2

Information System Building Blocks

Overview

Chapter 2 introduces information system building blocks that will be reinforced throughout the book. These building blocks are adapted from John Zachman's internationally acclaimed Framework for Information Systems Architecture (see recommended readings at the end of the chapter). Essentially, our adaptation of Mr. Zachman's framework is compatible with a currently popular Gartner Group application infrastructure that suggests that a contemporary application or system consists of four distinct layers: data, logic (which we call processes), presentation (which we call interfaces), and networks (which we call communications). These layers become the basis for contemporary distributed computing which partitions or distributes various aspects of each of the first three layers (data, process, and interface) across the fourth layer (networks) as shown below.

Because some time may have passed since the student first completed the introduction to information systems course, a quick review of key definitions and applications is provided as an introduction to the information systems framework and building blocks.

A consistent color scheme is introduced in this chapter and used throughout the textbook. Each layer of the framework (DATA, PROCESSES, and INTERFACES) has its own color. When we move into systems modeling, the shapes in those models will use the same colors to associate themselves with the framework.

Chapter to Course Sequencing

Some adopters prefer to introduce these information system concepts prior to, or instead of, Chapter 1. We have intentionally repeated any key definitions that might be affected by swapping Chapters 1 and 2.

At Purdue we spend about one week examining this framework from top-to-bottom, bottom-to-top, left-to-right, and so forth. The framework has become an integral conceptual "homebase" for several of our courses, both in the systems analysis and design, as well as the data management course sequences. We are forever grateful for having the good fortune to have heard a keynote presentation on the original framework by John Zachman. He has changed our philosophic approach to the study and teaching of information systems.

What's Different Here and Why?

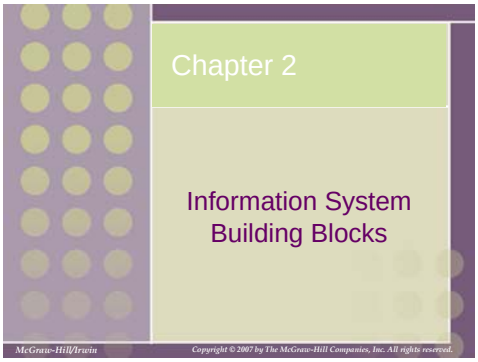
The following changes have been made to the + edition of the information system building blocks chapter:

1. As with all chapters, we have streamlined the SoundStage episode into a quick narrative introduction to the concepts presented the chapter. We believe this streamlined version will be more readable and thus more useful.
2. The explanation for Figure 2-2, Information Systems Applications, has been expanded. This single diagram really says so much about the roles of information systems in the real world.
3. We updated all technology references throughout the chapter.

Lesson Planning Notes for Slides

The following instructor notes, keyed to slide images from the PowerPoint repository, are intended to help instructors integrate the slides into their individual lesson plans for this chapter.

Slide 1

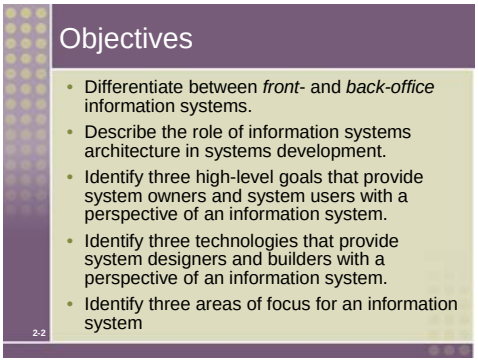


slide appearance after initial mouse click in slide show mode

This repository of slides is intended to support the named chapter. The slide repository should be used as follows:
Copy the file to a unique name for your course and unit.
Edit the file by deleting those slides you don't want to cover, editing other slides as appropriate to your course, and adding slides as desired.
Print the slides to produce transparency masters or print directly to film or present the slides using a computer image projector.

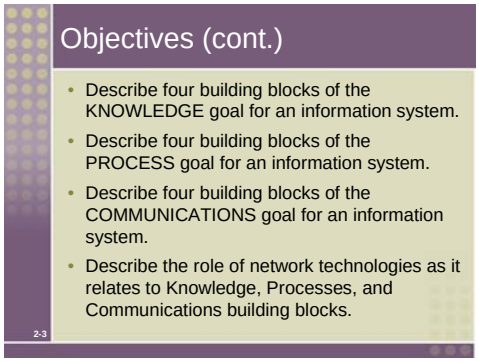
Most slides include instructor notes. In recent versions of PowerPoint, notes by default display in a window under the slide. The instructor notes are also reprinted below.

