetically by name
- Report describing each element and indicating the user or department that is responsible for data entry, updating or deletion
- Report of all data flows and data stores that use a particular data element
- Detailed reports showing all characteristics of elements, records, data flows, processes or any other selected item stored in Data dictionary.

Process Description Tools

A **Process description** documents detail of functional primitives and represents a specific set of processing steps and business logic.

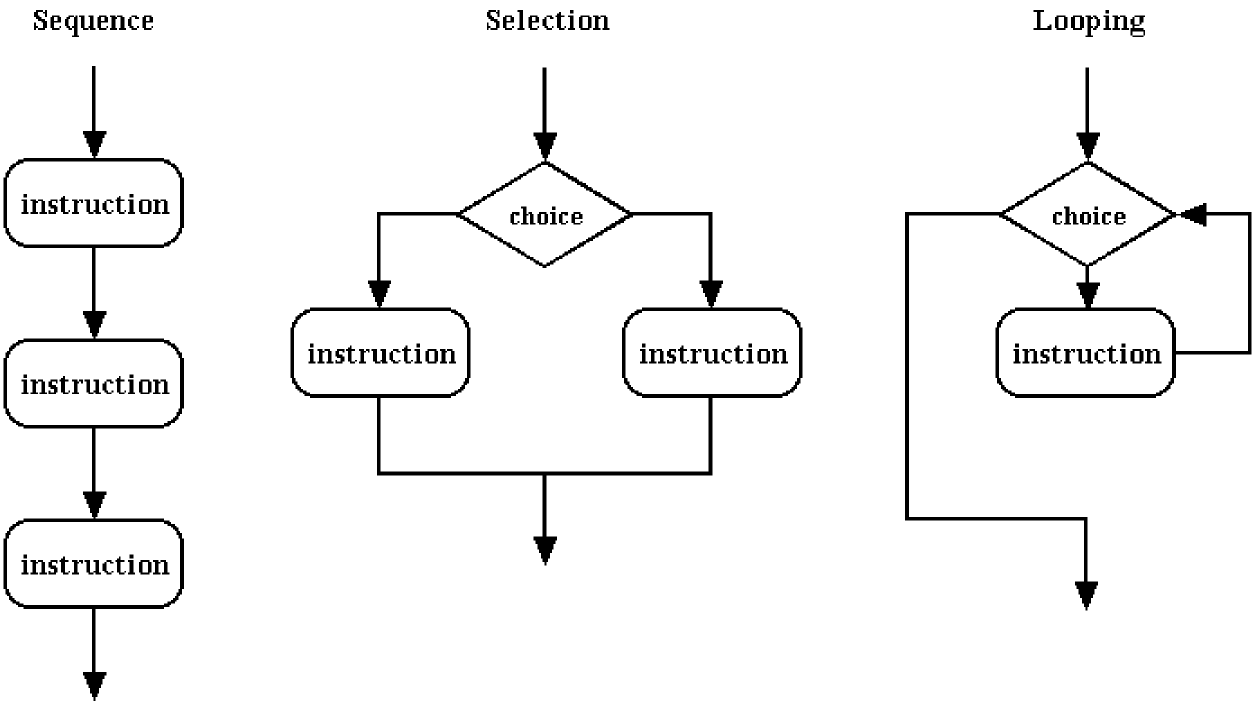
Process Description Tools:

- Structured English
- Decision tables
- Decision trees

Modular Design

When analyzing functional primitive, break processing steps down into smaller units called **modular design. Modular Design** based on combinations of **logical structures (control structures)** serving as building blocks for process. Each structure have a **single** entry and exit point.

Rectangle = step or process
Diamond = condition or decision



- **Sequence** completion of steps in sequential order… one after another.
- **Selection** completion of one of two or more process steps based on results of test or condition.
- **Iteration** completion of process step that is repeated until specific condition changes (**looping)**

Structured English

Subset of standard English describing logical processes clearly and accurately. Following rules apply:

- Use only the 3 building block of sequence, selection and iteration.
- Use indentation for readability
- Use limited vocabulary, including standard terms used in data dictionary and specific words describing processing rules.

Represents **pseudocode** used in program design.

Primary purpose to describe underlying business logic. Must be understandable to users who must confirm that process is correct as well as other analysts and programmers.

Example:

Label: Verify order

Description: Accept or reject customer order based on credit status and product availability

Entry Type: Process

Process Description:

Input data flows: ORDER, CREDIT STATUS PRODUCT DETAIL
Output data flows: REJECTED ORDER, ACCEPTED ORDER

```
For each ORDER
  If CUSTOMER STATUS CODE = Y and if PRODUCT DETAIL = OK
        Output ACCEPTED ORDER

  Else

        Output REJECTED ORDER
```

Decision Tables

Logical structure showing combination of conditions and outcomes.

Table with 1 condition

Only 2 possibilities = Yes or No (Condition available OR not).

Table with 2 conditions

(page 223 in text book)

Process description contains 2 conditions: Product in stock and customer credit status. **Both** must be met for order to be accepted OR gets rejected. (number of rules double each time you add another condition)

Step 1 Place name of process in a heading at the top
Step 2 Enter conditions under heading with one condition per line
Step 3 Enter all potential combinations of Y/N each column shows numbered possibility called a **rule.**
Step 4 Place an X in action entries for each rule to indicate where to accept or reject:

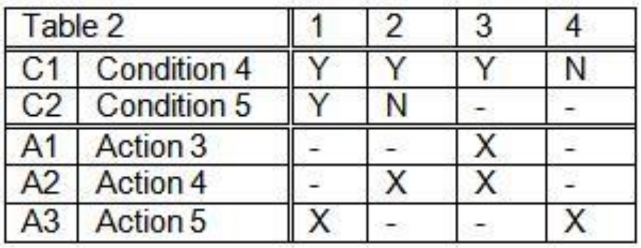
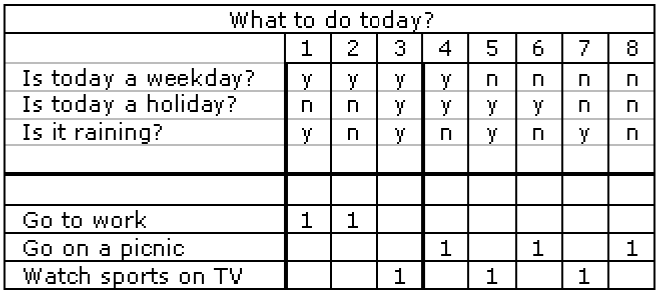


Table 2		1	2	3	4
C1	Condition 4	Y	Y	Y	N
C2	Condition 5	Y	N	-	-
A1	Action 3	-	-	X	-
A2	Action 4	-	X	X	-
A3	Action 5	X	-	-	X

Table with 3 conditions

No there will be 8th possible rule.

Regardless of number of conditions, each numbered column or rule represents a different set of conditions. Analyze the logic carefully and show outcome for each rule. (below ones should be X)



What to do today?								
	1	2	3	4	5	6	7	8
Is today a weekday?	y	y	y	y	n	n	n	n
Is today a holiday?	n	n	y	y	y	y	n	n
Is it raining?	y	n	y	n	y	n	y	n
Go to work	1	1						
Go on a picnic				1		1		1
Watch sports on TV			1		1		1	

Figure 3 Conditions and Actions mapped into a Decision Table – Expanded View

When all outcomes determined you can simplify table in multi-condition table, some rules might be duplicated, redundant or unrealistic, Simply by following these steps:

Step 1 Study each combination of conditions and outcomes. Only one or 2 may control outcome
Step 2 Identify conditions not affecting outcome, mark with dashes (-)
Step 3 Combine and renumber rules

Shown on Page 228 in Text Book.

Multiple Outcomes

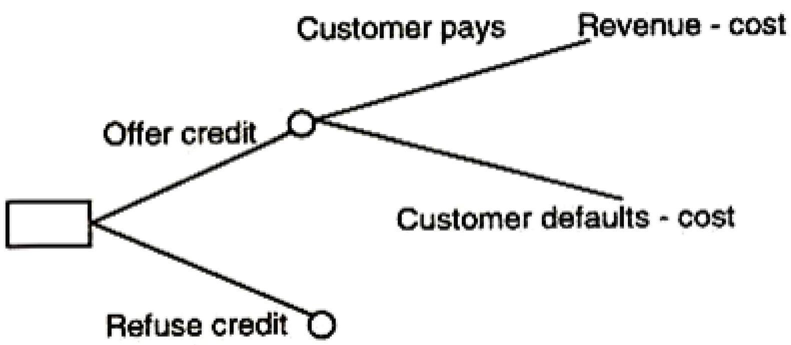
See example on page 228 of text book, very simple.

Decision table are best way to describe complex set of conditions and easy for programmers to work from when developing code.

Decision Trees

Graphical representation of conditions, actions and rules found in a decision table. Logic structure in horizontal form.

Decision tree on credit granting decision



Also see example on page 230

Logical Versus Physical Models

Structured analysis tools used to develop logical model for NEW IS, can use to develop physical models of IS. Physical model shows how system's requirements are implemented. Create physical model of NEW IS that follows from logical model and involves operational tasks and techniques.

Four-Model Approach

Develop physical model of current system…
then Logic model of current system
then Logic model of New system
and lastly physical model of New system.

Benefit: give clear picture of current system functions before you make modifications or improvements.

Disadvantage: added time and cost needed to develop physical and logical model of current system.

Glossary

alias	Any name other than the standard data element name
balancing	Maintains consistency among a set of DFDs by ensuring that input and output data flows align properly
black box	A process symbol in a DFD
black hole	A process that receives input, but produces no output
business rules	Another term for business logic
child diagram	Lower-level diagram in exploded DFD
context diagram	Top-level view of an information system that shows the system's boundaries and scope
control structures	Another term for logical structures
data element	Smallest piece of data that has meaning within an information system
data flow	A path for data to move from one part of the information system to another
data flow diagram	Uses various symbols to show how the system transforms input data into useful information
data item	Another term for data element
data repository	Another term for data dictionary
data store	Symbol used in a DFD to represent data that the system stores for later use
data structure	Another term for record
decision table	Logical structure that shows every combination of conditions and outcomes
decision tree	Graphical representation of the conditions, actions, and rules found in a decision table
decomposing	Another term for leveling
diagram 0	Zooms in on the system to show major internal processes, data flows, and data stores
diverging data flow	Data flow in which the same data travels to two or more different locations
domain	Set of values permitted for the data element
entity	Rectangle, which may be shaded to make it look three-dimensional, used to represent an external entity in a DFD
exploding	Another term for leveling
four-model approach	Developing physical and logical models of both the current system and the new system
functional primitive	Process that consists of a single function that is not exploded further
Gane and Sarson	Symbol set used in DFDs; used in the textbook DFD examples
gray hole	A process that has at least one input and one output, but the input obviously is insufficient to generate the output shown
iteration	Completion of a process step that is repeated until a specific condition changes
length	Maximum number of characters or digits for a data element
leveling	The process of drawing a series of increasingly detailed diagrams, until all functional primitives are identified
logical model	Shows what the system must do, regardless of how it will be implemented physically
logical structures	Serve as the building blocks for the process: sequence, selection, and iteration
looping	Another term for iteration
modular design	Based on combinations of three logical structures

parent diagram	Higher-level diagram in an exploded DFD
partitioning	Another term for leveling
physical model	Describes how the system will be constructed
process	Receives input data and produces output that has a different content, form, or both
process 0	The starting process symbol in a context diagram that represents the entire information system
pseudocode	Used as a shorthand notation for the actual code
record	Meaningful combination of related data elements that is included in a data flow or retained in a data store
selection	Completion of one of two or more process steps based on the results of a test or condition
sequence	Completion of steps in a sequential order, one after another
source	Entity that supplies data to the system
spontaneous generation	A process that produces output, but has no input data flow
structured English	Subset of standard English that describes logical processes clearly and accurately
terminators	Another name for DFD entities, because they are data origins or final destinations
type	Refers to whether the data element contains numeric, alphabetic, or character values
validity rules	Additional rules that may define a data element's domain
Yourdon	Symbol set used in DFDs

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PHASE 2 – OPTIONS FOR DEVELOPMENT

OVERVIEW

Review of internet's impact, software outsourcing options, and in-house software development alternatives.

Impact of the internet

Internet's impact and how it compares to traditional methods:

Software as a service

Traditional model, software vendors develop and sell application packages to customers and customers purchase licenses for right to use them under terms of license agreement.

New model: **SAAS – Software as a service** deployment where app is hosted as service provided over the internet. Reduce need for software maintenance, operation and support.

Traditional vs Web-Based Systems Development

TRADITIONAL DEVELOPMENT:

- System design influenced by compatibility issues, incl existing hardware and software platforms and legacy system requirements.
- System designed to run local and WAN.
- Systems often utilize Internet links and resources but Web-based features are treated as enhancements rather than core elements of the design.
- Follow one of 3 main paths:
  - in-house
  - purchase of SW with possible modification
  - use of outside consultants.
- Scalability effected by network limitations and constraints
- Apps require substantial desktop computing power and resources
- Security issues less complex than with Web-based systems, private company network.

WEB-BASED DEVELOPMENT:

- Developed and delivered in an Internet-based framework .NET or WebSphere.
- Web as platform rather than communication channel.
- Easily scalable, run on multiple HW environments.

- Large firms deploy Web-based systems as enterprise-wide software solutions for apps as CRM, order processing and materials management.
- Software apps as service so less dependent on desktop computing power and resources.
- When as a Service rather than a Product, they purchase, can limit in-house involvement to a minimum and have vendor install, configure and maintain system by paying agree-upon fees.
- Requires additional layers called **middleware** to communicate with existing SW and legacy systems.

Web 2.0 and Cloud Computing

Web 2.0
Second generation of the Web that will enable people to collaborate, interact and share info much more effectively. Based on continuously available user apps rather than static HTML Web pages without limitations regarding the number of users or how they will be able to access, modify and exchange date. Enhance interactive experiences like wikis, blogs and social-net-working.

Cloud computing
Will offer overall online software and data environment supported by supercomputer technology. Ultimate form of SaaS delivery service where users just need Internet connection and a browser.

