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INFORMATION TECHNOLOGY WITH INTRODUCTION TO DATABASE MANAGEMENT SYSTEM

CONTENTS

UNIT-1 BUSINESS PROCESSES AND INFORMATION SYSTEMS FOUNDATIONS

CONTENTS

INTRODUCTION TO INFORMATION SYSTEMS

As "Pottermania" reached epidemic proportions recently, it provided a good example of how a single business event can strain critical information systems in even the most advanced organizations. When each Harry Potter book was due for release, pre-orders for the book swamped bookstores and Internet booksellers. This demand had an impact on the supply chain, from the publisher who needed to predict how many copies to produce, to booksellers who accepted pre-orders at a record pace, to the Fedex drivers charged with getting books delivered on the official release date. As the fourth book neared release, Amazon.com received over 275,000 advance orders for the single volume, exceeding its previous record-setting preorder of 43,000 copies of John Grisham's This large number of orders challenged Amazon's information systems in many ways. Although advance orders were accepted, for example, the book's title was not made public until shortly before the release date, leaving Web developers scrambling to update the many Web screens on which Harry Potter and the Goblet of Fire needed to appear. Amazon also made careful arrangements with Fedex to ship the first 250,000 preordered copies on the announced delivery date, which happened to fall on a Saturday. Fedex scheduled 100 flights and 9,000 delivery specialists to meet the deadline.

But perhaps the biggest challenge of all fell to the Information Systems staff at Amazon.com. Because the orders were received weeks or even months ahead of time, data on each customer needed to be confirmed and stored for the future shipment. Billing information for the shipment had to be verified ahead of time, even though billing could not be completed until the shipment was released. Then the data was updated as each delivery was packaged and kept in a warehouse until Fedex shipped. These proved to be challenging data quality issues for Amazon. Each order was confirmed by sending e-mail to customers to make sure that delivery information was correct. Customer credit card charges were readied to enable billing as soon as legally possible on the Saturday of the shipment.1

Many business professionals at Amazon.com had to work together to be able to plan and implement the successful Harry Potter release. They had to address Information Systems issues across several business processes as part of this effort. These business processes in organizations, including management, operations, and information functions, are assisted by—and sometimes operated by—large, complex enterprise systems that govern the collection and sharing of data by various groups. Sometimes business processes extend to business partners through the Internet, permitting electronic business relationships to flourish. In the case of Amazon.com, the Internet is not an alternative communications channel, but the lifeblood of its business. Amazon's e-business systems had to be highly reliable even when faced with unprecedented levels of demand. To be successful, business profession also must understand their roles and responsibilities in the context of the surrounding business processes and information technologies. In this text we help you to connect your business knowledge to business processes and information technologies to which professional activities are inextricably linked. This book will teach you to evaluate and understand what the impacts of technology are on your organization's operations and success, and how new technologies may change your business and job performance in the future.

This text revolves around the influence of three themes on contemporary business practices:

(1) enterprise systems,

(2) electronic business (e-business), and

(3) information technology.

Enterprise systems are integrated software packages designed to provide complete integration of an organization's business information processing systems and all related data. Data is shared across systems to support the operation and management of the organization. Modules within these packages are named for the functions that they support and include logistics (sales and distribution, procurement, inventory management), accounting (financial accounting, treasury, controlling), manufacturing (planning and scheduling, cost accounting, capacity planning), and human resources (payroll, employee tracking, tax compliance). It is critical that business professionals understand these systems because they are members of teams that install and operate them in their organizations, and they require access to information captured within these systems to be effective managers. Installing an enterprise system requires that the business processes of an organization be understood and documented. Sometimes, the business processes must be changed and then mapped to the enterprise system. A major part of installation is configuring the enterprise system to tailor it to the business processes. Consultants, business process owners, system users, and evaluators must understand these systems and be able to install, use, and assess them. Unit 2 describes a tool set for diagramming business processes that will help us analyze those processes. Unit 3 describes enterprise systems more fully and these systems in their business context appear throughout the remainder of the book.

E-business is the application of electronic networks (including the Internet) to undertake business processes between individuals and organizations. These processes include interaction between back-office processes (internal processes such as distribution, manufacturing, and accounting) and front-office processes (external processes such as those that connect an organization to its customers and suppliers). Electronic networks include the Internet and electronic data interchange (EDI), both described in Unit 4. E-business has created entirely new ways of working within and across organizations. For example, organizations are buying and selling goods and services at virtual marketplaces, changing the way organizations identify customers and select vendors. E-business is also changing how to determine what it costs to acquire goods from a vendor and what price(s) to charge customers for products. Obviously, business professionals should be aware of the opportunities and risks associated with this new way of doing business. Unit 4 explains e-business and a closely related concept, Internet commerce, more fully, and instances appear throughout the remainder of the text.

Information Technology, or simply, Technology, is the third theme reflected in the side panel icons. This concept is more broadly defined than the other two, as it encompasses any hardware, software, or communications technology that might be adopted by an organization to support or control a business process, enable management decisions, or provide a competitive advantage. The side-panel technology icons signal discussion of an electronic mechanism that is either in wide use, represents the state of the art, or may be adopted by business in the near future. Units 8 and 9 introduce the use of technology to provide security, privacy, or internal control of operations. Technology can be used to support enterprise systems and e-business applications as well. Business professionals need to be aware of the availability of new technologies, and be able to evaluate the costs, benefits, and usefulness of each.