Slide 2



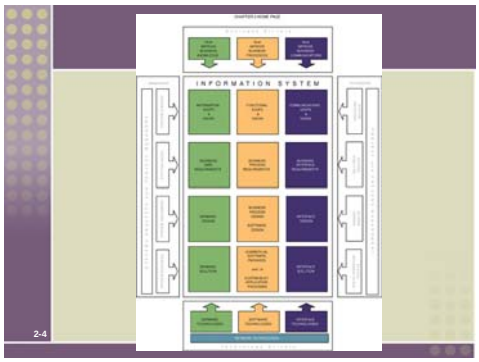
No additional notes

Slide 3



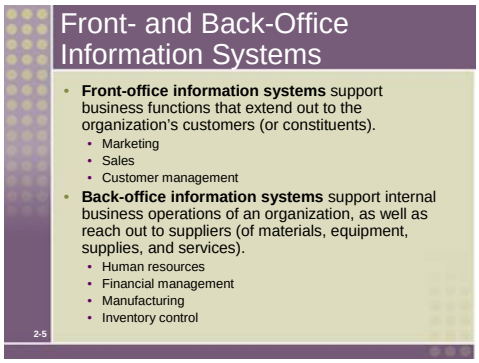
No additional notes

Slide 4



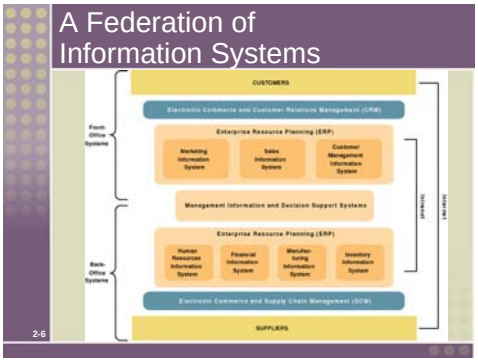
Teaching Notes
This is the capstone figure for the chapter—the complete information systems building blocks framework.
Emphasize that ALL building blocks are relevant to ALL information systems that the student will encounter or develop during the course of their career.
Emphasize that the building blocks must be synchronized both horizontally and vertically when building information systems.
Vertical synchronization ensures that each block represents fully the perspectives of the other blocks in the same column. For example, a *database schema* must implement the intended *data requirements.*
Horizontal synchronization ensures that each block in a given row is consistent and complete with respect to the other blocks in that same row. For example, each table in a *database schema* requires *application software and specifications* to maintain the data stored in those tables.

Slide 5



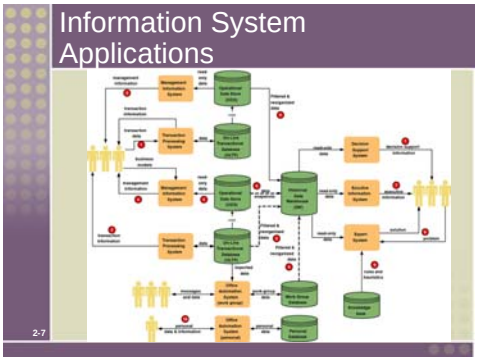
Teaching Notes
This classification scheme comes from popular usage in the trade literature.
This terminology is not to be confused with *office automation*. In fact, office automation systems can be either front-office or back-office, just as with other types of information system applications.

Slide 6



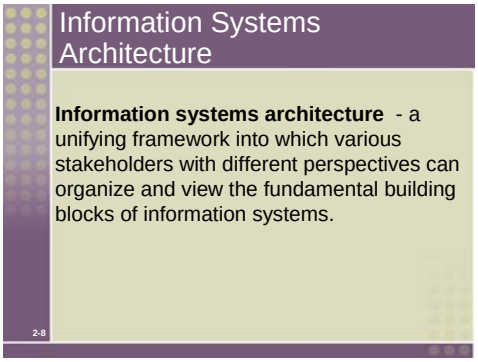
Teaching Notes
This slide visually illustrates front- and back-office applications and highlights the following:
Many organizations purchase their back-office systems in the form of enterprise resource planning (ERP) products such as SAP, PeopleSoft, and Oracle.
The ERP industry is trying to expand into the front-office applications.
It might be noted that electronic commerce and business extensions are being added to both front- and back-office applications in order to streamline interfaces to both customers and suppliers.
E-commerce is being driven by the Internet (and private extranets).
E-business is being enabled by intranets.

Slide 7



Teaching Notes
It may be useful to walk through this diagram in class. The textbook coverage included numbered annotations that highlight portions of this diagram.
Remind students that any given information system may include many instances of each of these IS application processes and databases.

