ICT2622 Object-Oriented Analysis Notes Phase Ch 6 – Summary Notes
SATZINGER JACKSON BURD (6TH EDITION)

CHAPTER 6: Essentials of Design and the Design Activities

DESIGN AND DESIGN ACTIVITIES

- During **ANALYSIS**, the focus is on understanding what the system should do (i.e., the requirements), whereas during **DESIGN** the focus is on the solution (i.e. specifying how the system will be built and what the structural components of the new system will be)
- The objective of systems analysis is to thoroughly understand the organization's informational needs or requirements and to document those requirements in a set of specifications - WHAT the solution needs to do
- The objective of systems design is to define, organize, and structure the components of the final solution system that will serve as the blueprint for construction - HOW the solution will be configured and constructed.
- The objective of software construction is to build a system that satisfies those requirements.
- Systems design is the bridge that takes the project from requirements to solution.

THE ELEMENTS OF DESIGN

Network Diagram - a model that shows how the application is deployed across networks and computers

- Analysts first identify the overall application deployment environment by defining the hardware and software environments.
- The hardware environment includes computers, networks and firewalls.
- The software environment includes such things as what operating systems, what database management
- system, and what kind of network protocol will be used

Systems Design - those activities that enable the project team to describe in detail the system that solves the need

Architectural Design - broad design of the overall system structure

- also called general design or conceptual design

Detail Design - low-level design that includes the design of the specific program details

- design should proceed in a top-down fashion

INPUTS AND OUTPUTS FOR SYSTEMS DESIGN

- Design is a model-building activity. Analysts convert the information gathered during analysis—the requirements models—into models that represent the solution system.
- Design is much more oriented toward technical issues and requires less user involvement and more involvement by other systems professionals.
- Design involves describing, organizing, and structuring the system solution.
- The output of the design activities is a set of diagrams and documents that model and document various aspects of the solution system

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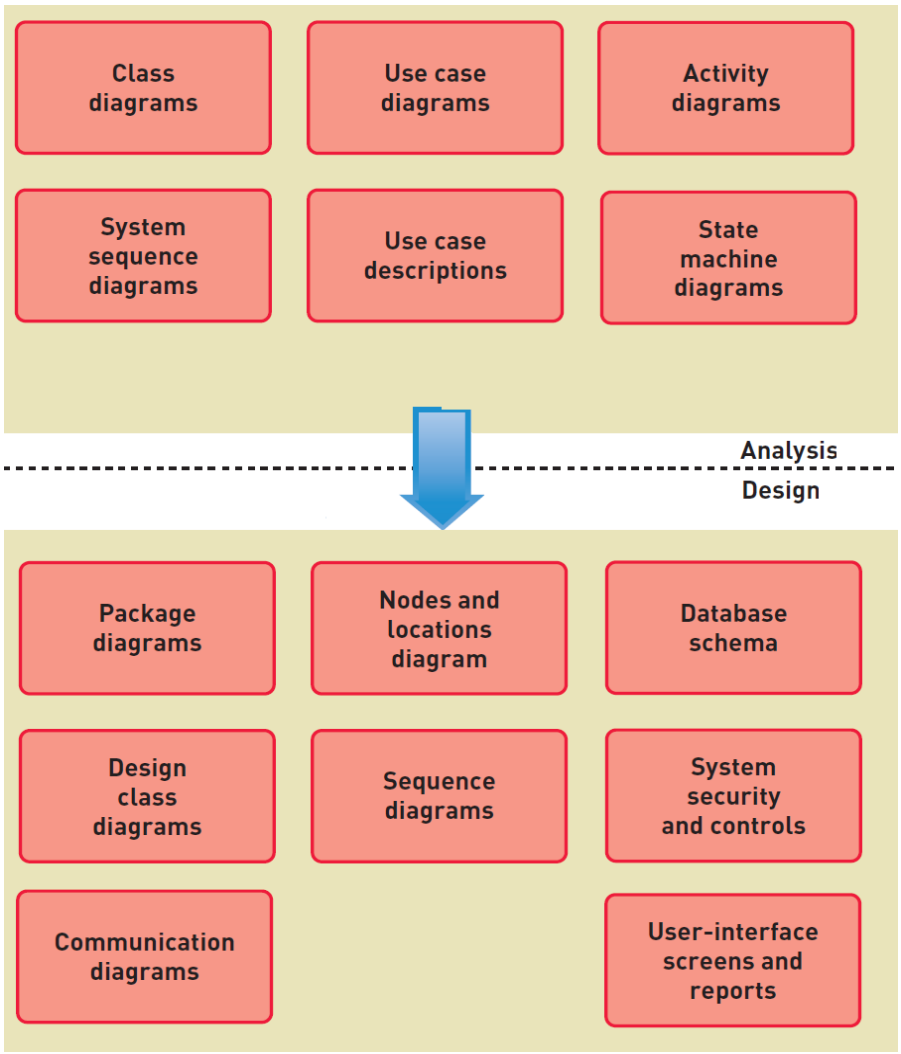