Challenges and Opportunities for the Business Professional

Are you preparing yourself to be effective in the future? Will you be able to adapt to advances in technology? Are you equipped to take advantage of technology improvements? You should prepare yourself to use the available technology and to participate in planning for and growing with the technology. For example, Unit 5 introduces business intelligence systems and explains why the use of such systems is a competitive imperative for many organizations. These are not conditions of the distant future; most of these changes are already underway. For example, the Radio Frequency ID tags described in Technology Insight 1.1 (page 6)will have a major impact on how material is acquired, warehoused, assembled into products, and distributed to customers. The people, activities, and technologies involved in all processes within the supply chain will change because of the impact of RFID.

Hardware and Software

The ability to plan and manage business operations depends partly on knowledge of the hardware and software available. For instance, is production manageable without knowledge of robotics? It goes without saying that technological developments have a profound effect on information systems; enterprise systems, e-business, databases, and business intelligence systems are but a few examples. Hardware and software technology provides the foundation on which IS and business operations rest.

Databases

Important to a complete understanding of IS are databases, both internal and external to the company; the quantity and type of data available in these databases; and methods of retrieving those data. To perform analysis or to prepare information for management decision making, a business professional must be able to access and use data from internal and external databases. Unit 3 explores the design and use of an organization's own databases.

Reporting

To design reports generated by an information system, the business professional must know what outputs are required or desirable. A user might prepare a report on an occasional basis using powerful report-generating tools or a database query language (discussed in Unit 3). Scheduled reports appear periodically as part of normal IS function. Government agencies such as the Internal Revenue Service and the Securities and Exchange Commission require some reports. Other reports, such as sales analysis, are useful internally.

Control

Traditionally, internal auditors and IS professionals have been charged with controlling business processes. However, this responsibility has expanded to others because of the difficulty of controlling modern, complex business processes. Today's business process owners need to work with internal auditing and the IS staff, and also business process owners in partnering companies, to ensure

that the activities in their business processes are secure and reliable. Units 8 and 9 discuss control, the means by which one assures that the intended actually happens. Business process Units 10 through 14 further demonstrate controls in action that facilitate development and implementation of well-controlled business processes.

The next three elements of Information Systems study, business operations, events processing, and management decision making, comprise a major focus of this text, business processes. A **business process** is a set of business events that together enable the creation and delivery of an organization's products or services to its customers. It was the successful interaction among business processes that enabled Amazon.com to fill all those Harry Potter book orders during peak demand periods. Knowledge of these processes is essential for success as a technology user, consultant, business process owner, or Information Technology (IT) specialist.

Business Operations

Organizations engage in activities or operations, such as hiring employees, purchasing inventory, and collecting cash from customers. An IS operates in concert with these business operations. Many IS inputs are prepared by operating departments—the action or work centers of the organization—and many IS outputs are used to manage these operations. Managers must analyze and IS in light of the work the organization performs. For example, to advise management and to prepare reports for management decision making, a marketing manager must understand the organization’s product cycles.

Events Processing

As organizations undertake their business operations, events, such as sales and purchases, occur. Data about these events must be captured and recorded to mirror and monitor business operations. The events have operational, managerial, and IS aspects. To design and use the IS, the business professional must know what event data are needed and how they are processed.

Management Decision Making

The information used for a decision must be tailored to the type of decision under consideration. Furthermore, information is more useful if it recognizes the personal management styles and preferences of the decision maker. For example, the manager of Department A prefers to receive a monthly cash flow statement that groups receipts and payments into broad categories. The manager of Department B, on the other hand, wants to see more detailed information in the form of an analysis of payments by vendors. Unit 5 examines decision making and the business intelligence systems that support it.

Systems Development and Operation

Information Systems that process business events and provide information for management decision making must be designed, implemented, and effectively operated. Business professionals often participate in systems development projects. They may be users or business process owners contributing requests for certain functions, or auditors advancing controls for the new system. Choosing the data for a report, designing that report, or configuring an enterprise system are examples of systems development tasks that can be accomplished by a business professional. Units 6 and 7 examine systems development and operation, and the business professional’s role in those processes.

Communications

To present the results of their endeavors effectively, business professionals must possess strong oral and written communication skills. Have your professors been drumming this message into you? If not, you’ll become acutely aware of its importance when you enter the job market. There are few easy answers in the study of IS. Professionals must evaluate alternatives, choose solutions, and defend their choices. Technical knowledge won’t be enough for the last task.

Business Principles

To design and operate the IS, a business professional must understand the use to which the information will be put. As an illustration, suppose you were designing an IS for the billing function at XYZ, Inc. Would you invoice customers at the time the customer’s purchase order was received, or would you wait until XYZ’s shipping department notified you that the goods had been shipped? You need to know the situations for which the former is normally correct (e.g., e-business retail sales) and for which the latter is correct.

What Is an Information System?

This section provides a definition for Information Systems (IS) and defines related terms to establish a background for later study. The section concludes by discussing how the business professional interacts with the IS and with the current business environment.

Systems and Subsystems

A **system** is a set of interdependent elements that together accomplish specific objectives. A system must have organization, interrelationships, integration, and central objectives. Figure 1.2a depicts a system consisting of four interrelated parts that have come together, or integrated, as a single system, named “system 1.0.” Each part of a system—in this case, parts 1.1, 1.2, 1.3, and 1.4—is known as a **subsystem**. Within limits, any subsystem can be further divided into its component parts or subsystems. Figure 1.2b depicts subsystem 1.2 as a system consisting of three subsystems. Notice

that we use the term system (versus subsystem) to describe the area of immediate focus. For example, in a typical university, the College of Business and the College of Engineering are subsystems of the university system, and the Operations Management and Marketing Departments are subsystems of the College of Business system.