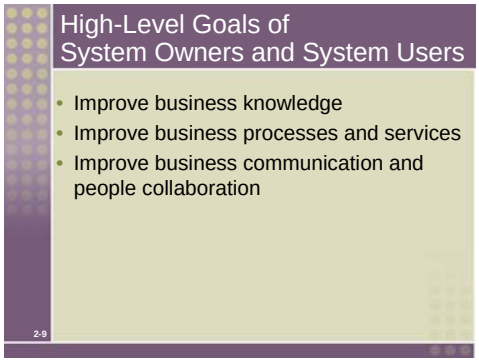
Slide 8



Teaching Notes
If you did not cover chapter 1, you will want to define *stakeholder* here.

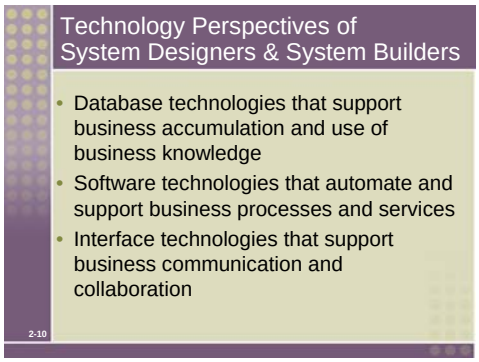
The rest of the chapter will be spent looking at an information system architecture.

Slide 9



Teaching Notes
It may be useful to contrast the goals of system owners and system users with the perspectives of system designers and system builders shown on the next slide. System owners and users are not overly interested in technologies, but they are keenly interested in things that accomplish these goals.

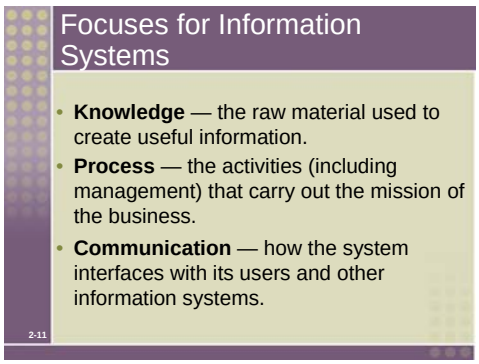
Slide 10



Teaching Notes
See notes on the prior slide. If your students have sufficient experience, you could illustrate each of these technologies, such as

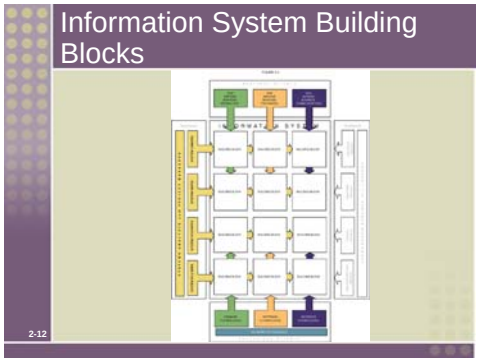
- Database – Oracle
- Software – Java
- Interface – HTML

Slide 11



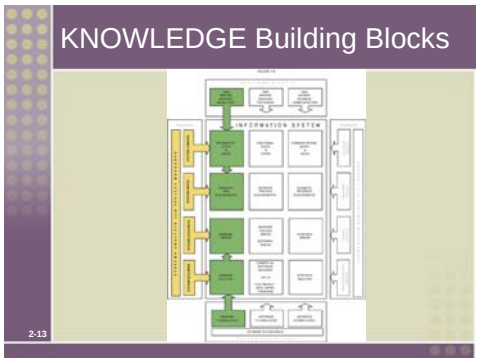
Teaching Notes
Make sure students make the connection between the three points on this slide and the three points on each of the prior two slides.

Slide 12



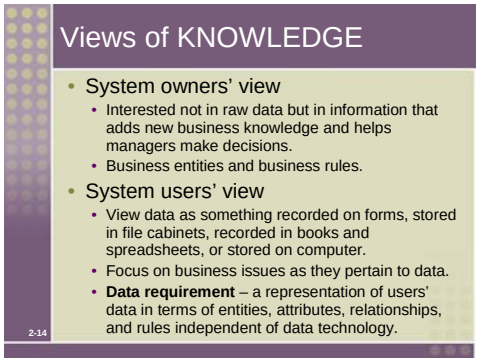
Teaching Notes
This slide serves to establish the focus for the chapter. The highlighted cells are the information system building blocks that are described in detail as this chapter unfolds.

Slide 13



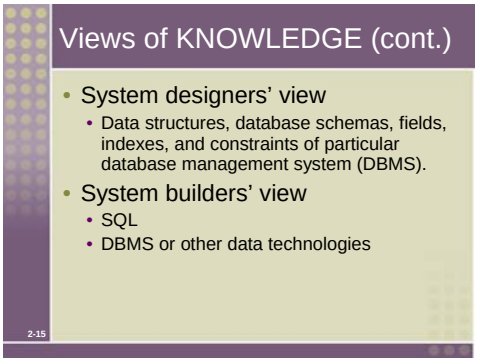
Teaching Notes
This slide visually illustrates the chapter's discussion of the KNOWLEDGE focus as seen by different stakeholders.
If your students have taken a database course, it can be useful to summarize that experience within the context of the KNOWLEDGE column.