Outsourcing

Transfer of IS development, operation or maintenance to an outside firm for a fee.
BPO (Business process outsourcing) outsourcing of basic business process.

Growth of Outsourcing

Service provider offers outsourcing solutions. Two popular outsourcing options:

App Service Provider (ASP)

Delivers software app or access to an app by charging usage or subscription fee. Rents operation package to customer, provide SW such as databases and accounting packages.

Internet Business Service (IBS) – managed hosting

Provides Web-based support for transaction such as order processing, billing and CRM.
Advantages:
- online data center support
- mainframe computing power
- Universal access via internet.

Outsourcing Fees

Several models exist:

- **Fixed fee**
  Set fee based on level of service and user support.
- **Subscription**
  Variable fee based on number of users or workstations
- **Usage or transaction**
  Variable fee based on volume of transactions or operations performed.

Outsourcing Issues and concerns

Effects firm's resources, operations and profitability.
Sensitive information, trust to maintain security, confidentiality and quality.
Review insurance, potential liability, licensing and information ownership, warranties and disaster recovery.

Offshore Outsourcing

Also known as **Global outsourcing** practice of shifting IT Dev, support and operations to other countries.
Concerns about project control, security, disparate cultures and effective communication with critical functions.

In-House Software Development

Company develop own system, purchase, possibly customize and implement.
Important consideration = TCO

Make or Buy Decision
Choice between Dev and purchasing.
Software vendors are companies who develop software for sale.
VAR enhances commercial package by adding custom features and configuring it for particular industry.
Horizontal App software package can be used by different types of organizations.
Vertical App software package handle info requirements for specific type of business.

Comparison/Reasons choosing between In-House and buying:

In-House	Purchasing
Satisfy unique business requirements	Lower costs
Minimize changes in business procedures &policies	Less time to implement
Meet constraints of existing systems	Proven reliability and performance benchmarks
Meet constraints of existing technology	Less technical Dev staff
Develop internal resources and capabilities	Future upgrades provided by vendor
Satisfy unique security requirements	Obtain input from other companies

Customizing Software Package

Can customize if needs aren't met in 3 different ways:

- Purchase basic package that vendors will customize to suit your needs. (add-ons)
- Negotiate directly with software vendor to make enhancements to meet your needs an pay for changes.
- Purchase and make own modifications if permissible under terms of software license.

Disadvantages:

- System analysts and programmers unfamiliar with SW
- If customized, modified package costs more and longer to obtain
- Issue with future support
- Future upgrades might not be able to upgrade customized version

Creating User Applications

User App utilizes standard business software such as Excel which has been configured in specific manner to enhance user productivity. Excel linked with system for quick calculations.
IT staff can create a **user interface** (includes screens, commands, controls and features) enabling user to interact more effectively with App.

Main objective is to allow lower-level employees more access to data they require with no intervention from IT department. Accomplished by creating effective user interfaces for company-wide apps such as accounting, inventory and sales systems or customizing Word, Excel etc.

Help desk or Information center (IC) provide technical support in medium-sized companies.

Some apps have powerful **screen generators** and **report generators** allowing users to design own data entry.

Role of Systems Analyst

Objective is to obtain product with lowest TCO but actual cost and performance can be difficult to forecast. When selecting analysts work as an **evaluation and selection team**. Team approach ensure critical factors aren't overlooked and sound choice is made, must include users to participate and feel ownership of new system.

Primary objective is to eliminate system alternatives not meeting requirements, rank alternatives that are feasible and present viable alternatives to management for final decision.

Analyzing Cost and Benefits

Financial analysis tools and techniques applied to evaluate Dev strategies and decide hot project will move forward. Accurate estimate of TCO is critical.

Financial Analysis Tools

Payback analysis determines how long it takes an IS to pay for itself through reduced costs and increased benefits.

ROI (Return on Investment) percentage rate comparing total net benefits received from project to total costs.

NPV Net present value total value of benefits minus total value of costs with both costs and benefits adjusted to reflect point in time at which they occur.

Cost-Benefit Analysis Checklist

- List each Dev strategy considered
- Identify all costs & benefits, indicate when costs will be incurred and benefits realized
- Consider future growth/scalability
- Include support costs for HW and SW.
- Analyze various SW licensing options, including fixed fees and formulas based on # users and transactions.
- Apply financial analysis tools to each options
- Study results and prepare report to management

Software acquisition Process

Step 1: Evaluate IS Requirements

- **Identify Key Features**
  Clear, detailed list of features serving as an overall specification for the system.

- **Consider network and Web-related issues**
  run on a network, internet or intranet?
- **Estimate volume and future growth**
  Show estimates with current activity levels and two forecasts based on existing processing procedures and another that assumes new site is operational.
- **Specify HW, SW or personnel constraints**
  Will it affect acquisition decision and investigate company's policy regarding outsourcing IT functions. Define in-house staffing requirements to Dev, acquire and implement and maintain the system.
- **Prepare a request for Proposal or quotation**

  RFP (Request for Proposal) – Document describes company, lists IT services or products and specifies features you require. Spells out service and support levels you require. Designate some features as essential and others as desirable. Requires pricing and payment terms.
  Can use **evaluation model** (technique uses common yardstick to measure and compare vendor ratings).

  RFQ (Request for Quotation) – More specific than RFP. Already know specific product or service and need to obtain price or bids. Involves outright purchase or variety of leasing options and can include maintenance or technical support terms.

Step 2: Identify Potential Vendors or Outsourcing Options

Through internet or work with consulting firm and can also use Internet bulletin board (system contains thousands of forums called **news groups**), good place to share info and share ideas. Blogs, technical chats, webcasts.

Step 3: Evaluate the Alternatives

Obtain info from as many sources possible. As part of evaluation process information must try and get info from following sources:

- **Existing users**
- **Application Testing** (get users in organization to test product)
- **Benchmarking** measures time package takes to process certain number of transaction and measure other products against it.

Step 4: Perform Cost-Benefit Analysis

Calculate TCO for each option. Try to prepare charts to show results graphically and build “what if” capability. Consider a supplemental **maintenance agreement** (offers additional support and assistance from vendor).

Step 5: Prepare a Recommendation

Recommendation that evaluates and describes the alternatives together with costs, benefits, advantages and disadvantages of each option.

Step 6: Implement the Solution

Tasks depend on solution selected. In-house more time and effort than outsourcing. Network installations if needed. Before new SW becomes operational you must complete all implementation stems including loading, configuring and testing the software, training and converting data files to the new system’s format.

Completion of System Analysis Tasks

To complete Systems analysis phase must prepare the System requirements document and presentation to management.

System Requirement Document

Contains requirements and describes alternatives considered with recommendation to management. Starting point for measuring performance, accuracy and completeness.

Presentation to Management

End of systems analysis phase. System Requirement Document basis for presentations.

- Brief overview of purpose and primary objectives and what decisions need to be made
- Summarize primary viable alternatives (costs, pro’s and con’s)
- Explain evaluation and selection team chose for alternative recommendation
- Allow time for discussion Q & A’s
- Obtain final decision or agree on timetable for next step.

Management will choose one of 5 alternatives:

- **Develop in-house**
  Begin system tasks described in next chapters.
  If outsourcing chosen, work with representatives of service provider

- **Modify current system**

- **Purchase or customize software package**
  Negotiate purchase terms, if no mode plan implementation phase otherwise Systems design phase. If vendor makes mods start planning testing and documentation.

- **Perform additional systems analysis work**
  might be various requests, further investigation, create prototype… action and schedule new follow-up presentation.

- **Stop all further work.**
  File research

Transition to Systems Design

Preparing for Systems Design – requires accurate documentation.

Logical and Physical Design
Logical – "WHAT" must take place, NOT "how"
Physical – like set of blueprints for actual construction of a building. Describe actual processes of entering verifying and storing data.

System Design Guidelines

Step 1
Review system Requirements

Study carefully to understand logical design.

Step 2
Design system

- **User interface, output and input issues**
  Design user interface, screens, commands, controls and features. Input output forms etc.
- **Data issues**
  Determine how data will be organized, stored, maintained, updated, accessed and used.
- **System architecture issues**
  Determine processing strategies and methods, client/server interaction, network config and internet/intranet interface issues.

Step 3
Create system design specification

Describe proposed design.

Step 4
Deliver management presentation

Include progress report, budget update and timetable.

Goal of system Design is for system to be:

- Effective
- Reliable
- Maintainable

User Considerations

- Consider any point where users receive output or provide input
- Anticipate future needs
- Provide flexibility

Parameter is a value that user enters whenever a query is run which provides flexibility and enable users to access info easily.

Data Considerations

- Enter data as soon as possible
- Verify data as it is entered
- Use automated methods of data entry whenever possible
- Control data entry access and report all entries or changes to critical values.
- Log every instance of data entry and changes.
- Enter data once
- Avoid data duplication

Architecture considerations

- Use modular design
- Design modules that perform a single function

Design Trade-Offs

Making system easier to use might need more complex programming requirements. Or making it more flexible increase maintenance requirements. Meeting one makes it more difficult to satisfy another user's needs. Normally Quality versus costs.

Prototyping

Produces early, rapidly constructed working version. Involves repetitive sequence of analysis, design, modeling and testing. Users input essential at every stage.

Prototyping Methods

System Prototyping – produces full-featured working model of IS. System prototype is ready for implementation in the SDLC.

Design Prototyping (throwaway prototyping) – objectives more limited, user-approved model. Makes it possible to capture user input and approval while continuing to develop the system.

Benefits:

- Users and systems developers can avoid misunderstandings
- Developers can create accurate specifications for finished system based on prototype
- Managers evaluate working model more effectively
- Analysts can use to develop testing and training procedures
- Reduces risk and potential financial exposure that occurs when finished system fails

Problems:

- Rapid pace of Dev can create quality problems only discovered when system is fully operational.
- Reliability and maintainability can't be tested.
- In complex systems prototype becomes unwieldy and difficult to manage.

Prototyping Tools

Mainly done in CASE.

4GL (fourth-generation language) commands tend to resemble natural statements that people use.

Limitations of Prototypes

Final version of system demands higher-level performance. Prototype model and not full system, slower and might lack security.

SOA – Service-oriented architecture – Architectural style whose goal is to archive loose coupling among interacting software objects that provide services.

Loose coupling – means that objects can interact but are essentially independent.

Glossary

.NET	Microsoft Web-based development environment
application service provider (ASP)	Firm that delivers a software application, or access to an application, by charging a usage or subscription fee
audit trails	Reports that trace the data entry and changes to critical data values
build or buy	Another term for make or buy
business process outsourcing (BPO)	The outsourcing of a basic business process
cloud computing	Refers to the cloud symbol that indicates a network, or the Internet
evaluation and selection team	Team that selects hardware and software
evaluation model	Technique that uses a common yardstick to measure and compare vendor ratings
fourth-generation environment	Framework for rapid, efficient software development
fourth-generation language (4GL)	Commands tend to resemble natural statements that people use
global outsourcing	Another term for offshore outsourcing
help desk	Responsible for providing user support
horizontal application	Software package that can be used by many different types of organizations
in-house software	Software made, built, or developed by the company's IT department
information center (IC)	Another term for help desk
Internet business services (IBS)	Provide powerful web-based support for transactions such as order processing, billing, and customer relationship management
logical design	Defines what must take place, not how it must take place
loose coupling	Objects can interact, but are essentially independent
maintenance agreement	Offers additional support and assistance from the vendor
make or buy	Choice between developing versus purchasing software
managed hosting	Another term for IBS because system operations are managed by the outside firm, or host
net present value (NPV)	Total value of the benefits minus the total value of the costs of a project
newsgroup	Forum that covers any imaginable topic
offshore outsourcing	Practice of shifting IT development, support, and operations to other countries
outsourcing	The transfer of information systems development, operation, or maintenance to an outside firm
payback analysis	Determines how long it takes an information system to pay for itself through reduced costs

	and increased benefits
physical design	Describes the actual processes of entering, verifying, and storing data
prototype	An early, rapidly constructed version of the proposed information system
prototyping	Produces an early, rapidly constructed version of the proposed information system
report generator	Allows users to design their own reports
request for proposal (RFP)	Document that describes your company, lists the IT services or products you need, and specifies the features you require
request for quotation (RFQ)	More specific than an RFP; Used to obtain price quotations or bids for a specific product or service
return on investment (ROI)	Percentage rate that compares the total net benefits received from a project to the total costs of the project
screen generator	Allows users to design their own data entry forms
service provider	Firm that offers outsourcing solutions
service-oriented architecture (SOA)	An architectural style whose goal is to achieve loose coupling among interfacing software objects that provide services
Software as a Service (Saas)	A model of software deployment where an application is hosted as a service provided over the Internet
software requirements specification	Another term for a systems requirements document
software vendors	Companies that develop software for sale
subscription model	Variable fee based on the number of users or workstations that have access to the application
system prototyping	Produces a full-featured, working model of the information system
system requirements document	Contains the requirements for the new system, describes the alternatives considered, and makes a specific recommendation
systems design	Has as its goal to build a system that satisfies business requirements
transaction model	Another term for a usage model
user application	Utilizes standard business software, which has been configured in a specific manner to enhance user productivity
value-added reseller (VAR)	Firm that enhances a commercial package by adding custom features and configuring it for a particular industry
vertical application	Software package developed to handle information requirements for a specific type of business
Web 2.0	A second generation of the Web that will enable people to collaborate, interact, and share information much more effectively
WebSphere	IBM Web-based development environment
Y2K issue	When some older programs that used only two characters to store the year might not adjust properly to the new century

Table of Contents

PHASE 3 – Designing the Interface

OVERVIEW

UI (User Interface) – describes how users interact with a computer system (all HW, SW, screens, menus, functions, output and features that effect two-way communications between user and computer.

Evolution of UI

UI manly consisted of **process-control** screens that allowed user to send commands to the system, this changed to a more user-centered systems. In **user-centered** system, distinction blurs between input, output and the interface itself.

HCI

HCI describes relationship between computers and people who use them to perform their jobs. It includes all communications and instructions necessary to enter input in to system and obtain output.

GUI (Graphical User Interface) – using icons, graphical objects and pointing devices.