The Information System

An **Information System** is a man-made system that consists of an integrated set of computer-based and manual components established to facilitate an organization’s operational functions and to support management decision making by providing information that managers can use to plan and control the activities of the firm. Figure 1.3 depicts the functional components of an Information System. Imagine a simple IS used to maintain inventory balances for a shoe store. The inputs for such a system might be receipts of new shoes or sales of shoes; the process might be to update (in storage) the inventory records for the particular shoe; and the output might be a listing of all the various kinds and sizes of shoes and their respective recorded balances.

Assume that, while entering data about shoe sales, we also enter data about who purchased the shoes, how they paid for the shoes, and why they decided to buy their shoes at our store. We might store those data and then periodically print reports useful in making decisions about advertising effectiveness. Or, we might decide, on the basis of analysis of our sales data, to engage in joint advertising campaigns with a credit card company whose cards are often used in the store.

The shoe store example shows that an IS often divides into components based on the organizational function being supported. For example, the IS in the shoe store supports inventory control (a logistics function) by maintaining records for each shoe stocked in the store. The shoe store IS also supports a sales and marketing function by analyzing sales in a variety of ways. Other typical IS components include personnel, production, finance, and accounting. As discussed in Unit 3, however, integrated computer processing has blurred the distinctions among these separate systems.

Now consider the technology components of the IS model in Figure 1.3. **Input data** are data received by the Information System from the

external environment or from another area within the Information System. Data input includes capturing data (for example, scanning a bar code on a sales item at a grocery store) and, if necessary, conversion of the data to machine-readable form. Input data are normally recorded in **business event data stores**.3 These business events comprise the activities of the organization, such as purchasing goods from vendors and collecting cash from customers. Business event data are used often as a key source of data to update various master data. A **master data update** is an information processing activity whose function is to incorporate new business event data into existing master data. Updating includes adding, deleting, and replacing master data and/or records. For example, the sales event data are used to update the accounts receivable master data by adding new accounts receivable records. 3 Business event data and master data represent the relevant
portions (or views) of the corporate-wide database being used for a particular application.

Master data updates are recorded on master data stores. **Master data stores** are repositories of relatively permanent data maintained over an extended period of time.4 **Master data** contain data related to entities—persons (e.g., employees, customers), places (e.g., buildings), and things (e.g., inventory). Master data include such data as the accounts receivable master data, the customer master
data, and the inventory master data. 4 See note 3.

Two types of updates can be made to master data: information processing and data maintenance. **Information processing** includes data processing functions related to economic events such as financial events, and internal operations such as manufacturing. **Data maintenance**, on the other hand, includes activities related to adding, deleting, or replacing the **standing data** portions of master
data. Master data **standing data** include relatively permanent portions of master data, such as the credit limit on customer master data and the selling price and warehouse location on inventory master data. This textbook emphasizes information processing, and analysis of internal controls related to master data updates is restricted to master data updates from information processing. There are references however, to controls related to data maintenance at appropriate points in the text.

Logical Components of a Business Process

A business process has three component processes that work together to support its logical activities. The IS supports all three processes in that it frequently embodies many of the policies and procedures that help define each process.

The **information process** is that portion of the overall IS related to a particular business process. The information process plays a critical role in the way all three processes work together.

An **operations process** is a human-made system consisting of the people, equipment, organization, policies, and procedures whose objective is to accomplish the work of the organization. Operations processes typically include distribution, manufacturing, human resources, and their sub-processes.

The **management process** is a human-made system consisting of the people, authority, organization, policies, and procedures whose objective is to plan and control the operations of the organization. The three most prominent management activities are planning, controlling, and decision making. These are discussed in Unit 5. These processes work together to accomplish the objectives of the business process—and therefore the organization. In order to accept and fill a customer order for a Harry Potter book from Amazon.com.

The management process:

(1) hires personnel and establishes the means for accomplishing the work of the organization. For example, management designs the procedures used to warehouse inventory and then to ship those goods to the customers.

(2) establishes broad marketing objectives and assigns specific sales quotas by which progress toward the long-run objectives can be measured. Also designs the information processes' procedures for facilitating operations, such as the procedures used to pick and ship goods to the customer.

The information process:

(3) receives a customer's order over the Internet for a Harry Potter book.

(4) prepares an invoice and sends it electronically to the credit card company/bank.

(5) receives an electronic payment acknowledgement from the credit card company/bank.

(6) acknowledges the customer's order by sending an e-mail message to the customer.

(7) sends to the warehouse a request to ship a Harry Potter book to the customer. This request identifies the book and its location in the warehouse. Also sends a packing slip to be attached to the book.

The operations process:

(8) attaches to the shipment a document (i.e., a packing slip) identifying the customer and the book and ships the book to the customer.

(9) reports to the IS that the book has been shipped.

The information process:

(10) sends a shipping acknowledgement to the customer via e-mail.

(11) sends management a report comparing actual sales to previously established sales quotas.

These 11 activities highlight several important concepts.

• The information process facilitates operations by maintaining inventory and customer data and by providing electronic signals (such as those used in automated warehouses) and paper documents with which to execute business events, such as shipments to customers.

• The information process provides the means by which management monitors the operations process. For example, management learns sales results only from the sales report.

• Management designs the operations and information processes and establishes these processes by providing people, equipment, other physical components, and policies.

• Information process users include operations personnel, management, and people outside the organization, such as the customer.