Slide 14



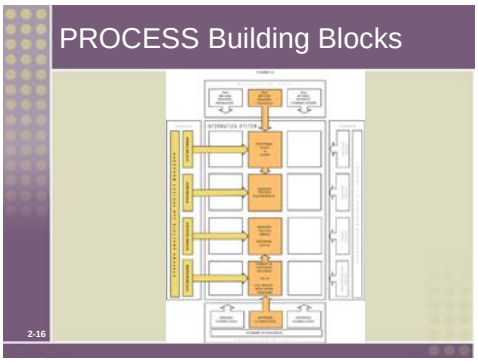
Teaching Notes
This slide places definitions and key terms relevant to the KNOWLEDGE focus into the context of stakeholders.

Slide 15



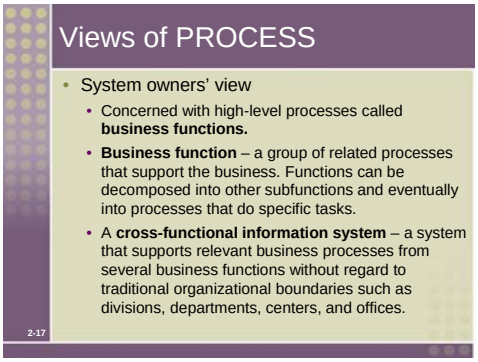
Teaching Notes
This slide places definitions and key terms relevant to the KNOWLEDGE focus into the context of stakeholders.

Slide 16



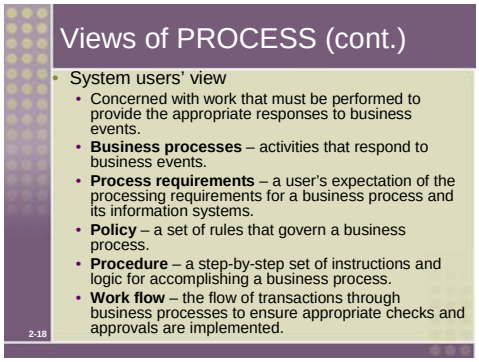
Teaching Notes
This slide visually illustrates the chapter's discussion of the PROCESS focus as seen by the different stakeholders.
Most students have some programming experience. Accordingly, it can be useful to summarize that experience within the context of the PROCESS column. Consider summarizing that experience by working bottom-to-top in the column to reinforce their perspective of the "application programs" they wrote.
The programming instructor typically played the roles of system owners, users, and analysts when they wrote the programming assignments. The student typically played the roles of designer (e.g., flowcharts) and builder (e.g, programming code).

Slide 17



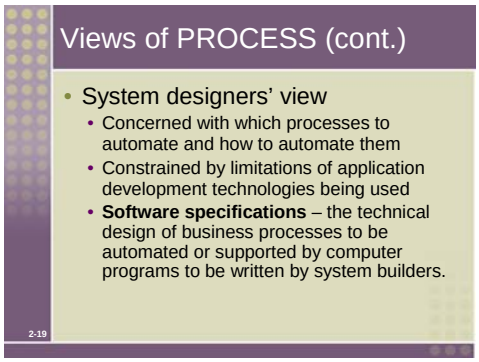
Teaching Notes
This slide places definitions and key terms relevant to the PROCESS focus into the context of stakeholders.

Slide 18



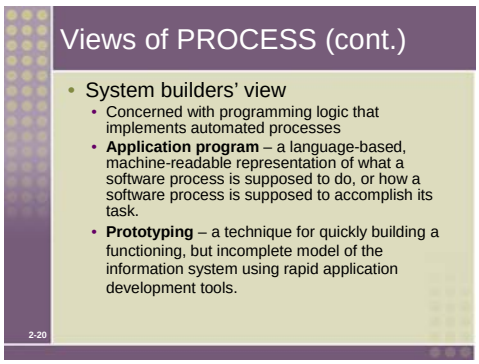
Teaching Notes
This slide places definitions and key terms relevant to the PROCESS focus into the context of stakeholders.