User Rights

IBM's usability expert DR. Clare-Marie Karat notes that "in this new computer age, the customer is not only right, the customer has rights" as listed below:

- **Perspective –** User right, if there is a problem, the system is the problem, not the user.
- **Installation** – User has right to install and uninstall SW and HW easily without negative consequences.
- **Compliance** – System to perform exactly as promised.
- **Instruction** – Easy-to-use instructions
- **Control** – Right to be in control and get system to respond quick.
- **Feedback** – System to provide clear, understandable and accurate info.
- **Dependencies** – Right to be informed clearly about systems requirements
- **Scope** – Know limits of system's capabilities
- **Assistance** – right to communicate with provider and receive thoughtful helpful response
- **Usability** – User should be master of SW and HW, product should be natural and intuitive to use

7 Principles of User-Centered Design

1. Understand Business

Understand underlying business function and how system supports individual, departmental and enterprise goals. Objective to design UI that helps users perform jobs. FDD good starting point.

2. Maximize Graphical Effectiveness

People learn better visually.

3. Think like a User

Understand user experience, knowledge & skill levels. Accommodate novice and experienced users.

4. Use Modes and Prototypes

UI critical part because this is where they interact with the system. Create Prototypes for user approval. Can present initial screen design in form of a **Storyboard** (sketch showing general screen layout and design). Interface designers can obtain data **usability metrics (**software records and measures user interaction with system).

5. Focus on Usability

Interface should include all tasks, commands and communications between users and IS.

6. Invite Feedback

Even after system is operational.

7. Document everything

Document all screen designs for later use by programmers.

Designing UI

Good interface is a combination of:
Ergonomics (how people work, learn and interact).
Aesthetics (how an interface can be made attractive and easy to use.
Interface Technology (operational structure required to carry out design objectives)

8 Basic Guidelines:

1. Transparent Interface

- Facilitate system design objectives rather than calling attention to the interface
- Easy to learn and remember
- Improve user efficiency and productivity
- Commands, actions, and system responses that are consistent and predictable
- Minimize data entry problems
- Users to correct errors easily
- Logical and attractive layout

2. Easy to learn and use

- Clearly label controls, buttons and icons
- Only images users can understand easily and on-screen instructions that are logical, concise and clear.
- Show all command in list of menu items, dim commands not currently available
- Easy to navigate or return to an level in menu structure

3. Enhance Productivity

- Organize tasks, command and functions in groups that resemble actual business operations.
- Alphabetical menu lists or frequently at top (or let users decide).
- Shortcuts avoiding multiple menu levels
- Default values
- Duplicate value function
- Fast-find feature displaying list of possible values when entering first few letters
- **Natural language** allowing users to type commands or requests in normal English phrases

4. Easy for Users to obtain help or correct errors

- Help must always be available
- Provide **User selected help** (when user requests it) and **Context-sensitive help** offer assistance for task in progress
- Provide direct route for users to return to point from where help was requested. Help text should be simple and concise.
- Include contact info
- Require user confirmation before data deletion (Are you sure?) and method of recovering data
- Provide Undo key
- If user-entered command contains error, highlight erroneous part
- Hypertext links to navigate through help topics

5. Minimize input data problems

- Create **input masks** (templates or patterns) and allow data validation rules.
- Event-driven messages and reminders.
- List of predefined values that users can select
- Build rules for data integrity (info needed before action can be performed)

6. Provide feedback to users

- Messages at logical place on screen
- Alert users to lengthy processing times or delays, on-screen progress report
- Message on screen long enough for users to read them
- Let user know if task or operation was successful or not
- Provide text explanation if icon or image is used
- Use specific, understandable and professional messages

7. Attractive layout and design

- Appropriate colors
- Use special effects sparingly
- Hyperlinks
- Group related objects and info
- Screen density and keep uncluttered
- Display titles, messages and instruction in consistent manner
- Consistent terminology
- Commands always have same effect
- Similar mouse actions (double-clicking example)

8. Familiar terms and images

- Green = Go, Red = Stop etc
- Provide keystroke (easy to remember) File, Exit.
- Familiar commands (Cut, Copy and paste)
- Windows look and feel if user used to Windows
- Avoid complex terms.

Control Features

- **Menu bar** – top of screen and display menu options
- **Toolbar** – contains icons or buttons representing shortcuts
- **Command button** – initiates action such as printing
- **Dialog box** – user insert info about task
- **Text box** – User insert data
- **Toggle button** – represent on or off status
- **List box** – list of choices
- **Drop**-down list box – show current selection when user clicks arrow
- **Option button (radio button)** – one or more choices from group
- **Check Box** – select one or more choices from a group
- **Calendar control** – allow user to select date

A **switchboard** uses command buttons enabling users to navigate system and select from groups of related tasks

Output Design

Questions before Designing output:

- Purpose?
- Who, why and how will it be used?
- What specific info to be included?
- Output be printed, on-screen or both?
- When and how often?
- Security or confidentiality issues?

Report Design

Different ways to view (screen, print) must obtain info user needs, not too much or too few resulting in no value, different type of reports:

Detail Reports

One or more lines of output for each record processed. Each line is called a **detail line**. (SOH, info for each line).

Exception Reports

Displays only records that meet a specific condition or conditions. (only view due accounts or only view employees who worked overtime.

Summary Reports

Upper-level managers want to see total figures. Sales per rep and not each sale.

User Involvement in Report Design

Design **mock-up** report or prototype for users to review. This can be on word or Exce, when approved you should document design by creating a **report analysis form** which contain info about the layout fields, frequency distribution, data security considerations and other issues.

Report Design Principles

Printed reports to be attractive, professional and easy to read. When value of a control field changes, a **control break** occurs which usually causes specific actions such as printing subtotals for a group of records, that type of detail report is called a **control break report.** To produce a control break report the records must be arranged, or sorted in **control field order.**

Design Features:

- **Report Headers and Footers**
  Header identify report with date and necessary info
  Footer can include Grand totals for numeric fields etc.

- **Page Header and Footers**
  Header appear at top of page with column heading identifying data
  Footer at bottom of page and is used to display report title and page number.

- **Column Heading Alignment**
  Left-adjustment for name fields, Right-adjustment for numeric fields

- **Column Spacing**
  Crowded report is hard to read, and large gaps make if difficult for the eye to follow

- **Field Order**
  Displayed and Grouped in Logical order

- **Grouping Detail Lines**
  Based on control field, Can print a **Group Header** and a **Group Footer**.

- **Repeating Fields**
  Store number repeated on every row… find out from users. Show 0 values or not.

- **Consistent Design**
  Reports should be uniform and consistent. Abbreviations should also be consistent.

Output Technology Types

Various output types exist, listed below:

- **Internet-based Information Delivery**
  Output displayed online (catalogue with SOH)
  Webcasts (audio or video media files)

- **E-Mail**
  Confirming online stock trades, replaced memos and printed correspondence

- **Blogs**
  Web-based output, written from particular point of view. Review Products…

- **Instant Messaging**
  communicate over internet.

- **Wireless Devices**
  Mobile, handheld computers, phones.

- **Digital Audio, Images and Video**
  Transmitted as output to users who reproduce the content. Attach to email, sent as clip.

- **Podcasts**
  specially formatted digital audio file downloaded by Internet users. Used as sales and marketing tool.

- **Automated Facsimile Systems**
  allows customer to request a fax using e-mail.

- **Computer Output to Microfilm (COM)**
  Scan and store images of original docs to provide high-quality records management and archiving. Legal reasons, display signature, date stamp or other visual features.

- **Computer Output to Digital Media**
  Storing paper apps (insurance) and retrieved quickly. Magnetic tape, CDs, DVD's

- **Specialized Forms of output**
  Portable Web-connected devices running apps and so forth
  Retail POS, credit card transactions, print receipts
  ATM's, deposit slip
  Plotters

Input Design

GIGO!! ☺ Good input design requires attention to human factors as well as technology issues.

Source Documents and Forms

Source documents collects input data, provides a record of the original transaction. Generally paper based but also provided online. Good **form layout** makes form easy to complete. Data entry positions to be marked clearly with blank lines or boxes and descriptive captions.

Different Zones:

- Heading zone (company name or logo)
- Control zone (Codes, identification, numbers)
- Instruction zone (instructions for competing form)
- Body zone (at least half the page)
- Totals zone
- Authorization zone (signatures)

Data Entry Screens

Data capture uses automated or manually operated device to identify source data and convert it into computer-readable form.
Devices = Credit card scanners, barcode readers.

Data entry is manually entering data, keystrokes, mouse, touch screens.

Most effective is **form filling** where blank form that duplicates or resemble source document is completed on screen.

Guidelines to design data entry screens:

- User access only to screen locations where data is entered.
- Descriptive caption for every field
- Sample format (YYYY/MM/DD)
- Require ending keystroke for every field (Enter)
- Do not require user to type 0's 045 or trailing zeroes 98.00
- Display default values and use when field value will be constant for successive records
- Display list of acceptable values for fields
- Provide way to leave data entry screen at any time
- Provide users with opportunity to confirm accuracy (Add this record? Y/N)
- Provide menus for users to move among fields in any way they choose
- Screen layout to match layout of source doc
- Allow users to add, change, delete and view records
- Method to allow users to search for specific info

Input Masks

Templates or patterns restricting data entry and prevent errors. Mask can manipulate input data and apply specific format. First lower case letter changed to capital.

Characters defining input masks:

- 0 – must enter digit (0-9)
- 9 – can enter a digit (0-9)
- # - user can insert digit, space plus, if skipped, access enters blank space
- L – user must insert letter
- ? – user can insert letter
- A - must enter letter or a digit
- a – can insert letter or digit
- & - must enter character or space
- C – can enter character or spaces
- .,:;-/ - Decimal and thousands placeholders, date and time separators – Regional settings
- > - Converts all characters that follow to uppercase
- < - Converts all characters that follow to lowercase

Validation Rules

Reducing number of input errors improves data quality, done by eliminating unnecessary data entry. A **data validation rule** improves input quality by testing data and rejecting any entry that fails to meet specified conditions.

Example of 8 Validation Rules:

- **Sequence check**
  If data must be in predetermined sequence

- **Existence check**
  Used for mandatory data items, will not allow to save record till suitable value is inserted (Item Group)

- **Data Type check**
  Numeric

- **Range Check**
  Certain values or **limit** check

- **Reasonableness check**
  If valid but unusual, verify it with this check

- **Validity check**
  if data must have certain values (referential integrity) new customer number not matching number already stored.

- **Combination Check**
  on 2 or more fields to ensure consistent and reasonable (field alone valid but in combination not)

- **Batch controls**
  Record counts and numeric field totals checked. If system total don't match input totals data entry error occurred. Batch control totals often are called **hash totals**.

Input Technology

Input methods should be cost-efficient, timely and simple as possible.

INPUT TECHNOLOTY		
Traditional	**Evolving**	**Emerging**
Keyboard	Body motion detection	Brain-Computer Interface (BCI)
Mouse	Advanced voice recognition	Neural networks
Pointing Devices	Biological feedback	Artificial Intelligence (AI)
Microphone	Embedded magnetic data	Advanced motion sensors
OCR (optical character recognition)	RFID	Two-way satellite interface
MICR (magnetic ink character recognition)	Advanced optical recognition	Virtual environments
Graphic input devices	Physical adaptation devices	3-D Technology

- **Batch Input** specific time schedule. Enters data as **batch**.

- **Online Input** (online data entry)
  Immediate validation and availability of data
  source data automation popular which combines online data and automated data capture using input devices such as RFID tags or magnetic data strips – Fast and accurate
  Examples of Source data automation:
  - POS (barcode scanners, magnetic swipe scanners)
  - ATM
  - Magnetic employee ID cards
  - Patient ID bracelets
  - Retail stores portable bar code scanners

Tradeoffs

Online advantages but more expensive than batch, decision depends on business requirements.

Input Volume reduction

1. Input necessary data ONLY
2. Do NOT input data user can retrieve from system files or calculate from other data
3. Do not input constant data, if orders in batch with same date then user should enter the order date only once for the first order in the batch.
4. Use codes, they are shorter than the data they represent.

Security and Control issues

Must protect data, own info and that of the customers, employees and suppliers.

Output Security and Control

Control

- Must be accurate complete, current and secure.
- Reports must have code, printing date and time period covered with pages numbered consecutively.

Security

- Privacy rights and shields organization’s proprietary data from theft or unauthorized access.
- Limit number of printed copies and use tracking procedure to account for each copy
- Procedure to ensure output delivered to authorized recipients only
- Where possible security should be designed into system by using passwords, holding sensitive data and controlling user access
- Some firms have **diskless workstation** = network terminal that supports full-featured user interface but limits printing or copying of data except to certain network resources that can be monitored and controlled.

Input Security and Control

Control

- When batch input used computer can produce input log file that identifies documents the date entered
- Should be traceable – **audit trail**
- Company must have procedures for handling source documents to ensure data not lost before entering the system

Security

- **Data recovery utilities should be able to restore lost or damaged data**
- **Company should have a records retention policy** that meet legal requirements and business needs.
- Protect data from unauthorized access. Allow user to view credit limit but not change it
- Sensitive data can be **encrypted** or coded (only users with decoding software can read it).