The data captured at the operations and business event processing level constitute the foundation for the vertical information flows that service a multilevel management function. At the operations management level, personnel such as supervisors use information to monitor the daily functioning of their operating units. The vertical information useful to operations management is a summarized and tailored version of the information that flows horizontally. For example, horizontal flows relate to specific business events, such as one shipment, or to individual inventory items. On the other hand, information useful to operations management personnel is often an aggregate of data related to several business events. For example, a report summarizing shipments made each day might be useful to the shipping manager.

At the tactical management level, middle managers such as a warehousing or distribution manager, might want information about the timeliness of shipments each month. Such information is more summarized and broader in scope than is the information used by operations management.

Finally, at the strategic management level, senior managers such as division managers, chief financial officers (CFOs), and chief executive officers (CEOs), require information that is even more summarized and broader in scope than is the information used by tactical management. For these managers information must relate to longer time periods, be sufficiently broad in scope, and be summarized to provide a means for judging the long-term effectiveness of management policies. External financial statements, annual sales reports, and division income statements are but a few examples of strategic-level information. Note, however, that information technology facilitates access to detailed data at all management levels.

How does the IS support the multiple information uses suggested by the preceding discussion? For example, how does the IS support such users as the organization's operations units, the organization's management, and people outside the organization? How does the IS supply the information needed by three levels of management? One key component enabling the IS to meet the needs of this diverse constituency is the entity wide database. The **entity wide** database is the central repository for all of the data used by the organization. Information processes, such as order entry, billing, and inventory, update the database. Output can be obtained by other information processes and by other users such as management. When processes or other users access the entity wide database, they get a view of the database appropriate for their needs. For example, when entering the customer order in the earlier example, the information process had access to that portion of the database that was required, such as the applicable customer and inventory data.

Management Uses of Information

An IS serves two important functions within an organization. First, the IS mirrors and monitors actions in the operations process by processing, recording, and reporting business events. For example, the IS processes customer orders; records sales to customers by updating sales, accounts receivable, and inventory data; and produces invoices and sales event

summaries. This event-based, operations-oriented function is depicted by the horizontal information flows shown along the bottom of Figure 1.5.
The vertical information flows shown in Figure 1.5 highlight the second major function of the IS: to support managerial activities in the management process, including management decision making. How do managers use this information? First, they monitor current operations to keep their ship on course. For example, managers need to know if enough inventory is being produced each day to meet expected demand. Managers' second use of information is to help them achieve satisfactory results for all of their stakeholders (e.g., customers, stockholders). For example, information can measure attainment of goals regarding product quality, timely deliveries, and cash flow. Finally, managers use the information system to recognize and adapt in a timely manner to trends in the organization's environment. For example, managers need answers to questions such as: "How does the time it takes us to introduce a new product compare to our competitors?" "Does our unit cost to manufacture compare to our competitors?"6 Because information systems provide critical support to such management activities, one must understand these activities, including decision making, to understand the features of good information systems. 6 To read more about measures of performance, see Robert S.

Data versus Information

Information is data presented in a form that is useful in a decision making activity. The information has value to the decision maker because it reduces uncertainty and increases knowledge about a particular area of concern. **Data** are facts or figures in raw form. Data represent the measurements or observations of objects and events. To become useful to a decision maker, data must be transformed into information. The most basic function of an IS, then, is to transform data into information that is useful in decision making. What attributes give information its utility value?

Qualities of Information

To provide output useful for assisting managers and other users of information, an IS must collect data and convert them into information that possesses important qualities. Exhibit 1.1 describes qualities of information that, if attained, will help an organization achieve its business objectives. Figure 1.6 (page 18) presents an overview of information qualities depicted as a hierarchy.

Understandability enables users to perceive the information's significance. For example, information must be in a language understood by the decision maker. By language, we mean native language, such as English or French, as well as technical language, such as one that might be used in physics or computer science. Information that makes excessive use of codes and acronyms may not be understandable by some decision makers. Information capable of making a difference in a decision-making situation by reducing uncertainty or increasing knowledge has **relevance**. For example, a credit manager making a decision about whether to grant credit to a customer might use the customer's financial statements and credit history because that information could be relevant to the credit-granting decision. The customer's organization chart would not be relevant. The description of reliability of information in Exhibit 1.1 uses the term "appropriate." Relevance is a primary component of appropriateness. Information that is available to a decision maker before it loses its capacity to influence a decision has **timeliness**. Lack of timeliness can make information irrelevant. For example, the credit manager must receive the customer's credit history before making the credit granting decision. Otherwise, if the decision must be made without the information, the credit history becomes irrelevant. Exhibit 1.1 describes availability as "being available when required." Thus, availability can increase timeliness.

Predictive value and **feedback value** improve a decision maker's capacity to predict, confirm, or correct earlier expectations. Information can have both types of value. A buyer for a retail store might use a sales forecast—a prediction—to establish inventory levels. As the buyer continues to use these sales forecasts and to review past inventory shortages and overages—feedback—he or she can refine decision making concerning inventory. If there is a high degree of consensus about the information among independent measurers using the same measurement methods, the information has **verifiability**. Real estate assets are recorded in financial records at their purchase price. Why? Because the evidence of the assets' cost provides an objective valuation for the property at that point.

Neutrality or **freedom from bias** means that the information is reliably represented. For example, the number of current members of a professional association may be overstated due to member deaths, career changers who don't bother to quit, or members listed twice because of misspellings or address changes. Notice that verifiability addresses the reliability of the measurement method (e.g., purchase
price vs. current value) and neutrality addresses the reliability of the entity doing the measuring.