Slide 19



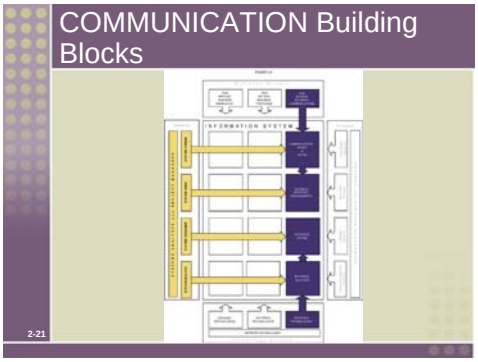
Teaching Notes
This slide places definitions and key terms relevant to the PROCESS focus into the context of stakeholders.

Slide 20



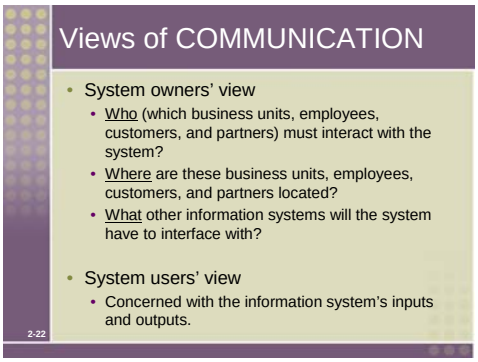
Teaching Notes
This slide places definitions and key terms relevant to the PROCESS focus into the context of stakeholders.

Slide 21



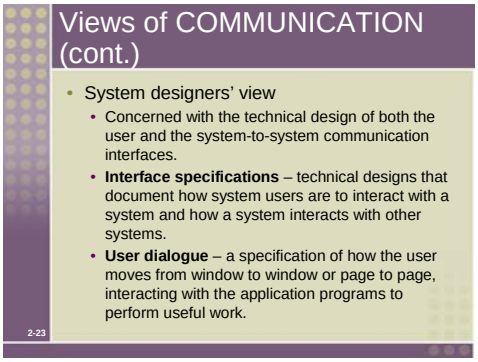
Teaching Notes
This slide visually illustrates the chapter's discussion of the COMMUNICATION focus as seen by the different stakeholders.
Many students have written programs for graphical user interfaces using languages such as *Access, Visual Basic* and *HTML*. Accordingly, it can be useful to summarize that experience within the context of the INTERFACE column.
While it is conceptually and practically useful to separate COMMUNICATION and PROCESS, it should be noted that many of today's contemporary application development environments (ADEs) such as *.NET* effectively integrate the technology used to construct both the user interface and the application logic. Some students find this confusing.
Interestingly, the emphasis on Web-based applications is truly separating the concerns. For example, the interface elements of a Web are written in *HTML* while the application logic is written in *C#* or *Java*.

Slide 22



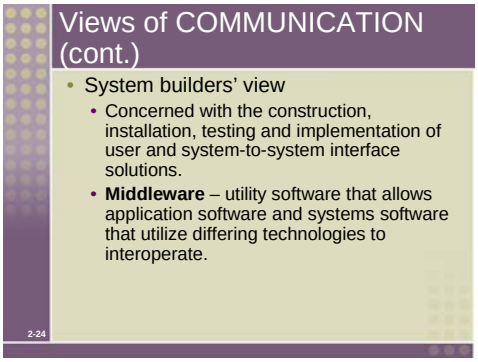
Teaching Notes
This slide places definitions and key terms relevant to the COMMUNICATION focus into the context of stakeholders.

Slide 23



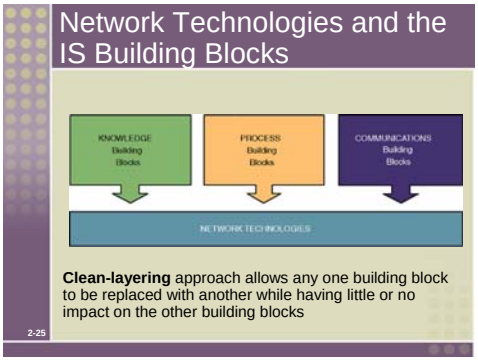
Teaching Notes
This slide places definitions and key terms relevant to the COMMUNICATION focus into the context of stakeholders.

Slide 24



Teaching Notes
This slide places definitions and key terms relevant to the COMMUNICATION focus into the context of stakeholders.

Slide 24



Teaching Notes
This slide illustrates the classic model of separating and partitioning the layers of an information system application across a network.
This *clean-layering* approach allows any one building block to be replaced with another while having little or no impact on the other building blocks.
This is called a distributed computing architecture and it can be implemented using either client/server or Internet/intranet technology, or a combination of both.

Answers to End of Chapter Questions and Exercises

Review Questions

1. Front-office information and back-office information systems are responsible for different business functions in an organization. Front-end office information system support business functions that extend out to the organization's customers. Back-office information systems primarily support internal business operations and may have a linkage to suppliers. .