Glossary

aesthetics	Focuses on how an interface can be made attractive and easy to use
audit trail	Records the source of each data item and when it entered the system
authorization zone	Contains any required signatures
batch controls	Totals used to verify batch input
batch input	Data that is entered on a specified time schedule
body zone	The main part of the form; contains captions and areas for entering viable data
calendar control	Allows the user to select a date that the system will use as a field value
command button	Initiates an action such as printing a form or requesting help
context-sensitive	Help that offers assistance for the task in progress
control break report	Detail report created as the result of a control break
control field	Field that controls the output
control zone	Contains codes, identification information, numbers, and dates that are used for storing completed forms
data capture	Uses an automated or manually operated device to identify source data and convert it into computer-readable form
data security	Policies and procedures that protect data from loss or damage
data validation rule	Improves input quality by testing the data and rejecting any entry that fails to meet specified conditions
detail report	Produces one or more lines of output for each record processed
diskless workstation	Network terminal that supports a full-featured user interface, but limits the printing or copying of data
drop-down list box	Displays the current selection; when the user clicks the arrow, a list of the available choices displays
encrypted	Coded
encryption	The coding of data so that only users with decoding software can read it
exception report	Displays only those records that meet a specific condition or conditions
existence check	Used for mandatory data items
faxback	Another term for automated facsimile
form filling	Most effective method of online data entry in which a blank form that duplicates the source document is completed on the screen
form layout	Good ____ makes the form easy to complete and provides enough space for users to enter data
garbage in, garbage out	Means the quality of the output is only as good as the quality of the input
graphical user interface (GUI)	Interface that uses icons, graphical, and pointing devices
group header	Appears above the first detail line in a group
input control	Includes the necessary measures to ensure that input data is correct, complete, and secure
list box	Displays a list of choices that the user can select
menu bar	Feature at the top of the screen that displays the main menu options

mock-up	A sample report used in designing a report
natural language	Feature that allows users to type commands or requests in normal English phrases
online data entry	Date entry over the Internet
output control	Methods to maintain output integrity and security
page header	Appears at the top of a page and includes the column headings that identify the data
podcast	Specially formatted digital audio file that can be downloaded by Internet users from a variety of content providers
radio button	Another term for option button
range check	Tests data items to verify that they fall between a specified minimum and maximum value
reasonableness check	Identifies values that are questionable, but not necessarily wrong
records retention policy	Governs the storage of source documents in a safe location for a specified length of time
referential integrity	Checking that a value entered refers to another value
report header	Appears at the beginning of a report and identifies the report
RFID tag	Type of input device for online data entry
text box	Can display messages or provide a place for a user to enter data
turnaround documents	Output documents that are later entered back into the same or another information system
usability metrics	Data regarding user interaction with a system
user interface (UI)	Describes how users interact with a computer system
user-centered	System where the distinction blurs between input, output, and the interface itself
Webcast	Audio or video media file distributed over the Internet

Table of Contents

PHASE 3 – Designing the Data

OVERVIEW

How data will be organized, stored and managed.

Data Design Concepts

Analyst must understand basic data design concepts including data structures and characteristics of file-oriented and DB management systems including Web-based design.

Data Structures

Is framework for organizing, storing and managing data, consist of files (tables) that interact in various ways. Each **file** or **table** contains data. Depending on how files and tables are designed an IS is called a **file-oriented system** or a **database management system**.

File-Oriented System

(File processing system) stores data in one or more separate files. Same data is stored in more than one location, this redundancy is a major disadvantage of file-oriented systems because it reduces efficiency and data quality.

Database Management System

All tables are connected by common fields like a customer number. Common field connecting two tables is said to *link, join* or *relate* the tables. This design also is called a **relational database** or **relational model**. Most popular approach.

Overview of File Processing

Older approach but some companies still use. Can be cost-effective in certain situations. In typical file processing environment a company might have 3 departments each with its own IS and data files.

3 Potential Problems:

- **Data redundancy** (more storage and maintaining and updating data in several locations is expensive.
- **Data integrity** problems occur if updates are not applied in every file and data only changed in one system will have different info in other.
- **Rigid data structure** when info is needed for decisions retrieving info from independent, file-based systems will be slow and inefficient.

File-oriented IS can contain various types of files:

- **Master File** – Relatively permanent data (Product)
- **Table File** – Reference data, also relatively static (Tax Table)
- **Transactional File** – records contain day-to-day business and operational data, this updates master file (payments file)
- **Work File** – Temporary file created by IS for single task (report files)
- **Security File** – saved for backup and recovery purposes (audit trail files)
- **History File** – Archiving purposes (Inactive student file)

Database System

Overall framework avoids data redundancy and supports real-time, dynamic environment. Several systems can be built around a single database.

A **DBMS (Database Management system)** is a collection of tools, features and interfaces that enables users to add, update, manage, access and analyze the contents of a set of data.
Main Advantage = offers timely, interactive and flexible data access, more advantages:

- **Scalability**
  System can be expanded, modified or downsized easily

- **Client/server better support**
  Processing is distributed throughout the organization.

- **Economy of scale**
  Better utilization of hardware. Powerful mainframe server less expensive than several smaller computers.

- **Flexible data sharing**
  Data shared across enterprise allowing more users to access more data.

- **Enterprise-wide application**
  DBA assess requirements and maintains the DB for benefit of entire organization rather than single department or user.

- **Stronger standards**
  Uniformity

- **Controlled redundancy**
  Storing data in one place

- **Better Security**
  DBA can define authorization procedures to ensure only legitimate users can access DB and allow different users to have different levels of access.

- **Increased Programmer productivity**
  Do not have to create the underlying file structure for a DB, concentrate on logical design.

- **Data independence**
  Flexibility to alter data structures without modifying IS that use the data.

DBMS Components

When users, database administrators and related information systems request data and services, the DBMS processes the request, manipulates the data and provides a response.

- **Users**
  Work with predefined queries and switchboard commands, also use **query language** (specify a task without specifying how the task will be accomplished).
  QBE (Query by example) resemble ordinary English sentences
  SQL (Structured query language) allow client workstation to communicate with servers

- **DBA (Database Administrators)**
  Responsible for DBMS management and support. Data security, integrity and preventing unauthorized access. Backup recovery, audit trails.

- **Related Information Systems**
  Support several related IS that provides input to and requires specific data from. No human interaction needed.

- **DML (Data Manipulation Language)**
  Control DB operations, storing, retrieving, updating and deleting data.

- **Schema**
  Complete definition of DB including descriptions of all fields, tables and relationships. Also have **subschema** which is a view of the DB used by one or more systems or users (defines only portions of DB that a particular user needs or is allowed to access). (read, view, edit rights in AX)

- **Physical Data Repository**
  contains Schema and subschemas. Might be centralized or distributed. Companies use **ODBC (Open DB connectivity)** enabling communication among various systems and DBMSs, makes it possible for software from different vendors to interact and exchange data.
  Other standard **JDBC (Java database connectivity)** enables Java apps to exchange data with any DB that uses SQL statements and is JDBC-compliant.

Web-Based Database Design

Characteristics

Internet serves as interface. Provides power and flexibility because not tied to any specific combination of hardware and software.

CHARACTERISTIC	EXPLANATION
Global access	Worldwide access, using existing infrastructure and standard telecommunications protocols
Ease of use	Web browsers provide familiar interface, user-friendly and easy to learn
Multiple platforms	Not dependent on specific combo of HW and SW, just browser and internet connection
Cost effectiveness	Only browser and Web-based systems do not require powerful workstations. Flexibility is high, numerous outsourcing options exist for Dev, hosting, maintenance and system support
Security issues	Universal issue but Internet connectivity raises special concerns
Adaptability issues	Migrating a traditional DB design to Web can require design modification, additional SW and some added expense

Internet Terminology

Web Browser – app enabling user to navigate, browse internet

Web page – is text document written in **HTML** (Hypertext Markup Language)

Tags – Formatting codes used by HTML which specify how text and visual elements will be displayed

Web server – where Web pages are stored

Web site – Web pages and Web server together

Intranet – Private, company-owned network to provide Web-based access to internal users

Extranet – Extension of a company intranet allowing access by external users (customers/suppliers)

Web-centric – Intranets and extranet use same **protocols** (data transmission standards) as the internet

Connecting a Database to the Web

DB must be connected to the Internet or intranet. DB and Internet speak different languages, objective is to connect DB to Web and enable data to be viewed and updated.

To bridge the gap it is necessary to use **middleware** (software integrates different apps and allows them to exchange data. Middleware interpret client requests in HTML form and translate requests into commands DB can execute.

4 Steps:

1. Client workstation requests a Web page
2. Web server uses middleware to generate a data query to DB server
3. DB server responds
4. Middleware translates retrieved data into an HTML page that can be sent by the Web server and displayed by user's browser.

Data Security

Well-designed systems provide security at 3 levels:

- DB itself
- Web server
- Telecommunication links that connect components of the system.

Data Design Terminology

Data design terms include the following Definitions:

- **Entity**
  Person, place, thing or event for which data is collected & maintained.(Customer, order)

- **Table or File**
  Contains set related records (2-dim structures consisting of vertical columns & horizontal rows.

- **Fiel**d
  Also called **attribute**, single characteristic or fact about entity. A **common field** is an attribute that appears in more than one entity.

- **Record**
  Also called **tuple** (set of related fields)

Data design use **key fields** to organize, access and maintain data structures. Contain following keys:

- **Primary Key (PK)**
  Field or combination of fields that uniquely and minimally identifies particular member of an entity. (Student Number)
  Can also be **combination key** (Composite key) (Student ID + Course ID).

- **Candidate Key**
  Any field that can serve as PK.
  Any field that is not a primary key or candidate key is called a **nonkey field.**

- **Foreign Key**
  Is a field in one table that must match primary key value in another table to establish the relationship. Foreign key need to be unique and can appear more than once in record unlike PK.

- **Secondary Key**
  Field or combination of fields that can be used to access or retrieve records. Values are not unique. Can be used to sort or display record in a certain order.

Referential Integrity

Set of rules that avoids data inconsistency and quality problems. In relational DB, referential integrity means that a foreign key value cannot be entered in one table unless it matches an existing PK in another table.

Without referential Integrity you might have an order called an **orphan** because it had no related customer (customer not created). RI will now allow order to be created if customer doesn't exist.

RI will also prevent deletion of a record if record has a PK that matches FK in another table.

Entity-Relationship Diagrams

IS must recognize relationships among entities. **ERD** is a model showing logical relationships and interaction among system entities. Overall view of system and blueprint for creating physical data structures.

Drawing an ERD

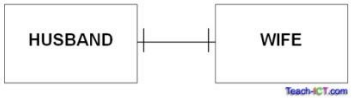
List entities and consider nature of relationships that link them. Unlike data flow diagrams, ERD depict relationships and not data or information flows.

Types of Relationships

One-to-One (1:1)

Office Manager – Heads – Office
Vehicle ID number – Assigned to – Vehicle
Department Head – Chairs – Department

One-to-one relationship



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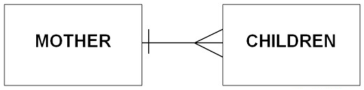
One-to-Many (1:M)

When one occurrence of first entity can relate to many instances of second entity.

Department –Employs – Employees
Individual – owns – Automobile
Customer – Places - Order

One-to-many (or many-to-one) relationships

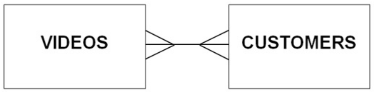


Many-to-Many (M:N)

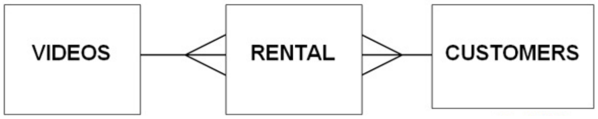
One instance of 1st entity can relate to many instances of 2nd entity and one instance of 2nd entity to many instances of 1st entity. Not allowed when designing a DB, must find a way to make M:N into 1:M

Student – Enrolls in – Class
Passenger – Reserves seat on – Flight

Many-to-many relationships

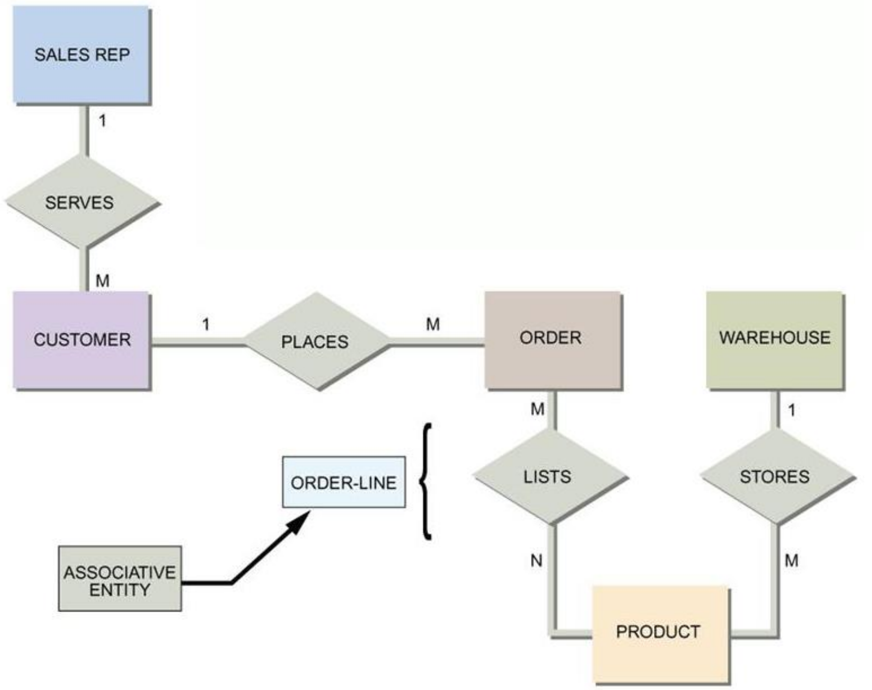


Event or transaction that links the two entities is actually a third entity called an **associative entity** (own characteristics) Rental being it below:



When placing an order:

Order – Lists – Product
Lists – (Order-Line) – with Order-Line being the Composite Entity.

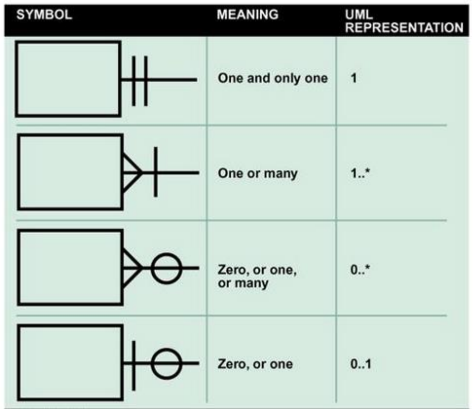


Cardinality

Describes numeric relationship between 2 entities and shows how instances of 1 entity relate to instances of another.