Analysis and Design Models

Design system components

- *Design the environment* - the network and hardware linking the system together
- *Design application architecture and software* - the computer programs
- *Design user interfaces* - screens, reports, and controls for the inputs and outputs from users
- *Design system interfaces* - the communications to other systems
- *Design the database* - structure of the database
- *Design system controls and security* – firewall, physical and logical security controls

- Systems design activities are usually done in parallel e.g. the database design is used heavily in software design and even affects user-interface design.
- Application architecture drives many of the decisions for how the network must be configured.

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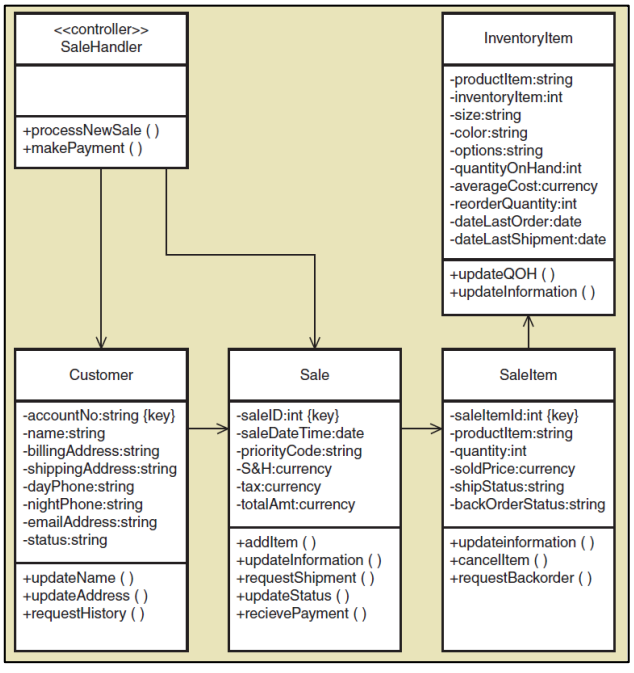
CHAPTER 6: Essentials of Design and the Design Activities

1. Design the Environment

- The environment is all the technology required to support the software application that is being developed.
- Environment includes computers and other hardware required for the deployment of the application as well as such things as server computers, desktop computers, mobile computers, firewalls, routers and cabling, fibre optics, and wireless access points
- Some applications are simple stand-alone applications that execute on a single computer, laptop, or mobile computing device. Others are entirely server based and utilize an application server, a database server, and perhaps some content delivery network, with the users accessing all the application's functions on their computers through a local browser.
- Still other applications may be deployed to remote computing devices, such as smartphones or remote monitoring devices.
- Identify and define all the types of computing devices that will be required as well as locations and communication protocols necessary to integrate computing hardware.
- Also identify operating systems, communication protocols and systems, and other supporting software required (i.e. middleware) e.g. the deployment of a Web-based system will involve server operating systems as well as the operating systems on the users' computers

2. Design the Application Architecture and Software

- Includes decisions about the structure and configuration of the new system as well as the design of the computer software
- Early step in this design process is partitioning the software into subsystems
- Decide which subsystems will need to reside on which pieces of equipment
- The other part of application design is designing the application software at a detailed level
- Detailed design is primarily a model-building activity
- Creating models not only enables the design process, but it also provides the documentation necessary for writing code
- These models include activity diagrams, sequence diagrams, design class diagrams, and other physical models
- For the traditional approach, such models as data flow diagrams are developed
- For object-oriented design, one of the primary models is the design class diagram, which identifies the classes, their attributes, and their methods