Comparability is the quality that enables users to identify similarities and differences in two pieces of information. If we can compare information about two similar objects or events, the information is comparable. Comparing vendor pricing estimates where one vendor gives a per unit price, and another a price per case is problematic in choosing a low-cost vendor. If, on the other hand, we can compare information about the same object or event collected at two points in time, the information is
consistent. Analyzing sales growth, for example, might require horizontal or trend analysis for two or more years for one company. As noted in Exhibit 1.1, integrity is an information quality that can be expanded into three very important qualities: validity, accuracy, and completeness. In Figure 1.6 these are components of reliability. Information about actual events and actual objects has **validity**. For example, suppose that the IS records a sale and an account receivable for a shipment that didn't actually occur. The recorded information describes a fictitious event; therefore, the information lacks validity.

Accuracy is the correspondence or agreement between the information and the actual events or objects that the information represents. For example, if the quantity on hand indicated on an inventory report was 51 units, when the actual physical quantity on hand was 15 units whether the cause was a transposed number or an erroneous count, the information is inaccurate.

Completeness is the degree to which information includes data about every relevant object or event necessary to make a decision. We use relevant in the sense of all objects or events that we intended to include. For instance, suppose that a shipping department prepared 50 shipping notices for 50 actual shipments made for the day. Two of the notices fell to the floor and were discarded with the trash. As a result, the billing department prepared customer invoices for only 48 shipments, not for 50.

These qualities appear again, in addition to some not discussed here (efficiency, confidentiality, and compliance), in subsequent units.

Costs and Benefits of Information We often hear people say that, before an action is undertaken, the estimated benefits of that action should exceed the estimated costs. This is a basic expectation, as basic as the American assumption that truth, justice, and the American way will prevail. In business, we make an assumption that there is a cost associated with each improvement in the quality of information. For example, the information reflected in an inventory data store could be improved if it were checked against a physical count of inventory each week. But imagine how costly that would be! Many companies use perpetual inventory balances for most of the year, or estimate their inventory balances based on sales or past years' levels.

In practice, the benefits and sometimes the costs of information are often hard to measure. Unit 6 provides some ideas for measuring the costs and benefits of an information system.

Conflicts Among Information Qualities It is virtually impossible to achieve a maximum level for all of the qualities of information simultaneously. In fact, for some qualities, an increased level of one requires a reduced level of another. As one instance, obtaining complete information for a decision may require delaying use of the information until all events related to the decision have taken place. That delay may sacrifice the timeliness of the information. For example, to determine all the merchandise shipments made in November, an organization may have to wait until several days into

December to make sure that all shipments get recorded. As another example, to obtain accurate information, we may carefully and methodically prepare the information, thus sacrificing its timeliness. To ensure the accuracy of a customer invoice, billing clerks might check the invoice for accuracy several times and then get their supervisor to initial the invoice, indicating that she also has checked the invoice for accuracy. Though ensuring accuracy, these procedures certainly hurt timeliness.

Prioritizing Information Qualities In cases where there are conflicts between qualities of information, defining a hierarchy establishes the relative importance of each quality. We could decide

that accuracy is more important than any other quality. Or we could insist that timeliness be achieved even if that means that accuracy is sacrificed. For example, a marketing manager wanting to know quickly

the impact of a new advertising campaign might check sales in just a few regions to get an early indication. The information may be timely, but it might be collected so hastily that it has limited
reliability. In some situations, managers choose to sacrifice maximum attainment of individual goals or values for achievement of a higher goal. For many decision makers, relevance of information is the key quality when choosing among many viable options. Maximizing one objective, rather than obtaining the highest possible levels for individual subordinate values, is a strategic choice. Later units revisit these information qualities and their role in the design, control, and use of various business processes.

The Role of the Business Professional

In relation to an Information System, the business professional may assume one or more of three roles: designer, user, and evaluator. As a designer of an IS, the business professional brings a knowledge of business, information systems techniques, and systems development methods. In designing the IS, the business professional might answer such questions as:

- What will be recorded (i.e., what is a recordable business event)?
- How will the event be recorded (i.e., what data stores will be used)?
- When will the event be recorded (i.e., before or after occurrence)?
- What controls will be necessary to provide valid, accurate, and complete records; to protect assets; and to ensure that the IS can be audited?
- What reports will be produced, and when will they be produced?
- How much detail will the reports include?

The business professional is also a user of the IS to perform functions. The business professional's effectiveness depends on how well she knows the IS and the technology used to implement it. For instance, to analyze financial information, a financial analyst must know what data are stored in the IS, how to access those data, what analysis tools exist and how to use them, and how to present the information using available report-writing facilities. As a user, the business professional may also be called on to participate in the IS design process. In fact, an Information System user should insist on being involved to make sure that a new system contains required features. To be effective in the design process, the user must know how systems are developed, the techniques used to develop a system, and the technology that will be used in a new system.

REVIEW QUESTION

1. What 10 elements are included in the study of IS?
2. Describe various uses of information by the management.
3. What are the of a business professional in an information system?
4. What are the cost and benifit of Information
5. Give a detail about the logical components of information process
6. Differentiate data and information. What should be the quality of good information.
7. Discuss about information system and its components

FURTHER READINGS

- Information System Tecnology- Ross Malaga
- Information System Today-Leonard Jessup
- An Illustrated Information Technology-Alan Witchcomb
- Information Technology For Management Henry C.Lucas
- Information Technology in Business Management Dr. Mukesh Dhunna, J.B. Dixit

IMPORTANT NOTES

UNIT-2 DOCUMENTING BUSINESS PROCESSES AND INFORMATION SYSTEMS

CONTENTS

Introduction

When you learn to read, you first learn individual letters, then string them together in words, and finally the words collectively make sentences. It is only when you practice reading that real understanding occurs, and you open up a new path to learning. These diagramming techniques are another pathway, one that gives a visual overview of complex organizational relationships. This unit begins by showing you how to read data flow diagrams, systems flowcharts, and entity-relationship diagrams. Then, in the appendices, you see how to prepare data flow diagrams and systems flowcharts. You will use these documentation tools throughout the remainder of the textbook. Don’t be a passive observer; work along with the text and practice these tools to develop your skills.