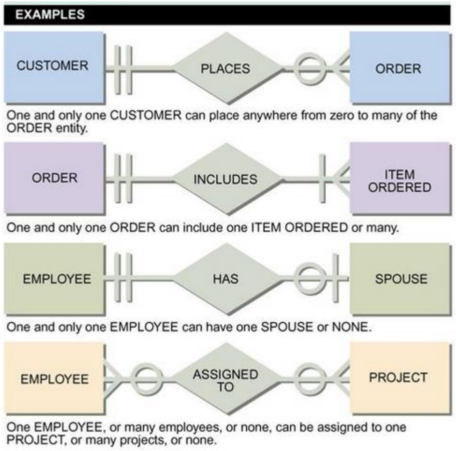
One customer can have none or many orders, but each order must have one and only one customer.

Crow's foot notation method of cardinality notation



SYMBOL	MEANING	UML REPRESENTATION
	One and only one	1
	One or many	1..*
	Zero, or one, or many	0..*
	Zero, or one	0..1

Examples of Cardinality Notation:



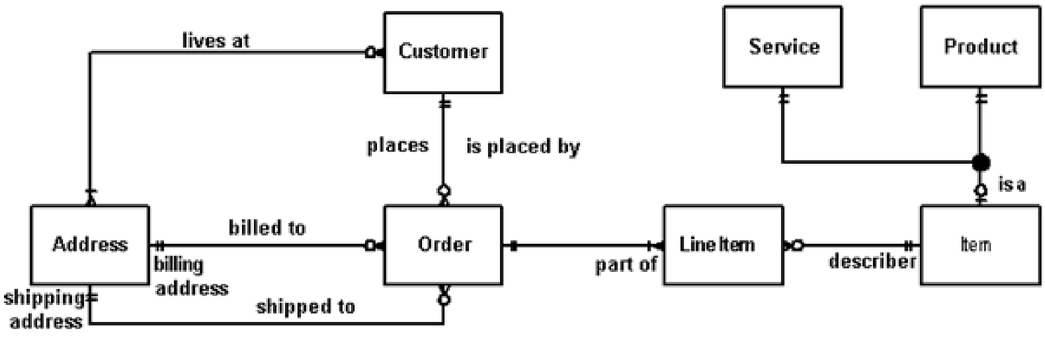
One and only one CUSTOMER can place anywhere from zero to many of the ORDER entity.

One and only one ORDER can include one ITEM ORDERED or many.

One and only one EMPLOYEE can have one SPOUSE or NONE.

One EMPLOYEE, or many employees, or none, can be assigned to one PROJECT, or many projects, or none.

Full Example in Practice



Normalization

Process of creating table designs by assigning specific fields or attributes to each table in DB. A **table design** specifies fields and identifies the PK in particular table or file.

Normalization used to develop overall DB design that is simple, flexible and free of data redundancy. Involves applying set of rules that help identify correct inherent problems and complexities.

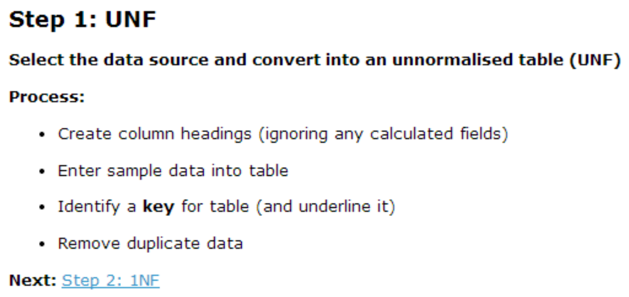
Standard Notation Format:

Name of Table, followed by parenthetical expression that contains field names separated by commas with the PK field(s) underlined:

NAME (FIELD 1, FIELD 2, FIELD 3)

Four Stages:

Unnormalized Design (Repeating Groups)



Step 1: UNF

Select the data source and convert into an unnormalised table (UNF)

Process:

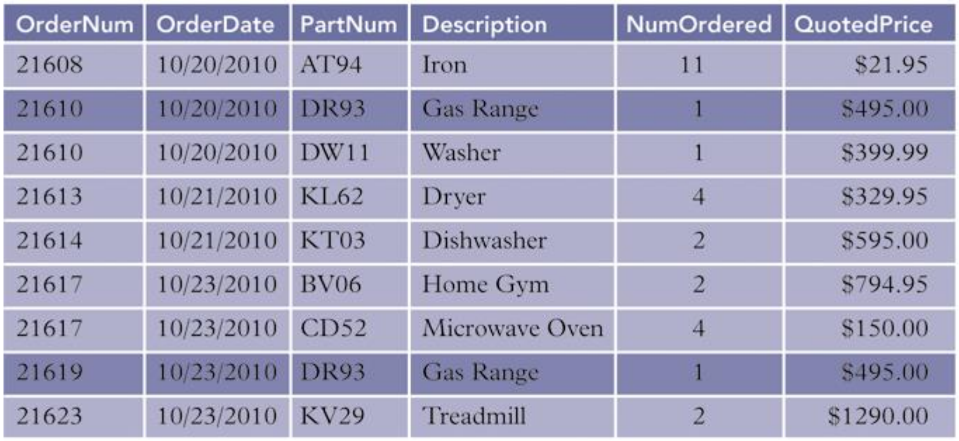
- Create column headings (ignoring any calculated fields)
- Enter sample data into table
- Identify a **key** for table (and underline it)
- Remove duplicate data

Next: Step 2: 1NF

Repeating group is set of one or more fields that occur any number of times in a single record with each occurrence having different values.

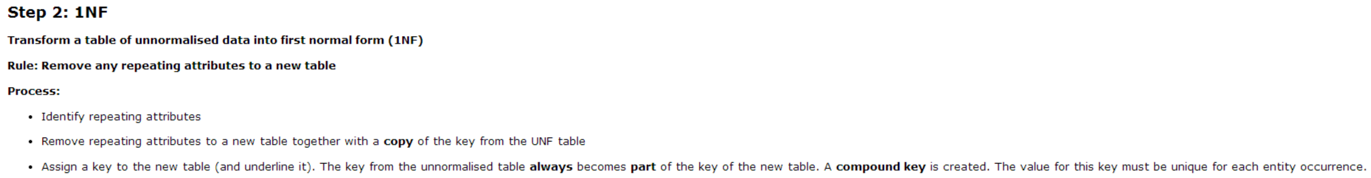
Table design containing repeating groups is called **unnormalized**. STD notation method representing Unnormalized design is to enclose repeating group of fields within a second set of parentheses:

NAME (FIELD 1, FIELD 2, FIELD 3, (REPEATING FIELD 1, REPEATING FIELD 2).



OrderNum	OrderDate	PartNum	Description	NumOrdered	QuotedPrice
21608	10/20/2010	AT94	Iron	11	$21.95
21610	10/20/2010	DR93	Gas Range	1	$495.00
21610	10/20/2010	DW11	Washer	1	$399.99
21613	10/21/2010	KL62	Dryer	4	$329.95
21614	10/21/2010	KT03	Dishwasher	2	$595.00
21617	10/23/2010	BV06	Home Gym	2	$794.95
21617	10/23/2010	CD52	Microwave Oven	4	$150.00
21619	10/23/2010	DR93	Gas Range	1	$495.00
21623	10/23/2010	KV29	Treadmill	2	$1290.00

First Normal Form (1NF)



Step 2: 1NF

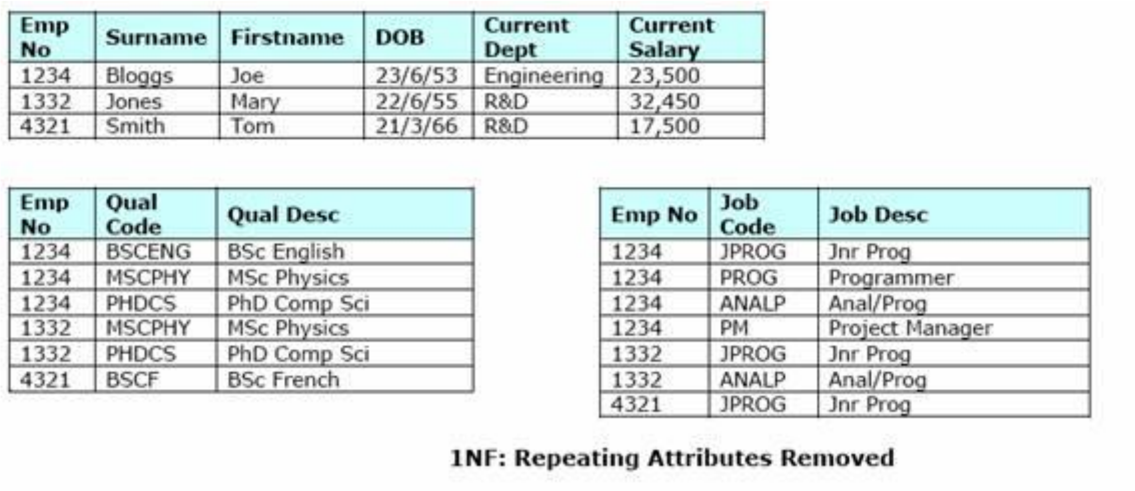
Transform a table of unnormalised data into first normal form (1NF)

Rule: Remove any repeating attributes to a new table

Process:

- Identify repeating attributes
- Remove repeating attributes to a new table together with a **copy** of the key from the UNF table
- Assign a key to the new table (and underline it). The key from the unnormalised table **always** becomes **part** of the key of the new table. A **compound key** is created. The value for this key must be unique for each entity occurrence.

To convert into 1NF must expand table's PK to include the PK of the repeating group. When eliminating repeating groups additional records emerge, one for each combination of a specific order and a specific product, result is more records but a greatly simplified design.



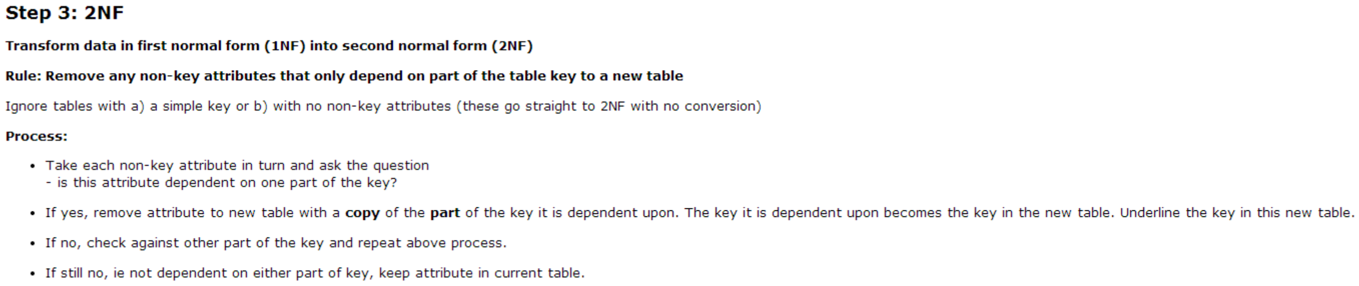
Emp No	Surname	Firstname	DOB	Current Dept	Current Salary
1234	Bloggs	Joe	23/6/53	Engineering	23,500
1332	Jones	Mary	22/6/55	R&D	32,450
4321	Smith	Tom	21/3/66	R&D	17,500

Emp No	Qual Code	Qual Desc
1234	BSCENG	BSc English
1234	MSCPHY	MSc Physics
1234	PHDCS	PhD Comp Sci
1332	MSCPHY	MSc Physics
1332	PHDCS	PhD Comp Sci
4321	BSCF	BSc French

Emp No	Job Code	Job Desc
1234	JPROG	Jnr Prog
1234	PROG	Programmer
1234	ANALP	Anal/Prog
1234	PM	Project Manager
1332	JPROG	Jnr Prog
1332	ANALP	Anal/Prog
4321	JPROG	Jnr Prog

1NF: Repeating Attributes Removed

Second Normal Form (2NF)



Step 3: 2NF

Transform data in first normal form (1NF) into second normal form (2NF)

Rule: Remove any non-key attributes that only depend on part of the table key to a new table

Ignore tables with a) a simple key or b) with no non-key attributes (these go straight to 2NF with no conversion)

Process:

- Take each non-key attribute in turn and ask the question
  - is this attribute dependent on one part of the key?
- If yes, remove attribute to new table with a **copy** of the **part** of the key it is dependent upon. The key it is dependent upon becomes the key in the new table. Underline the key in this new table.
- If no, check against other part of the key and repeat above process.
- If still no, ie not dependent on either part of key, keep attribute in current table.

Functional Dependence is a relationship that exists when on attribute uniquely determines another attribute.

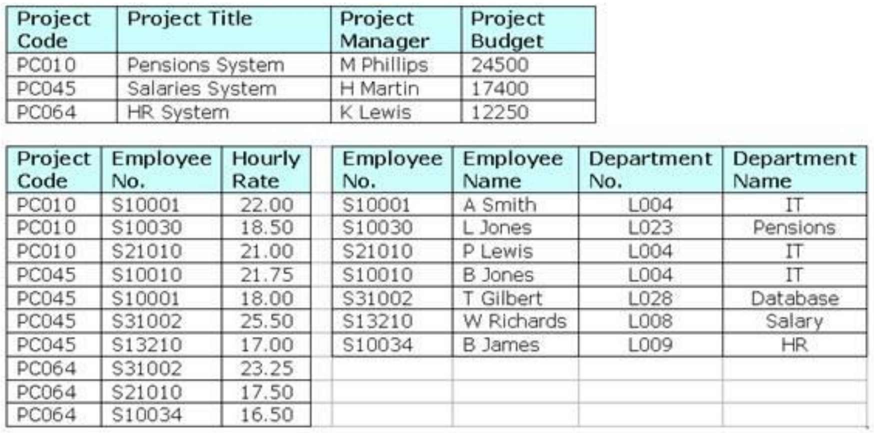
Design is in 2NF If it is in 1NF and all fields that are not part of the PK are functionally dependent on the entire PK.

STEPS

1. Create and name separate table for each field in the existing PK.
2. Create new table for each possible combination of original PK
3. Study 3 tables and place each field with its appropriate PK on which it functionally depends. Remove any table that did not have any additional fields assigned to it.

Problems that exist in 1NF but not in 2NF:

- Won’t be able to change product description in one place and will need to update each record.
- Contain inconsistent data, nothing prevents product number from having different product description in different records.
- Adding new product is a problem, PK must include an order number and a product number but you need values for both fields in order to add a record.
- Deleting product also a problem, all related records are deleted once order is filled and paid for. If product deleted ordered products lose main data of product.