2. Transaction processing systems are used to process transaction data that users input. Using the data stored in the TPS, management information system will then produce reports or information. A snapshot of data from the TPS will also be used to populate a data warehouse. Using the data in the data warehouse, DSS will be utilized to support management decisions.

3. The Information system architecture provides a foundation for organizing the various components of any information system you are to develop. It serves as a **unifying** framework into which various stakeholders with different perspectives can organize and view the fundamental building blocks of information systems.

4. The three main business goals are 1) to improve business knowledge, 2) to improve business processes, and 3) to improve business communications and people collaboration.

   The three technology perspectives are 1) on the database technologies that support business accumulation and use of business knowledge, 2) software technologies that automated and support business processes and services, and 3) the interface technologies that support business communications and collaboration.

5. In developing an information system for an organization, understanding the business functions is critical. Thus, knowing what the business goals are is absolutely necessary. However, knowing the business drivers only is not enough because information technologies will be involved in a system development. Hence, the technology drivers are then used to achieve the needs of the business. If we look at the business drivers and technology drivers carefully, we generally find that they are complementary. To improve business knowledge, database technologies are used; to improve business processes, software technologies are used; to improve business communications, interface technologies are used. Only when we take into account both the business drivers and the technology drivers can a system be developed successfully.

6. System owners, system users, system designers, and system builders

7. System designers tend to be concerned about the database technology that will be used to support business knowledge. System designers design the database for the information system. They will also choose what database management system (DBMS) will be used as well. For system designers, knowledge is viewed as the data structure, database schemas, fields, indexes, and other technology-dependent components.

   System builders tend to view knowledge as a very precise representation of data. To do so, they use database languages such as structured query language (SQL).

8. Sales, Service, Manufacturing, Shipping, Receiving, and Accounting

9. Examples:
   Event: Customer searches for a CD.
   Response: CD information is presented to the customer.
   Event: Customer selects and pays for the CD.
   Response: Receipt is generated and CD will be shipped.

10. Graduation approval is a policy. It has rules determining if a student can graduate. The procedures needed to make such a determination will be an audit of the classes a student has taken to see if the requirements for graduation are fulfilled.

11. Prototyping is a technique for quickly building a functioning but incomplete model of the information system using rapid application development tools.

    Prototyping is used because it allows system users more interaction with the system as it is being built. The more users are involved in the development process, the higher their satisfaction level with the system tends to be.

12. Information system must provide effective and efficient communication interfaces to the system's users. These interfaces should promote teamwork and coordination of activities.

    Information system must interface effectively and efficiently with other information systems—both internally and increasingly with other businesses' information systems.

13. User dialogue specifies how the user will navigate, i.e., move from window to window or page to page, and interact with the application programs in the system to perform useful work.

14. The trend toward graphical user interfaces such as Windows and web browser has simplified life for system users but complicated the design process for system designers. In a typical Windows application, there are many different things users can do at any given time. Thus, the system designer views the interface in terms of various system states, events that change the system from one state to another, and responses to t hose events.

    System designers did not need to face the complicated design process because in the past when GUI was not popular, all the systems were menu-driven system. Users were only able to one thing at a time.

15. Network technology is used to connect the three major building blocks—knowledge, process, and communications—together. The best-designed information system is to keep them as three separate entities but have them connected through a network technology.
    This network technology allows any one building block to be replaced with another while having little or no impact on the other building blocks.

Problem and Exercise

1. Front-office information systems support business functions that directly involve customers. Examples include marketing, sales, and customer relations management (CRM) information systems.

   Back-end information systems support internal business functions and interactions with suppliers. Examples include human resources, financial management, manufacturing and inventory control systems.

2. The information systems architecture is a high-level picture of the fundamental building blocks of an organization's information system(s). Its purpose is to provide a framework for organizing, viewing and understanding the various components of the information system from the perspectives of different stakeholders.

3. The three goal-oriented perspectives are to:

   a. Improve business knowledge, which is a product of information and data.
   b. Improve business processes, which are the essential activities (including management) which carry out the mission of the organization

c. Improve business communications, which represents how the system interfaces with its users and other information systems, as well as how people communicate and collaborate with each other.

4. System owners, system users, system designers, and system builders each tend to have a different perspective of the system processes. Their typical views are shown below:

   System Owners are concerned with high-level processes or business functions from a strategic viewpoint
   System Users are concerned with the processes or 'work' that must be performed to provide the appropriate responses to business events from an operational viewpoint.
   System Designers are concerned with the business processes from a technical viewpoint of which to automate and how best to automate them.
   System Builders are concerned with the business processes from the technical viewpoint of the programming logic to be used.