Although we discuss drawing diagrams as if you were to draw them with pencil and paper, keep in mind that professionals using these techniques prefer using specialized flowcharting or documenting software. Specialized tools produce highly professional-looking diagrams that are much easier to update and share. You may have access to one of these tools through your instructor or workplace.

Reading Systems Documentation

This unit shows you how to read and interpret three types of systems documentation: data flow diagrams, systems flowcharts, and entity-relationship diagrams. We will look at data flow diagrams first.

Reading Data Flow Diagrams

A **data flow diagram (DFD)** is a graphical representation of a system. A DFD depicts a system’s components, the data flows among the components, and the sources, destinations, and storage of data.

Context Diagram A **context diagram** is a top-level, or least-detailed diagram of an information system. The diagram describes data flows into and out of the system and into and out of external entities. **External entities** are items such as persons, places, or things outside a system that send data to, or receive data from, a system. Used in this manner, entities is a narrower concept than that used in Unit 1. External entities must be able to send or receive data.

Physical Data Flow Diagram A **physical data flow diagram** is a graphical representation of a system showing the system's internal and external entities, and the flows of data into and out of these entities. An **internal entity** is an entity (i.e., person, place, or thing) within the system that transforms data.4 Internal entities include, for example, sales clerks (persons), departments (places), and computers (things). Therefore, physical DFDs specify where, how, and by whom a system's processes are accomplished. A physical DFD does not tell us what is being accomplished, though. For example, in Figure 2.3 we see that the Sales clerk receives cash from the Customer and sends cash, along with a register tape, to the Cashier. So, we see where the cash goes and how the cash receipts data are captured on the register tape, but we don't know exactly what was done by the Sales clerk.

4 Used in this manner, entities is a narrower concept than that used in Unit 1. Internal entities must be able to transform data. Notice that the physical DFD's bubbles are labeled with nouns and that the data flows are labeled to indicate how data are transmitted between bubbles. For example, the Sales clerk sends cash and a register tape to the Cashier. Also, see that a data store's location indicates exactly where (in the Computer) and a data store's label indicates how (in the sales data store) a system maintains sales records. Finally, while the entity boxes on the context diagram define external entities in the relevant environment, the bubbles in the physical DFD define internal entities.

Logical Data Flow Diagram A **logical data flow diagram** is a graphical representation of a system showing the system's processes and the flows of data into and out of the processes. We use logical DFDs to document information systems because we can represent the logical nature of a system—what tasks the system is doing— without having to specify how, where, or by whom the tasks are accomplished. What a system is doing will change less over time than will how it is doing it. For example, a cash receipts system will typically receive customer payments and post them to the customer's account. Over time, however, the form of the payment—cash, check, electronic funds—and the method of recording—manual, computer—may change.

Reading Systems Flowcharts

A **systems flowchart** is a graphical representation of information processes (activities, logic flows, inputs, outputs, and data storage), as well as the related operations processes (entities, physical flows,
and operations activities). Including both manual and computer activities, the systems flowchart presents a logical and physical rendering of the who, what, how, and where of business processes and Information Systems. Systems flowcharts can be complex and cumbersome when they depict a large or complicated process. DFDs can be drawn at many levels of complexity, so someone needing only a high level view or a picture of only a part of the process doesn't need to work through the complexities of a systems flowchart. However, for detailed analysis of business processes, the complexity of a systems flowchart is invaluable.

Common Systems Flowcharting Routines Follow along with us as we describe each of these routines.

The data entry clerk (such as a telephone sales clerk) keys a sales input document while online. The computer accesses data in data store 1 (perhaps a table of valid codes, such as customer codes) and in data store 2 (perhaps a table of open sales orders) to edit/validate the input. The computer displays the input, including any errors. The clerk compares the input document to the display, keys in corrections as necessary, and accepts the input. The computer updates the table in data store 2 and notifies the clerk that the input has been recorded.

• The editor validate step may be performed with one or more data stores.

• The display is implied with most, if not all, data entry processes.

• By combining the “Edit/validate input” rectangle with the “Record input” rectangle, we could depict this input process in one—rather than two—steps without losing much detail about the activities being performed.

• The manual processes undertaken by the clerk are isolated in a separate column to distinguish them from the automated processes undertaken by the computer.

• We show the input document at the bottom of the column to indicate that the document “flows” through the input process.

A user keys a query request online into a computer. The computer accesses the table(s) in one or more data stores and presents a response to the user.

• The user and computer activities are again isolated in separate columns.

• The display is an implied element of the online computer.

New data (a customer address change, for example) previously recorded on disk are input to the computer, along with the existing (old) master data (customer master data, for example). The computer updates the existing master data and creates a new version of the master data.

Notice the following about Figure 2.7, part (c): • When sequential master data is updated, we show two data store symbols on a flowchart. One symbol represents the existing (old) version and the other represents the new version.

• A dashed line connects the new with the old master data version to show that the new becomes the old version during the next update process.