Example design class diagram

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CHAPTER 6: Essentials of Design and the Design Activities

3. Design the User Interfaces

- The user interface is everything the user comes into contact with while using the system—conceptually, perceptually, and physically.
- New technology has led to many new requirements for the user interface - PDAs, mobile phones, tablets
- As information systems become increasingly interactive and accessible, the user interface is becoming a larger and more important part of the total system.
- Designing the user interface can be thought of as an analysis and a design activity.
- Analysis activity - developers must understand the user's needs and how the user carries out his or her job. User interface must also be ergonomically efficient and esthetically attractive
- Design activity - requires creativity and conformity to rigorous technology requirements
- Models and tools are used to perform user-interface design, including mock-ups, storyboards, graphical layouts, and prototyping with screen-modelling tools

4. Design the System Interfaces

- New information system will affect and utilize many other information systems.
- The component that enables systems to share information is the system interface, and each system interface needs to be designed in detail.
- Form of system interfaces varies dramatically.
- In some cases, a file is sent from one system to another. In other cases, real-time data exchange is necessary, and live transactions are transferred between system
- The format of the interchange can also vary, from binary format to encrypted formats to text-based formats.
- From the beginning of a systems design, analysts must ensure that all the systems work together well
- Increasingly, organizations are linking systems together across organizational boundaries
- One standardized method for defining text-based system interfaces is to use eXtensible Markup Language (XML). Much like HTML, XML uses tags to define the structure of the record
- Some system interfaces link internal organizational systems, so the analyst
- May have information available about other systems

5. Design the Database

- Integral part of every computer information system is the information itself, with its underlying database.
- Data model (the domain model) is created early during systems analysis and is then used to create the implementation model of the database.
- The first decision is determining the database structure: files, relational databases
- The internal properties of the database must also be designed: tables, attributes, and links
- Many of the technical (as opposed to functional) requirements defined during systems analysis concern database performance needs (such as response times).
- Design work might involve performance tuning to make sure the system actually works fast enough.
- Security and encryption issues, which are important aspects of information integrity, must be addressed and designed into the solution.
- databases may be distributed across multiple database servers and located at completely different sites
- New databases must be integrated with existing databases

6. Design the Security and System Controls

- System controls - adequate safeguards to protect organizational assets
- Design of security and system controls should be included in all other design activities: user interface, system interface, application architecture, database, and network design
- User-interface controls limit access

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CHAPTER 6: Essentials of Design and the Design Activities

- System-interface controls ensure that other systems cause no harm to this system.
- Application controls ensure that transactions are recorded precisely and that other work done by the system is done correctly.
- Database controls ensure that data is protected from unauthorized access and from accidental loss due to software or hardware failure
- Network controls ensure that communication through networks is protected
- All system controls need to be thoroughly tested

7. Design the Environment - affects all the other design decisions

Design for Internal Deployment

Stand-Alone Software Systems

- Any software system that executes on a single computing device without connecting externally via an Internet or network connection is a stand-alone system
- Most standalone systems are developed by individuals and then sold or delivered to companies or other individuals e.g. office suites, Quickbooks
- Design issues are usually straightforward
- These systems usually read and write data into files without database access
- The biggest issue with stand-alone systems is that they often need to be deployed on various pieces of equipment

Internal Network-Based Systems

- An internal network-based system is one that is for the exclusive use of the organization that builds it or buys it
- Made up of Local Area Network, Client and Server computers. Server computers provide applications over the network or access to large storage data
- Desktop application systems and Browser-based application systems are deployed in a client-server architecture
- Browser based network system - the presentation of screens and reports to the user's computers (i.e., the clients) is handled by an Internet browser.
- Most of the processing and heavy calculation is done by the server and then passed to the client computers as Hypertext Markup Language (HTML) pages.
- High-speed computers are usually purchased to provide the necessary computing power. Possible limiting factor is that the presentation of the user-interface screens and reports must conform to the capabilities provided by the browsers