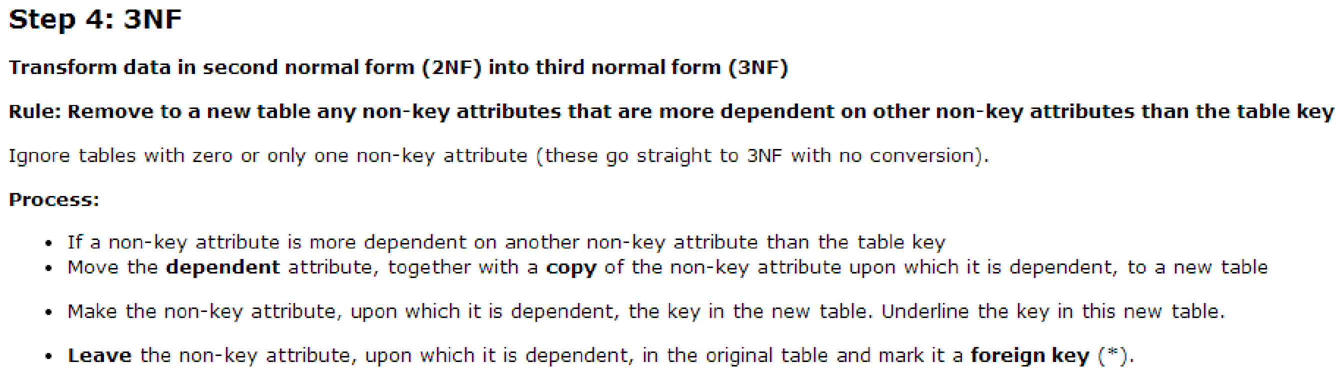
Project Code	Project Title	Project Manager	Project Budget
PC010	Pensions System	M Phillips	24500
PC045	Salaries System	H Martin	17400
PC064	HR System	K Lewis	12250

Project Code	Employee No.	Hourly Rate
PC010	S10001	22.00
PC010	S10030	18.50
PC010	S21010	21.00
PC045	S10010	21.75
PC045	S10001	18.00
PC045	S31002	25.50
PC045	S13210	17.00
PC064	S31002	23.25
PC064	S21010	17.50
PC064	S10034	16.50

Employee No.	Employee Name	Department No.	Department Name
S10001	A Smith	L004	IT
S10030	L Jones	L023	Pensions
S21010	P Lewis	L004	IT
S10010	B Jones	L004	IT
S31002	T Gilbert	L028	Database
S13210	W Richards	L008	Salary
S10034	B James	L009	HR

2NF: Partial Key Dependencies Removed

Third Normal Form (3NF)



Step 4: 3NF

Transform data in second normal form (2NF) into third normal form (3NF)

Rule: Remove to a new table any non-key attributes that are more dependent on other non-key attributes than the table key

Ignore tables with zero or only one non-key attribute (these go straight to 3NF with no conversion).

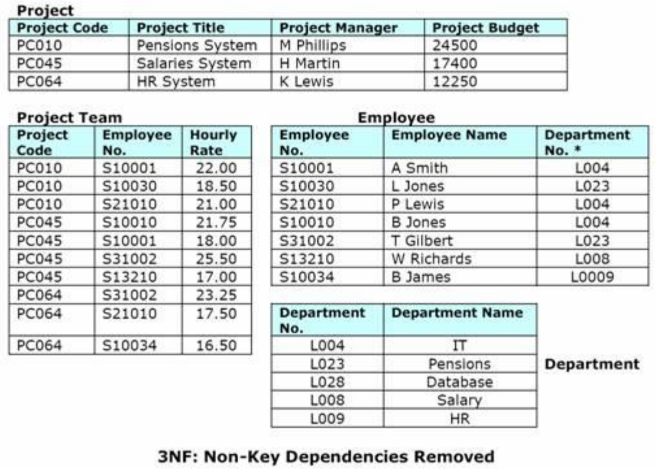
Process:

- If a non-key attribute is more dependent on another non-key attribute than the table key
- Move the **dependent** attribute, together with a **copy** of the non-key attribute upon which it is dependent, to a new table
- Make the non-key attribute, upon which it is dependent, the key in the new table. Underline the key in this new table.
- **Leave** the non-key attribute, upon which it is dependent, in the original table and mark it a **foreign key** (*).

Every nonkey field depends on the PK, the whole key and nothing but the key!!

This avoids redundancy and integrity problems that still can exist in 2NF designs.

A table is in 3NF if it is in 2NF and if no nonkey field is dependent on another nonkey field.



Project

Project Code	Project Title	Project Manager	Project Budget
PC010	Pensions System	M Phillips	24500
PC045	Salaries System	H Martin	17400
PC064	HR System	K Lewis	12250

Project Team

Project Code	Employee No.	Hourly Rate
PC010	S10001	22.00
PC010	S10030	18.50
PC010	S21010	21.00
PC045	S10010	21.75
PC045	S10001	18.00
PC045	S31002	25.50
PC045	S13210	17.00
PC064	S31002	23.25
PC064	S21010	17.50
PC064	S10034	16.50

Employee

Employee No.	Employee Name	Department No. *
S10001	A Smith	L004
S10030	L Jones	L023
S21010	P Lewis	L004
S10010	B Jones	L004
S31002	T Gilbert	L023
S13210	W Richards	L008
S10034	B James	L0009

Department

Department No.	Department Name
L004	IT
L023	Pensions
L028	Database
L008	Salary
L009	HR

3NF: Non-Key Dependencies Removed

Summary of Rules for different Normalization levels:

1NF	• No repeating or duplicate fields • Each cell contains only a single value • Each record is unique and identified by PK
2NF	• All non-key fields depend on all components of the PK • Guaranteed when primary key is a single field
3NF	• No non-key field depends upon another • All non-key fields depend only on the PK

Using codes during Data Design

Student number, Customer accounts, Zip Codes is example of Codes.
Codes often are shorter than the data they represent, they save storage space and costs, reduce data transmission time and decrease data entry time.

Types of Codes

- **Sequence codes**
  Specific order. No additional info other than an indication of order of entry into the system. Employee code “1233”.

- **Block sequence codes**
  number for different classifications, First year subjects end with “01” 2nd year subjects end with “02”.

- **Alphabetic codes**
  Use alphabet letters to distinguish one item from another based on a category and abbreviation:
  - **Category codes** (Identify group of related items)
  - **Abbreviation codes** (Standard state codes NY for New York, ZA etc)

- **Significant digit codes**
  Distinguish items by using a series of subgroups of digits (Zip Codes, Inventory location codes)

- **Derivation codes**
  Data from different item attributes or characteristics to build the codes. Magazine subscriber code, name, code, address (Derived from address).

Developing a Code

- Keep codes concise
- Allow for expansion
- Keep codes stable
- Make codes unique
- Use sortable codes
- Avoid confusing codes
- Make codes meaningful
- Use code for single purpose
- Keep codes consistent

DB Design: One step at a time

After normalizing table designs, you can create physical DB.

1. Create initial ERD. Start by reviewing your DFDs and class diagrams to identify all system entities
2. Create an ERD. Carefully analyze each relationship to determine if it is 1:1, 1:M or M:N
3. During modeling, you created data dictionary. Now review all the data elements to be sure each one is assigned to an appropriate entity.
4. Review 3NF designs for all tables and verify all PK, SK and FK. If associative entities created during design process, update ERD now.

Now changing logical model into a physical data structure that will support user needs and business requirements.

Data Storage and Access

Involve strategic business tools such as data warehousing and data mining software, as well as logical and physical storage issues, selection of data storage formats and special considerations regarding storage of date fields.

Strategic Tools for Data Storage and Access:

Data Warehousing

Integrated collection of data that can include seemingly unrelated info no matter where it is stored in the company. It can link various IS and DB, and provides an enterprise-wide view to support management analysis and decision making.

Allows users to specify **dimensions** or characteristics. Rather than accessing separate systems, a data warehouse stores transaction data in a format that allows users to retrieve and analyze data easily.

Other firms prefer a **data mart** designed to serve needs of a specific department such as sales and marketing, or finance.

Data Mining

Looks for meaningful data patterns and relationships. Help a consumer products firm identify potential customers based on prior purchases. Used as marketing tool
Clickstream storage, data gathering from visitors interaction on web by clicking and checkout amounts.

Logical and Physical Storage

Logical Storage

Data user can view, understand and access. Consist of alphabetic and numeric characters. When designing fields space should be provided for largest values that can be anticipated.
A **logical record** is a set of field values that describes a single person, place, thing or event.

Physical Storage

Involves **physical record**, or **block**, which is smallest data unit that can be handled by OS.
When system *reads* physical record, it loads data from storage into a **buffer** (segment of comp memory).
When system *writes* physical record, all data in memory buffer is saved physically to storage location

Data Coding and Storage

EBCDIC, ASCII and BINARY

EBCDIC (Extended Binary Coded Decimal Interchange Code) used on mainframe computers and high-capacity servers. *(require 8 bits, or one **byte** for each character)*

ASCII (American Standard Code for Information Interchange) used on most personal computers, *(require 8 bits, or one **byte** for each character)*

BINARY more efficient storage unit. Represent numbers as actual binary values rather as coded numeric digits.

Unicode

Two bytes per character. Creates translatable content right from the start. Very recent form of coding and supported by most popular OS.

Storing Dates

Most date formats are based on model established by ISO (**international Organization for Standardization (ISO).** Requires four digits for the year, 2 for month and 2 for day.

Absolute date is the total number of days from some specific base date. To calculate number of days between 2 absolute date you can subtract one date from the other.

Data Control

Limiting access to files and DB is most common way of protecting stored data. Users must furnish a proper **user ID** and **Password** to access file or DB.

Different **permissions** associated with different users.

Encryption and all system files and DB must be backed up regularly and a series of **backup** copies must be retained for specified period of time.

Special **audit fields** can be activated where additional control is kept about date when record was created, modified or number of time accessed.

Glossary

ASCII	American Standard Code for Information Interchange; Coding method used on personal computers
associative entity	Event or transaction that links the two entities of an M:N relationship, but has its own characteristics
attribute	Another term for field
binary storage format	Represents numbers as actual binary values, rather than as coded numeric digits
block	Another term for physical record
block sequence codes	Use blocks of numbers for different classifications
blocking factor	Number of logical records that each physical record contains
candidate key	Any field that can serve as a primary key
category codes	Identify a group of related items
clicks to close	Average page views to accomplish a purchase or obtain desired information
client-server	Type of system in which processing is distributed throughout the organization
data element	Another term for field
data manipulation language (DML)	Controls database operations, including storing, retrieving, updating, and deleting data
data mart	Data storage that is designed to serve the needs of a specific department
data structure	Framework for organizing, storing, and managing data
data warehouse	Integrated collection of data that can include seemingly unrelated information, no matter where it is stored in the company
derivation codes	Combine data from different item attributes, or characteristics, to build the code

encryption	Process of converting readable data into unreadable characters to prevent unauthorized access to the data
entity	Person, place, thing, or event for which data is collected and maintained
extranet	Extension of a company intranet that allows access by external users
first normal form (1NF)	A table that does not contain a repeating group
history file	Created for archiving purposes
JDBC (Java database connectivity)	Enables Java applications to exchange data with any database that uses SQL statements and is JDBC-compliant
key fields	Used to organize, access, and maintain data structures
logical record	Set of field values that describes a single person, place, thing, or event
long integer format	Binary storage format that uses 32 bits, or four bytes, to represent a 10-digit number in binary form
many-to-many relationship	Exists when one instance of the first entity can relate to many instances of the second entity, and one instance of the second entity can relate to many instances of the first entity
market basket analysis	Data mining technique described by Wikipedia wherein stores make use of a detailed analysis of items purchased together without attempting to explain the correlation
nonkey field	Any field that is not a primary key or a candidate key
one-to-many relationship	Exists when one occurrence of the first entity can relate to many instances of the second entity, but each instance of the second entity can associate with only one instance of the first entity
one-to-one relationship	Exists when exactly one of the second entity occurs for each instance of the first entity
password	Specific code that must be furnished by a user to access a file or database
query by example (QBE)	User provides an example of the data requested
record	Set of related fields that describes one instance, or occurrence of an entity
recovery procedures	Can be used to restore the file or database to its current state at the time of the last backup, in the event of a file catastrophe
relational model	Another term for relational database
repeating group	Set of one or more fields that can occur any number of times in a single record, with each occurrence having different values
second normal form (2NF)	A table design wherein the table is in 1NF, and all fields that are not part of the primary key are funtionally dependent on the entire primary key
secondary key	Field or combination of fields that can be used to access or retrieve records
subschema	View of the database used by one or more systems or users
table	Another term for file
table design	Specifies the fields and identifies the primary key in a particular table or file
table file	Contains reference data used by the information system
tags	HTML formatting codes
Unifided Modeling Language (UML)	Widely used method of visualizing and documenting software systems design
Web site	The Web server and the Web pages together
Web-centric	Using the same protocols as the Internet

work file Temporary file created by an information system for a single task

Y2K issue Major problem that faced many firms that used only two digits to represent the year at the beginning of the 21st century

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PHASE 4 – Making the System Operational

Software Quality Insurance

Avoid problems or to identify them as soon as possible. Poor quality can result from inaccurate requirements, design problems, coding errors, faulty documentation and ineffective testing. To improve finished product software engineering and ISO should be considered:

- **Software Engineering**
  Software DEV process that stresses solid design, accurate documentation and careful testing. **SEI** (Software Engineering Institute) have set of Dev standards called **CMM** (Capability Maturity Model), purpose to improve SW quality, reduce DEV time and cut costs. They also have new model **CMMI** (Capability Maturity Model Integration) that integrates SW and Systems Dev into much larger framework called **process improvement**. It track and organization's processes using 5 maturity levels where 1 is poorly controlled and Level 5 with optimal results.

- **ISO (International Organization for Standardization)**
  Establishes quality standards for products and services. International recognized symbols etc. ISO requires specific DEV plan, which outlines a step-by-step process for transforming user requirements into finished product.