Figure 2.7, part (d), depicts the input and reconciliation of computer inputs and might be described as follows:

The user collects a number of input documents in a “batch” (such as a week’s worth of time cards), prepares batch totals, and enters the documents into the computer. The computer records the inputs on a disk and notifies the user as each input is accepted. The user files the input documents in numerical sequence. At the end of the batch, the computer prepares an exception and summary report (a list of inputs accepted and rejected by the system) that includes batch totals. The user compares the computer batch totals to those prepared prior to entry of the documents to make sure the data were entered correctly.

Notice the following about Figure 2.7, part (d):

• The annotation makes it clear that the computer prepares the exception and summary report after the user has completed entry of the batch.

• The user's comparison of the batch totals is depicted with a dashed line—rather than a manual process. • If the batch totals had been input with the batch, the computer—rather than the user—could compare the batch totals.

A data entry clerk (perhaps clerk 1) enters documents into a PC (client) connected to a data entry system. The system records the inputs on a disk and notifies the user of the acceptance of each input. The documents are then forwarded to a different clerk (say clerk 2) who keys the documents again.6 Differences are resolved and the transaction data are updated to reflect the verifications and corrections.

The majority of data processing errors occur at the data entry stage and the majority of those errors can be attributed to misreading or miskeying the input. Because it is unlikely that two different clerks will make the same reading or keying mistake, the rekeying by a different clerk will discover the majority of these errors.

• The key-to-disk unit is an offline device and should be depicted with a square—rather than a rectangle—and in a column separate from the computer.

• We show the data entry clerks in two columns to emphasize that the keying and two different clerks perform verification steps.

• Clerk 2 probably follows an established procedure to reconcile differences found during the verification step. We use the annotation about error routine to suggest the existence of these procedures.

A clerk scans a document (e.g., a customer's billing stub) into the computer. Using the data from the scanned document, the computer updates the data located on one or more data stores.

• We represent the scanner with the offline process symbol.

• We could include a display coming from the scanner, showing the clerk the document that had just been scanned.

• To be able to read data from the document, the scanner must have optical character recognition (OCR) capabilities.7 7 Document scanning and OCR are discussed in Unit 4.

A clerk scans a document into the computer. The computer routes an image of the scanned input to a data entry clerk, who keys data from the document's image into the computer. The computer records the keyed data with the scanned document.

You should quickly become reasonably proficient in reading flowcharts if you learn these routines. You may encounter many different flowcharting methods during your career, but the principles you learn here will carry over to those techniques.

Reading Entity-Relationship Diagrams

As a professional you will likely be performing one or more of four functions. You might be (1) a business process owner; (2) a designer of an IS; (3) an IS user; or (4) an evaluator of an IS. To effectively perform these roles, you must be aware of the procedures used to develop and install an IS. Systems development procedures include two concurrent and often inseparable processes: the development of the system procedures and the design of the database. DFDs often portray system procedures, and entity-relationship diagrams often depict specifications for the database.

Preparing Data Flow Diagrams

We use DFDs in two main ways. We may draw them to document an existing system, or we may create them from scratch when developing a new system. Construction of DFDs for new systems will be described in the systems development units (Units 6 and 7). In this section, we explain a process for deriving a set of DFDs from a narrative that describes an existing system.

The Narrative

Figure 2.9 (page 40) contains a narrative describing the cash receipts system for the Causeway Company. The first column indicates the paragraph number; the second column contains the line number for the text of the narrative. We describe here an orderly method for drawing the DFDs for the Causeway system. You will get the most benefit from this section if you follow the instructions carefully,
perform each step as directed, and don't read ahead. Draw your diagrams by hand or use the software package of your choice.

Table of Entities and Activities

Our first step is to create a table of entities and activities. In the long run, this list will lead to quicker and more accurate preparation of DFDs and a systems flowchart because it clarifies the information
contained in a narrative and helps us to document the system correctly.
To begin your table, go through the narrative line-by-line and circle each activity being performed. An **activity** is any action being performed by an internal entity or an external entity. Activities can include actions related to data (originate, transform, file, or receive) or to a business process. Business process activities might include picking goods in the warehouse, inspecting goods at the receiving dock, or counting cash. For each activity there must be an entity that performs the activity. As you circle each activity, put a box around the entity that performs the activity.
Now you are ready to prepare your table. List each activity in the order that it is performed, regardless of the sequence in which it appears in the narrative. List the activity, along with the name of the entity that performs the activity and the paragraph number indicating the location of the activity in the narrative. After you have listed all activities, consecutively number each activity. Compare your table to Table 2.1 (page 41). Notice that the narrative refers to some entities in more than one way. For example, we have "accounts receivable" and the "clerk" on line 16. Notice that we listed both activity 7 and activity 8. It might be that activity 7 describes activity 8 and does not need to be listed itself. However, it is better to list doubtful activities than to miss an activity. See how we listed activity 11, found on lines 23 and 24. We changed to the active form of the verb "notify" so that we could show the activity next to the entity that performs the action. Before continuing, resolve any differences between your list of entities and activities and those in Table 2.1.

Drawing the Context Diagram We are now ready to draw the context diagram. Since a context diagram consists of only one circle, we can begin our context diagram by drawing one circle in the center of our paper. Next, we must draw the external entity boxes. To do this, we must decide which of the entities in Table 2.1 are external and which are internal to the system.