5. You should **not** automatically make changes, even if they appear obvious, nor should you request approval to add these data elements directly from the system users, without consulting first with the systems analyst(s) who developed the requirements document. What you should do is ensure that any changes to the requirements documents follow a structured process involving the impacted stakeholders before they are made.

6. Typically, your design would include interfaces to other systems such as inventory management, forecasting, financials, billing, and credit card settlement. Your design would also probably include interfaces to keyless data entry systems such as a bar code reader.

7. a. Sales order processing
   b. Order fulfillment
   c. Shipping
   d. Billing
   e. Post-sales service and support (as applicable)

8. Middleware is a layer of utility software that sits between application software and systems software to transparently integrate differing technologies so that they can interoperate. It reduces complexity of the system, both in the development process and in system maintenance. Before middleware was developed, applications used point to point connection to exchange information or data. Middleware allows each application to only need one interface rather than requiring separate interfaces between each and every application. For each application it needs to talk to. From a graphic view, the architecture design resembles a 'hub and spoke' model.

9. There are a number of reasons to be able to distinguish between laws, policies and procedures. An organization can generally change its policies or procedures when there is a business need, but its policies and procedures must always be compliant with legal requirements. Additionally, procedures generally do not stand alone; they tie back to a law or policy. If one changes, the impact upon the others must be analyzed.

10. System owners tend to look at business processes in terms of "the big picture," i.e., the high level processes and their impact upon the ability of the organization to meet its goals and objectives. System users tend to be concerned with operational aspects, i.e., how the system works and how they interact with it.

    In the customer self check-in system scenario, the system owners, who would probably be executives from the marketing and operations units, would probably view the processes from the standpoint of whether customer satisfaction will increase while reducing labor costs. From the perspective of the system users, who are the customers in this case, the concern would be whether the self check-in kiosk is easy to use, reliable, and can perform the same services as a reservations agent.

11. System designers tend to view communications in terms of the technical design of the user- to/from- system and the system-to-system interfaces. For the customer self check-in, they would probably be concerned with how intuitively the system communicates with the customer, i.e., can the customer use the system quickly and easily the first time with no more than minimal instructions? System designers would also be concerned with how the check-in system communicates with the airlines' reservation and other systems. System builder's view of communications is technological rather than design-oriented, i.e., they are concerned with the interface technology to be used in building the system. For the self check-in system, they would probably tend to view communications in terms of the application development environment (ADE) required to construct the graphical user interface (GUI), as well as the middleware to be deployed between the different systems.

12. System designers must ensure that the interfaces between systems do not create unnecessary maintenance projects for legacy systems, do not compromise the design of new system, and are as transparent as possible to system users.

13. Dividing knowledge, process and communications into separate blocks sitting on top of a network technologies building block provides a modular methodology sometimes called the "clean-layering" approach. The chief advantage is the inherent modularity of the framework; anyone of the building blocks can be modified with little or no impact upon the other blocks.

14. Off-the-shelf systems are generally designed for a wide range of potential customers, and thus tend to have a corresponding wide range of features built into the software.

    Since the initial cost of development cost is spread among many customers, the purchase price of an off-the-shelf application is generally substantially less than the cost of developing a custom application. The systems can be implemented more quickly because extensive programming is not required. The software manufacturer takes on the responsibility of product upgrades, improvements and error corrections.

    On the other hand, support and upgrades for the off-the-shelf system depends on the manufacturer's ongoing success and presence. If the manufacturer goes out of business, the organization can lose its technical support and future improvements. It may have to switch to another product or live with the "orphaned" software. If the vendor releases an upgrade that is incompatible with the organization's current interfaces, the organization may have to modify its interfaces or live with an unsupported product when the manufacturer stops providing support for the old version.

    Further, a company's business processes may have to be modified to fit the software, which means that business needs may not be met in an optimal fashion. Also, there is a risk that users will be resistant to change in their business processes which they have been following for years. Even though the purchase cost is less for the product, the implementation and ongoing operational costs may be substantially higher. Just as with a custom-built application, the company risks losing its investment and even its competitive edge if the product does not adequately meet the business requirements after the implementation

15. In a custom-built application, system builders would view the custom application as something to be built using computer programming languages or application development software to tools. With a COTS package, that view would shift. The system builder would focus on the customization that needs to and can be done to the COTS system, the interface programs that need to be developed so the COTS system can interoperate with the organization's other systems, and on developing applications to extend the functionality of the COTS system where needed to meet business requirements.