Application Development Overview

Process of constructing the programs and code modules that serve as building blocks of the IS. Application DEV Tasks depends on method:

App DEV Tasks

Traditional Method (or O-O)

Ready to translate design into a functioning Application. At this point, coding and testing tasks begin. Although programmers typically perform the actual coding, IT manager usually assign systems analysts to work with them as a team.

Agile Method

Plan project, lay groundwork, assemble team and prepare to interact with customers. Intense communication and collaboration will now begin between IT team and users or customers. Uses various modes, including spiral model or Extreme Programming (XP).

System DEV Tools

Structured DEV relies heavily on DFDs and structure charts; O-O use variety of diagrams including use of Case, class sequence and transition state diagrams. System DEV can also use multipurpose tools to help translate system logic, tools include the following:

- Entity-Relationship Diagrams
- Flowcharts
- Pseudocode
- Decision Tables and Decision Trees4

Structured App Development

Usually involves a **Top-down approach** that proceeds from a general design to detailed structure. System broken down to subsystems and modules in a process called **partitioning**. Also called **modular design** and similar to constructing a leveled set of DFDs.

Structured Charts

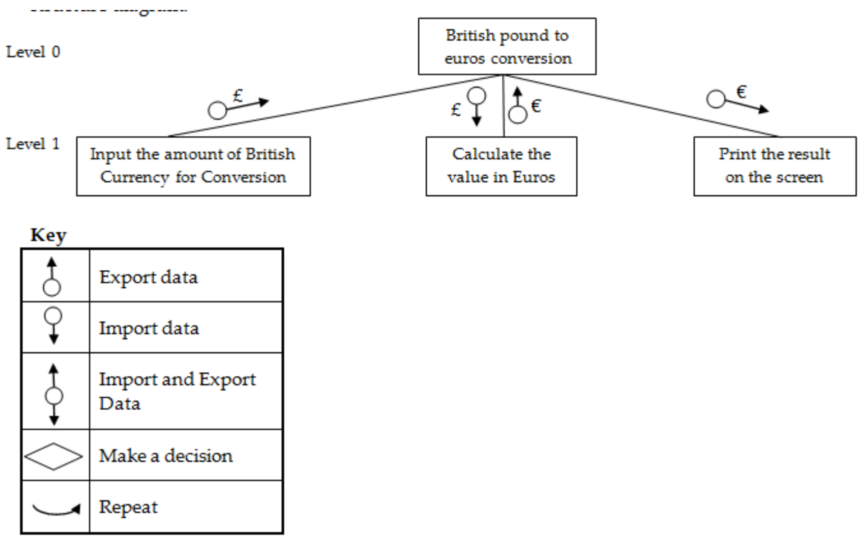
Show program modules and relationships among them. Consists of rectangles that represent program modules with arrows and other symbols. Typically a higher-level module is called a **control module**, directs lower-level modules called **subordinate modules**. Symbols represent various actions or conditions and represent the following:

Module

Rectangle. Rectangle with vertical lines at the edges indicate that module is a **library module** (Reusable code) *Fig 11-10 on page 515.*

Data Couple

Arrow with empty circle. Shows data that one module passes to another.


Level 0
British pound to euros conversion
Level 1
£
£
€
€
Input the amount of British Currency for Conversion
Calculate the value in Euros
Print the result on the screen
Key
Export data
Import data
Import and Export Data
Make a decision
Repeat

Control Couple

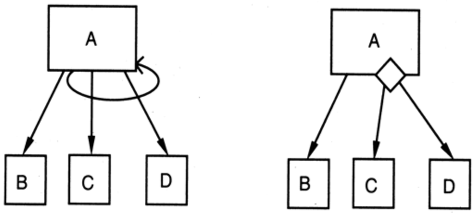
Arrow with filled circle. Shows a message also called a **status flag** which one module sends to another. Module uses a flag to signal specific condition or action to another module. Notification about account being overdue.

Condition

Diamond. A condition line indicates that a control module determines which subordinate module will be invoked depending on a specific condition.

Loop

Curved arrow that one or more modules are repeated.



Cohesion and Coupling

Cohesion measures module's scope and processing characteristics. Module performing single function or task has high degree of cohesion which is desirable. When you notice word *and* in module name, you know more than one task is involved.

Coupling describes degree of interdependence among modules. Modules that are independent are **loosely coupled** which is desirable, easier to maintain and modify. **Tightly coupled** is when one module is linked to internal logic contained in another module.

Drawing a Structure Chart

Will be based on DFD's, 4 steps to follow:

1. Review DFDs
2. Identify Modules and Relationships
3. Add Couples, Loops and Conditions
4. Analyze the structure Chart and data dictionary

Object-Orientated Application Development

O-O analysis makes it easier to translate an object model directly into an object-oriented programming language. Process is called **OOD** (Object-oriented Dev).

Characteristic of Object-Oriented App DEV

Relationships between objects already exist. Object interaction is defined during analysis, the App's structure is represented by the object model itself. Relationship and interaction among classes are described using a class diagram which includes the class **attributes** (describe characteristics of objects in the class) and **methods** (represent program logic).

Implementation of O-O Designs

Must analyze classes, attributes, methods and messages that are documented. Programmer makes necessary revisions and updates t class diagrams, sequence diagrams, state transition diagrams and activity diagrams. Programmer analyzes sequence diagrams and state transition diagrams showing the events and messages that trigger changes to an object. O-O app are called event-driven.

Object-Oriented Cohesion and Coupling

Classes should be as loosely coupled as possible as well as methods and highly cohesive.

Agile Application Development

Development team in constant communication with the primary user **customer**. XP Extreme Programming is the newest agile method which is an iterative approach.

User stores (User requirements) are implemented in **iteration cycles (**includes planning, designing, coding and testing of one or more features). **Iteration planning meetings** are held to break down user stories into specific tasks

Team regularly meets with customer for approval who tested prototype releases as they become available.

The onlooker examines code strategically to see the *forest* while the driver is concerned with individual *trees* immediately in front of him.

Coding

Process of turning program logic into specific instructions that the computer system can execute.

Programing Environments

To simplify integration of system components and reduce code DEV time, programmers use an **integrated development environment (IDE) .** IDE's make it easier to program interactive SW products by providing built-in tools and advanced features such as real-time error detection, syntax hints and highlighted code.

Testing the system

1. Compile program using a CASE tool or a language compiler. This process detects **syntax errors** which are language grammar errors.
2. Programmer checks the program. **Desk checking** process of reviewing program code to spot logic errors. Other companies need formal type of desk checking called a **structured walkthrough** or **code review**. Group of IT staff members participate
3. **Design walkthrough** session held with users to review CI with cross-section of people who will work with new system.

Unit Testing

Testing individual program or module. Obj to identify &eliminate execution errors that could cause program to terminate abnormally & logic errors that could have been missed during desk checking.

- **Test data** should contain both correct data and erroneous data and should test all possible situations that could occur. Programmers must test programs that interact with other programs and files individually before integrating then into the system.
- **Stub testing** where programmer simulates each program outcome or result and displays a message to indicate whether or not the program executed successfully. Each stub represents and entry or exit point that will be linked later to another program or data file.
- **Test Plan** consist of detailed procedures specifying how & when testing will be performed& who will participate,what test data will be used. Should include scenarios for every possible situation.

Integration Testing

Testing one or more program that depend on each other also called **link testing**. Like AX and ILS. Testing sequence should not move to the integration test stage unless it has performed properly in all unit tests.

System Testing

Involves entire IS. Includes all typical processing situations and is intended to assure users, developers and managers that the program meets all specifications and all necessary features have been included.

Objectives:

- Perform a final test of all programs
- Verify that the system will handle all input data properly, both valid and invalid
- Ensure that IT staff has the documentation and instructions needed to operate the system properly and that backup and restart capabilities of system are adequate.
- Demonstrate that users can interact with the system successfully
- Verify all components are integrated properly & actual processing situations will be handled correctly
- Confirm IS can handle predicted volumes of data in timely and efficient manner.

Successful completion key to user and management approval, system tests also called **acceptance tests**.

Documentation

Describes IS and helps users, managers and IT staff who must interact with it. Essential for successful system operation and maintenance. Documentation includes the following:

Program Documentation

Describes inputs, outputs and processing logic for all program modules. Starts with analysis phase and continues during systems implementation.

System Documentation

System's functions and how they are implemented. System documentation includes data dictionary entries, data flow diagrams, object models and screen layouts, source documents and systems request that initiated the project. Most prepared during the systems analysis and systems design phases.

Operations Documentation

Contains all information needed for processing and distributing online and printed output. Includes following

- Program, systems analyst, programmer and system identification
- Scheduling Info for printed output, frequency and deadlines
- Input files and where they originate, output files and destinations
- E-mail and report distribution lists
- Forms, including online forms
- Error and Informational messages to operators and restart procedures.
- Special instructions, such as security requirements

User Documentation

Consists of instructions and info to users who will interact with the system and includes user manuals. Help screens and tutorials. Includes the following:

- System overview clearly describing all major system features, capabilities and limitations
- Description of source document content, preparation, processing and samples instructions
- Example of reports that are produced regularly.
- Security and audit trail info
- Explanation of responsibility for specific input, output or processing requirements
- FAQs

Users prefer **online documentation**

Management Approval

Describe test results, update status of all required docs and summarize input from users who participated in system testing. Provide detailed time schedules, cost estimates, staffing requirements for making the system fully operational.

System Installation and Evaluation

Following sections describe system installation and evaluation tasks that are performed for every IS project whether developed or purchased, Remaining steps in systems implementation:

Operational and Test Environments

Environment for actual system operation is called **Operational environment** or **production environment**. Environment that analysts and programmers use to develop and maintain programs is called the **test environment**. Limited-access workstation.

Operational environment includes HW and SW config and settings, system utilities and any other components that might affect system performance. Test platform rigorously before system installations begins.

Training

Requires training for users, managers and IT staff members:

Training Plan

Should start with plan early in Sys Dev process. 3 Main groups for training:

- Users
  System Overview, Key terms, Main menus and Sub Menus, Major systems functions, Troubleshooting.

- Managers
  Project origin, Cost-benefit analysis, support for business goal, Handling system charges, Major reports and displays, User training

- IT Staff
  Project history and justification, system architecture, System documentation, vendor support, logging and resolving problems, Technical training

Types of training:

Vendor Training

Purchase of SW or HW, then vendor-supplied training is one of the features you should include in the RFP (Request for Proposal) and RFQ (request for Quotation). Might have to implement training in-house as well if IT staff customized the package.

Webinars, Podcasts and Tutorials

Many vendors offer these. **Webinar** combines words Web and seminar providing an interactive experience.
Webcast one-way transmission whenever a user wants or needs training support.
Podcast Web-based broadcast that allows user to download multimedia files to PC or portable device, can be prescheduled, made available on demand or delivered as automatic updates. Advantage is that **subscriber** can access recorded material anywhere.
Tutorial series of online interactive lessons that present material and provide a dialog with users.

Outside Training Resources

Can arrange for in-house as well or any providers outside.

Training Tips

If have helpdesk they might be able to handle user training. Multimedia effective training method.

- Group training sessions per function.
- Select most effective place to conduct the training
- Provide for learning by hearing, seeing and doing
- Rely on previous trainees (they can then assist other users)

Interactive Training

Most effective, interactive, self-paced and multimedia-based:

- **Online Training**
  should include step-by-step instructions. Materials should resemble actual screens and tasks should be typical of a user's daily work.

- **Video Tutorials**
  No need for a big budged, Capture screens, integrate screen images and text, Capture live-motion video, Record audio narration and then a Training video is produced.

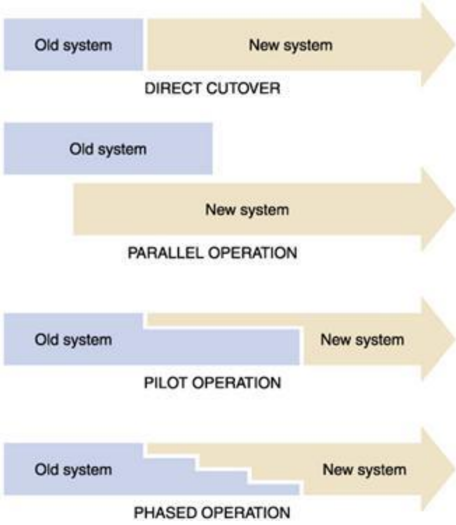
Data Conversion

Existing data is loaded into the new system. Data conversion might be needed before, during or after operational environment is complete depending on the system.

Data conversion plan must be developed as early as possible with conversion process and should be tested when the test environment is developed. Important for new system to be loaded with accurate, error-free data.

System changeover

Process of putting new info system online and retiring the old system. Can be rapid or slow depending on the method, There 4 different methods:



Direct Cutover

Least expensive, new system occur immediately, involves more risks. Timing should be planned properly, best to convert beginning of a quarter, calendar year or fiscal year.

Parallel Operation

Both old and new IS operate fully for a specified period. When users and management are satisfied that the new system operates correctly, the old system is terminated.

Pilot Operation

Implementing complete new system at a selected location of the company, new sales reporting system might be implemented in only one branch called the **pilot site (Brooklyn POS)**. Old system continues to operate for the entire organization including pilot site. If successful it will be implemented in the rest of the organization. Combination of parallel and direct cutover methods.

Phased Operation

Implement new system in stages or modules.

Post-Implementation Tasks

Assesses overall quality of IS. Verifies that new system meets specified requirements, complies with user objectives and produces anticipated benefits. Evaluation includes feedback for the following areas:

- Accuracy, completeness and timeliness of IS output
- User satisfaction
- System reliability and maintainability
- Adequacy of system controls and security measures
- HW efficiency and platform performance
- Effectiveness of DB implementation
- Performance of IT team
- Completeness and quality of documentation
- Quality and effectiveness of training
- Accuracy of cost-benefit estimates and DEV schedules.

Can apply same techniques in post-implementation that you used to determin the system requirements during systems analysis phase:

- Interview members of management and key users
- Observe users and computer operations personnel actually working on system
- Read all documentation and training materials
- Examine all source docs, output reports and screen displays
- Use questionnaires
- Analyze maintenance and help desk logs.