Three-Layer Client-Server Architecture

- Separates the user-interface routines (view layer) from the business logic routines and separate the business logic routines from the database access routines (data layer)

Advantages:

- Programmers can more easily focus their attention on solving one issue at a time
- Easier to upgrade and enhance different portions of the system
- Provides flexibility to deploy and redeploy information-processing resources in response to rapidly changing conditions

Design for External Deployment

Largest and most rapidly growing arena for new software applications is the deployment of systems that are purely for external use on the Internet

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CHAPTER 6: Essentials of Design and the Design Activities

Configuration for Internet Deployment - Is similar to the three-layer architecture
Advantages:

- Accessibility — Web browsers and Internet connections are nearly ubiquitous, Web-based applications are accessible to a large number of potential users (including customers, suppliers, and off-site employees).
- Low-cost communication — Traffic on the backbone networks travels free of extra charges to the end user. Connections to the Internet can be purchased from a variety of private Internet service providers at relatively low costs.
- Widely implemented standards — Web standards are well known, and many computing professionals are already trained in their use.

Disadvantages:

- Security — Web servers are a well-defined target for security breaches because Web standards are open and widely known.
    - Wide-scale interconnection of networks and the use of Internet and Web standards make servers open to hackers
    - Protection must be provided for the home systems, including the data, and for the data as they are transmitted over the Internet.

Throughput — When high loads occur, throughput and response time can suffer significantly.

- The configuration must support not only daily average users but also a peak-load number of users.
- Is unpredictable and can vary widely.

Changing standards—Web standards change rapidly.

- Client software is updated every few months.
- Developers of widely used applications are faced with a dilemma: Use the latest standards to increase functionality or use older standards to ensure greater compatibility with older user software

- Protection of data while in transit is accomplished through Hypertext Transfer Protocol Secure (HTTPS), which is a combination of Hypertext Transfer Protocol (HTTP) and Transport Layer Security (TLS) - an advanced version of Secure Sockets Layer (SSL) protocol used to transmit information over the Internet securely

- Performance is affected by capacity of the server computer and the amount of traffic that it must support
- Many companies that support very high volumes also build server farms, which consist of multiple data centres positioned around the country or even around the world. Each data centre houses many individual servers that are linked together with load-balancing hardware

- Throughput can also be increased by using a content delivery network (CDN). This is an additional set of computers that can be used to deliver static content, such as images or videos.

Hosting Alternatives for Internet Deployment

- Hosting refers to running and maintaining a computer system on someone's behalf where the application software and the database reside.

Critical issues that must be considered:

- Reliability — The hardware environment must be completely reliable. This often requires mirroring computers, hard drives, and database records.
- Security — The systems—hardware and software—must be secure
- Physical facilities — To ensure reliability and security
- Staff — To ensure reliability and security, a well-qualified technical staff

CHAPTER 6: Essentials of Design and the Design Activities

  - Growth — External systems often grow dramatically as a business expands, increasing the number of servers needed to respond to the traffic.

- Co-location - a hosting service with a secure location but in which the computers are usually owned by the client businesses
- Managed Services - hosting company's special technical staff manages the company's server system software
- Virtual server - a method to partition the services of a physical Web server so it appears as multiple, independent Internet servers
- Cloud computing - an extension of virtual servers in which the resources available include computing, storage, and Internet access and appear to have unlimited availability

Diversity of Client Devices with Internet Deployment

- Wide range of client devices
- Various devices have different screen sizes, screen display characteristics, Internet browsers, and operating environments
- Browsers on different devices differ in their capabilities
- Not uncommon to build two or three separate view layers so a software application can be viewed on all three types of devices

Design for Remote, Distributed Environment

- A remote, distributed environment has characteristics of the internal environment and the external, Web-based environment
- These systems are built by using the Internet and are called Virtual Private Networks (VPNs).
- A VPN is a network built on top of a public network such as the Internet, which offers security and controlled access for a private group
- Only computers with the exact software and keys can access the VPN network.
- Communication links are always encrypted to maintain security