Project and Research

1. a. No specific "right" answer, but response should provide sufficient information to give a basic picture of the organization.

   b. Could be any type of information system, e.g., sales, order, inventory, accounting, etc, that is used within the organization. Response should include a brief description of its nature and purpose within the organization.

   c. Generally, response should indicate the executive or top manager who is responsible for the business operations for which the system is maintained. There may also be multiple owners.

   d. Response should indicate that system owners tend to view an information system and the information it produces in terms of their strategic value to the organization.

   e. Response should indicate that project scope and vision of system owner will be focused on addressing a problem, opportunity and/ or constraint relevant to the specific organization.

   f. Depending upon the type of information system, typical users in terms of job level could be line personnel or managers/supervisors; in terms of job function, they could be in sales, marketing, administration, etc. Users could also be suppliers and customers. Response should be consistent with the nature of the information system selected, and should address the full range of probable users.

   g. Users who are supervisors or managers will tend to focus on the tactical aspects of the information produced by the system, e.g., sales trends of the office(s) for which they are responsible, budget reports, etc. Line workers, customers and suppliers will tend to be focused on the operational aspects of the information produced by the system, i.e., the information they need in order to carry out their job duties or to process an order.

   h. System owners and users tend to view the same information at different levels; generally system owners are looking at summary information for strategic purposes, while system users who are line personnel, suppliers or customers are looking at detailed information at the individual record level to meet operational needs. Supervisory and managerial users fall in-between at the tactical level.

2. Responses to 2a, 2b, 2c and 2d are open-ended and there is no one "right" answer, but should indicate that the student has engaged in more than a

cursory interview. In general, there should be a variety of responses, depending upon factors such as the expertise and skill set of the systems analyst, the organizational culture, the system development methodology used by the organization, etc. Response to 2e is also open-ended as to viewpoint, but should be logical, factual and supported by examples.

3. Answer 3a, 3b and 3d are open-ended depending upon the selected organization, but should be consistent with each other. Answer 3c, 3e and 3f should describe viewpoints similar to those in the text for these stakeholder groups (pages 67-70).

   Answers should generally be consistent with the following from the text:

   a. The system owners' are generally the functional or program areas responsible for the functions performed by the system. In general, they view the system processes in terms of high-level business functions.
   b. System users can be customers, suppliers, or employees of the organization. System users tend to view system processes as a series of activities and flows (data and work).
   c. System designers tend to view system processes in technical terms, using diagrams to showing process flows and connections, and specification documents to describe the software requirements.

4. Question 4 is intended to be extremely open-ended, and is intended to get students thinking about user interfaces in terms of design and usability. The answers can vary widely, but should indicate cognitive recognition of these issues.

5. a. Finding articles on ethical issues related to systems design will be more difficult than the similar question on ethical issues and systems analysis in the previous chapter. This is intentional, and the intent is to help students develop their ability to find pertinent information on research questions.

   b. Some of the ethical issues confronting system designers are the same as those for systems analyst, e.g., the system designer may recommend a specific software package, but have a conflict of interest with the vendor who wants to sell it to the system designer's company. Other ethical issues may be more subtle and technological in nature, such as designing user interfaces that intentionally mislead customers.

   c. The answer to this question is open-ended; however, the student should present a logical, convincing argument for her/his position.

6. There are a number of classical and contemporary IS architecture frameworks for which students should be able to readily find descriptive informa-

tion. Responses to 6a – 6d should indicate that the student understands the framework selected, as evidenced by the student's ability to compare it in structure and content against the framework used in the textbook. Responses to 6e and 6f are open-ended, but should be logical and consistent with the perspective of the respective stakeholder.

Minicases

1. Clearly, a large chasm exists between business managers and IT managers. The communication breaks down when neither speaks in a 'language' the other understands. This is a common (very common) exchange in business. While there are no "quick fixes" to this problem, IT managers must be diligent in presenting strong business cases for their funding requests, as well as outlining specific alternatives to their recommendation (i.e. is there a cheaper alternative, that may not be a perfect solution but will provide some help?). It is important to realize that not all funding requests can be granted, so the IT manager must prioritize the technology needs, and provide a clear assessment of the risks and downsides should the upgrade or other request not be funded.

2. Note to Professor: Many times, there is some overlap in data entry due to the incomplete information sharing across departments, even within a company. Usually departments do share some information.

3. Note to Professor: Many government service organizations are overwhelmed with information and are working with outdated computer systems. This is the first mini-case of a series that directs and involves students with this issue.

4. Answers will vary, but will most likely include the use of a bar code scanner, and a simple database with a cash register control. Implementing this project for a small grocery store is quite feasible for both undergraduate and graduate students.

5. Answers will vary, but will most likely include the use of a bar code scanner, and a simple database with a cash register control. As an aside, implementing this project for a small grocery store is quite feasible for both undergraduate and graduate students.

Team and Individual Exercises

There are no answers to this section.