Final report to management:

- Final versions of all system documentation
- Planned modifications and enhancements to the system that have been identified
- Recap of all systems Dev costs and schedules
- Comparison of actual costs and schedules to the original estimates
- Post-implementation evaluation

Glossary

acceptance tests	Another term sometimes used for system tests
application development	Process of constructing the programs and core modules that serve as the building blocks of the information system
attributes	Describe the characteristics of objects in the class
bug tracking software	Another term for defect tracking software
Capability Maturity Model Integration (CMMI)	SEI's new model that integrates software and systems development into a much larger framework
code review	Another term for structured walkthrough
coding	Process of turning program logic into specific instructions that the computer system can execute
cohesion	Measures a module's scope and processing characteristics
control couple	Shows a status flag that one module sends to another
data conversion	Existing data is loaded into the new system
defect tracking software	Used by system developers to document and track program defects, code changes, and replacement code
design walkthrough	Reviews interface with a cross-section of people who will work with the new system and ensures that all necessary features have been included
desk checking	Process of reviewing the program code to spot logic errors
direct cutover	Approach that causes the changeover from the old system to the new system to occur immediately when the new system becomes operational
documentation	Describes an information system and helps users, managers, and IT staff who must interact with it
exporting	Sending data in an acceptable format from the old system to the new system
integrated development environment (IDE)	Makes it easier to program interactive software products by providing built-in tools and advanced features
integration testing	Testing two or more programs that depend on each other
iteration planning meeting	Held at the beginning of each iteration cycle to break down the user stories into specific tasks that are assigned to team members
library module	Reusable code; Can be invoked from more than one point in a structure chart
link testing	Another term for integration testing
logic errors	Parts of the program code that produce incorrect results
loop	Indicates one or more modules are repeated
loosely coupled	Modules that are independent
methods	Represent program logic
module	Consists of related program code organized into small units that are easy to understand and maintain
online documentation	Provides immediate Help when users have questions or encounter problems
operational environment	Environment for the actual system operation
operations documentation	Contains all the information needed for processing and distributing online and printed output
parallel programming	Two programmers work on the same task on the same computer

phased operation	Changeover method that allows you to implement the new system in stages, or modules
pilot operation	Changeover method that involves implementing the complete new system at a selected location of the company
podcast	Web-based broadcast that allows a user to download multimedia files to a PC or portable device
process improvement	Large framework into which CMMI integrates software and systems development
pseudocode	Technique for representing program logic that is Similar to structured English, but not language-specific
release plan	Specifies when user stories will be implemented and the timing of the releases
software engineering	Software development process that stresses solid design, accurate documentation, and careful testing
status flag	Message one module sends to another
structure chart	Shows the program modules and the relationships among them using rectangles, arrows, and other symbols
stub testing	The programmer simulates each program outcome or result and displays a message to indicate whether or not the program executed successfully
subordinate modules	Lower-level modules that are directed by a higher-level control module
system changeover	Process of putting the new information system online and retiring the old system
system documentation	Describes the system's functions and how they are implemented
test data	Should contain both correct data and erroneous data and should test all possible situations that could occur
tightly coupled	One module is linked to internal logic contained in another module
top-down approach	Proceeds from a general design to a detailed structure
train-the-trainer	Training strategy in which you can select knowledgeable users who then conduct sessions for others
training plan	How to use the documentation material in future training sessions
tutorial	Series of online interactive lessons that present material and provide a dialog with users
Webcast	One-way transmission of a pre-recorded Webinar session, delivered whenever a user wants or needs training support

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PHASE 5 – SYSTEMS SUPPORT AND SECURITY

OVERVIEW

Involves 3 main concerns: User expectations, system performance, and security requirements. Systems analyst is like an internal consultant who provides guidance, support and training.

Systems support and security phase begins when system becomes operational and continues until system reaches the end of its useful life.

User Support

Provided in many forms:

User Training

With new employees or when existing system changes or new version is released the IT department might develop a **user training package**.

Help Desks

To make data more accessible and to empower users. Help desk is a centralized resource staffed by IT professionals who provide users with support they need to do their jobs. 3 Objectives:

- Show people how to use system resources more effectively
- Provide answers to technical or operational questions
- Make users more productive by teaching them how to meet their own info needs.

Help desk staff will perform some of the following tasks:

- Show user how to create a data query or report
- Resolve network access or password problems
- Recover damaged data
- Demonstrate advanced feature of a system
- Troubleshoot software issues via remote control utilities.

Maintenance Tasks

Important component of TCO, ongoing maintenance expenses determine economic life of a system. **Operational costs** include supplies, equipment rental and software leases. **Maintenance expenses** vary significantly during operational life and include spending to support maintenance activities. **Maintenance activities** include chaning programs, procudures or documentation to ensure correct system performance, adapting system to changing requirements and making system operate more efficiently. Different types of Maintenance:

Corrective Maintenance

- Diagnose and fix logic errors
- Replace defective network cabling
- Restore proper configuration settings
- Debug program code
- Update drivers
- Install software patch

Adaptive Maintenance

- Add online capability
- Crete new reports
- Add new data entry field to input screen
- Install links to Web site
- Create employee portal

Perfective Maintenance

- Install additional memory
- Write macros to handle repetitive tasks
- Compress system files
- Optimize user desktop settings
- Develop library for code reuse
- Install more powerful network server

Preventive Maintenance

- Install new antivirus software
- Develop standard backup schedule
- Implement regular defragmentation process
- Analyze problem report for patterns
- Tighten all cable connections

Maintenance Management

Requires effective management, quality assurance, and cost control.

Maintenance Team

- **System Administrator**
  manages computer and network systems. Primary responsibility for the operation, configuration and security of one or more systems. Routine maintenance and preventive action.

- **System Analysts**
  Investigate and rapidly locate source of problems.
  Analysis means examining the whole in order to learn about individual elements
  Synthesis involves studying parts to understand the overall system

- **Programmers**
  Application programmer, systems programmer and database programmer and programmer/analyst.

Maintenance requests

- **Initial Determination:**
  When user submits maintenance request, system administrator makes initial determination whether request is justifiable and involves severe problem that requires immediate attention. I f justifiable but noncritical, administrator determine whether request is within preauthorized cost level.

- **Systems review committee**
  when request exceeds predetermined cost level or involves major config change, systems review committee either approves or rejects.

- **Task Completion**:
  System administrator usually responsible for assigning maintenance tasks to individuals or to team.

- **User notification:**
  Users who initiate maintenance requests expect prompt response, especially if situation directly affects work.

- **Establishing Priorities:**
  Committee normally separates maintenance from new DEV requests when setting priorities.

- **Configuration Management:**
  CM – referred to as **change control (CC)**, process for controlling changes in system requirements during SW DEV. Keep track of all documentation and ensuring updates are distributed properly and important aspects of Config management.

- **Maintenance Releases**

  When **maintenance release methodology** is used, all noncritical changes are held till they can be implemented at the same time.

  When used all changes are tested together before new system version is released, fewer versions, less expense and less interruption for users.

- **Version Control**

  Process of tracking system releases or versions. When new version released prior release is **archived** or stored. Restore old version if new version gives problems.

- **Baselines**

  Formal reference point measuring system characteristics at specific time. 3 Types:

  Functional baseline: Config of system documented at beginning of project. All necessary system requirements and design constraints

  Allocated baseline: Documents at end of design phase and identifies changes since functional baseline. Includes testing and verification.

  Product baseline: describes system at beginning of system operation. Incorporates changes made since allocated baseline and includes results of performance and acceptance tests.

System Performance Management

To ensure satisfactory support for business operations, IT department must manage system faults and interruptions, measure system performance and workload and anticipate future needs.

Fault Management

Monitoring the system for sign of trouble, logging all slystem failures, diagnosing the problem and applying corrective action.

Performance and Workload Measurement

To measure system performance, many firms use **benchmark testing**, uses set of standards tests to evaluate performance and capacity. Performance measurements, called **metrics** can monitor number of transactions processed in a given time period, number of records accessed and volume of data.

Response Time

Overall time between request and delivery of the response. In online environment, response time is measured from the instant the user presses ENTER until requested screen display appears. Response time is the one that users notice and complain about the most.

Bandwidth and throughput

Bandwidth describes amount of data system can transfer in fixed time period, bits per second.

Throughput measures actual system performance under specific circumstances and is affected by network loads and HW efficiency.

System admin measure many other performance characteristic, typical examples:

- Arrivals – number of items that appear on a device during a given observation time
- Busy- Time given resource is unavailable
- Completions – number of arrivals processed during given observation period
- Queue Length – number requests pending for a service
- Service Time – Time it takes to process given task once it reaches front of queue
- Think Time – Time an app user to issue another request
- Utilization – how much of a given resource required to complete a task
- Wait Time – Time requests must wait for a resource to become available

Turnaround Time

Applies to centralized batch processing operations. Measures time between submitting request for info and the fulfillment of request. Also to measure IT support.

Capacity Planning

Process monitoring current activity and performance levels, anticipates future activity and forecasts resources needed to provide desired levels of service.

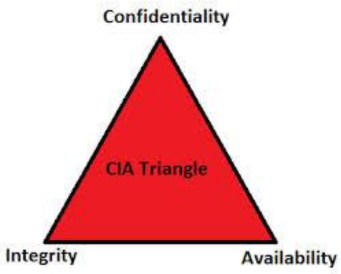
Can use **what-if analysis** vary one or more elements in a model in order to measure the effect on other elements.

System security overview

Protects system and keeps it safe, free from danger and reliable.

System Security Concepts

CIA triangle:



- **Confidentiality** protects info from unauthorized disclosure and safeguard privacy
- **Integrity** prevents unauthorized users from creating, modifying or deleting information
- **Availability** ensures authorized users have timely and reliable access to necessary information

Risk Management

Involves constant attention to 3 interactive tasks:

- Risk Identification – analyze assets, threats and vulnerabilities
- Risk assessment – measures risk likelihood and impact
- Risk Control – Develops safeguards that reduce risks and their impact

Risk Identification

List and classify business assets. HW, SW, networks, people etc.

A **threat** is internal or external entity that could endanger and asset, natural disasters, SW attacks, or theft.

Threat Categories:

THREAT	**CATEGORY**
Extortion	Hacker steals trade secrets & threaten to release if not paid
HW and SW failures	Router stops functioning or SW causes app server to crash
Human error or failure	Employee accidently deletes files
Natural Disasters	Floods destroy company building and networked systems
Service failure	Electricity is disrupted and brings entire system down for hours
SW attack	Group plants destructive SW, a virus, or worm in company network
Technical obsolescence	Outdated SW is slow, difficult to use and vulnerable to attacks
Theft of physical/intellectual Property	Server stolen, intellectual property is stolen or used without permission, physical or electronic
Trespass and Espionage	Employee enters unlocked server room and views payroll data
Vandalism	Attacker defaces Web site logo or destroys CEO’s hard drive physical or electronically

Risk assessment

Risk is impact of an attack multiplied by likelihood of a vulnerability being exploited. Critical risks will head the list.

Risk Control

Mitigation reduces impact of risk by careful planning and preparation.

Transference shifts risk to another asset or party

Acceptance nothing is done.

Attacker Profiles and Attacks

ATTACKER	DESCRIPTION	SKILL SET
Cyberterrorist	Attacks to advance political, social or ideological goals	High
Employee	Use unauthorized info or privileges into computer systems to steal info or cause damage	Varies
Hacker	Advances to attack computer systems with malicious intent or expose flaws and improve security	High
Hacktivist	Attacks to further social or political cause	Varies
Script Kiddie	Inexperienced or juvenile hacker to gain recognition	Low
Spy	Non-employee to steal info and sell it.	High

Type of attacks and examples

ATTACK	EXAMPLE
Back Door	Finds vulnerability in SW and exploits it
Denial of service	One or more computer send stream of connection requests to disable Web server
DNS poisoning	False DNS, Info steers user to attacker’s Web site
Dumpster diving	Scours trash for valuable info
Mail Bombing	Enormous volumes of e-mail sent to target address
Malicious Code	Infected e-mail with viruses, worms, Trojan horses, spyware
Man in the middle	Intercepts traffic and poses as recipient, after reading or modify it
Password Cracking	Discover password to gain entry
Privilege Escalation	Employee tricks computer into raising her account to admin level
Sniffing	Network traffic is intercepted and scanned for valuable info
Social engineering	Calls help desk posing as legitimate user and requests password to be changed
Spam	Unwanted, useless e-mail
Spoofing	IP address is forged t match trusted host.

Security Levels

- Physical Security
- Network security
- Application security
- File security
- User security
- Procedural security

Glossary

maintenance activities	Includes activities to ensure correct system performance, adapt to changing requirements, and operate efficiently
maintenance team	Includes a system administrator and one or more systesms analysts and programmers
malware	Hostile software designed to infiltrate, damage, or deny service to a computer system
network interface	Combination of hardware and software that allows the computer to interact with the network
obsolete	No longer supports user needs, or the platform is outmoded
offsiting	Practice of storing backup media away from the main business location in order to mitigate the risk of a catastrophic disaster
permissions	Another term for user rights; Describe the rights a user has to a particular file or directory on a server
power-on password	Another term for BIOS-level password
pretexting	Method of obtaining personal information under false pretenses
private key encryption	Is symmetric; A single key is used to encrypt and decrypt information
private network	Dedicated connection, similar to a leased telephone line
procedural security	Concerned with managerial policies and controls that ensure secure operations
response time	Overall time between a request for system activity and the delivery of the response
risk assessment	Measures risk likelihood and impact
security policy	Developed based on the three elements in the CIA triangle
service	Application that monitors, or listens on, a particular port
service packs	Maintenance releases provided by commercial software suppliers
superuser	Another term for administrator
transference	Shifts the risk to another asset or party
tunnel	Secure network connection
turnaround time	Measures the time between submitting a request for information and the fulfillment of the request
Universal Security Slot (USS)	Can be fastened to a cable lock or laptop alarm
vulnerability	Security weakness or soft spot
what-if analysis	Allows you to vary one or more elements in a model in order to measure the effect on other elements
Wired Equivalent Privacy (WEP)	Earliest form of wireless security; Required each wireless client to use a special, pre-shared key