DFD guideline 1:

Include within the system context (bubble) any entity that performs one or more information processing activities. Information processing activities are those activities that retrieve data from storage, transform data, or file data. Information processing activities include document preparation, data entry, verification, classification, arrangement or sorting, calculation, summarization, and filing—both manual and automated. The sending and receiving of data between entities are not information processing activities because they do not transform data. If we send data to another entity, we do not process data. If, however, we file data, we do perform an information processing activity. Likewise, if we receive data from another entity, we do not perform an information processing activity. But, if we retrieve data from a file or table, we do perform an information processing activity. Operational, or physical, business process activities are not information processing activities.

To discover which entities perform no information processing activities, we must inspect the table of entities and activities and mark those activities that are not information processing activities.

Any entities that do not perform any information processing activities will be external entities; the remaining entities will be internal. Go through your table of entities and activities and mark all the activities that do not perform information processing activities. These marked activities—mostly sends and receives—indicate data flows.

DFD guideline 2:

For now, include only normal processing routines, not exception routines or error routines, on context diagrams, physical DFDs, and level 0 logical DFDs.

Since activity 11 occurs only when the payment data contain an error, we will not consider this activity for now. Your table of entities and activities, with certain non-information processing activities marked, should now indicate that the mailroom, accounts receivable, the cashier, and the computer perform information processing activities and will be included in our diagrams as internal entities. The customer, on the other hand, does not perform any such activities and is an external entity. Are there other external entities to be included in our diagrams? To answer this question, go through the narrative one more time and put a box around those entities not yet marked. You should find the bank (line 30) and the general ledger office (line 40) that, in this system, do not perform information processing activities. These entities, along with the customer, are external entities and are

included in the context diagram as sources or destinations of data. We now have three external entities, four internal entities, and 19 activities. No other entities or activities are to be added because of the following guideline:

DFD guideline 3:

Include on the systems documentation all (and only) activities and entities described in the system narrative—no more, no less.

When we say narrative, we are talking about the narratives that you will find as problem material in this book. You are to assume, in those cases, that the narrative is complete and accurate. However, when you prepare a narrative to document a real-world case, you cannot assume that your narrative is perfect. It should be reviewed and revised by working with all participating internal entity representatives. When you have verified that your narrative is complete and that it accurately reflects reality, you must then follow DFD guideline 3.

Because there are three entities external to the Causeway cash receipts system—the customer, the bank, and the general ledger office—you must draw three boxes surrounding the one context bubble. Next, draw and label the data flows that connect the external entities with the bubble. Because logical (versus physical) labels are usually used on a context diagram, you should do your best to derive logical labels for the flows. The final step is to label the context bubble. Write a descriptive label that encompasses the processing taking place within the system. Our label in Figure 2.10 indicates the scope of the Causeway system—namely, cash receipts from charge customers. The Causeway system does not include cash receipts from any other source.

DFD guideline 4:

When multiple entities operate identically, depict only one to represent all. Drawing the Current Physical Data Flow Diagram To keep the current physical DFD balanced with the context diagram, start a current physical DFD by drawing the three external entities from the context diagram near the edges of a piece of paper. Next, draw and label each data flow going into the two destinations and coming out of the single source. Leave the center of the page, into which we will sketch the rest of the diagram, as open as possible. As this is a physical DFD, the data flows should have labels that describe the means by which the flow is accomplished. For example, the “Payment” from the customer should now be labeled “Checks and remittance advices,” and the “Deposit” should now be labelled “Deposit slip and checks.”

Because each internal entity listed in the table of entities and activities (Table 2.1) becomes a bubble in our physical DFD, we know that our current physical DFD will contain four bubbles: one each for the mailroom, the cashier, accounts receivable, and the computer. We will start adding these four bubbles by first drawing the bubbles on our diagram that are connected to the sources and destinations. During this process, you must consider all “send” and “receive” activities and the implied reciprocal activities. (Many of these were marked earlier to indicate that they were not data processing activities.) For example, activity 1 indicates that the customer “sends” the checks and remittance advices. Draw and label a mailroom bubble, an accounts receivable bubble, and a cashier bubble. Use a data flow to connect each of these three bubbles to its related external entity.

To complete the physical DFD, we must go through the table of entities and activities once again and draw all the remaining entities and flows. Activity 5 indicates a connection between the mailroom and accounts receivable. Activity 6 indicates a connection between the mailroom and the cashier. Activity 8 tells us that the accounts receivable clerk enters data into the computer. Draw the computer bubble, label it "4.0," and connect it to accounts receivable. To perform activity 18, accounts receivable must receive the reports from the computer. Draw and label one or two flows (we chose two flows) from the computer to accounts receivable. To perform activity 14, the cashier must receive the deposit slip from the computer. Activity 16 implies that the table of accounts receivable master data must be read so that the open invoice record can be retrieved. Draw the data store for the accounts receivable master table and a flow from the data store to the computer bubble. Notice that the label on the data store shows that the physical storage medium is a disk. We draw a flow only from the data store because a data request is not a flow of data. Therefore, we do not show the request for the open invoice record. The movement of the record out of the data store in response to this request is a flow of data and is shown. Also, notice that we did not show a flow from the accounts receivable data store

directly to the accounts receivable bubble. Because the accounts receivable data store is on a computer disk, only the computer can read from or write to that disk. This also excludes any direct connection between computerized data stores. To update the data on one computerized data store from another, you must go through a computer bubble.

Because the open invoice record must be read into the computer, updated, and then written back to the accounts receivable master table, activity 10 requires a data flow from and to the accounts receivable data store. But, since we drew a flow from the data store for activity 9, we need only draw a flow back to the data store. Activity 12 requires that we draw a data store for the cash receipts log and that we draw a data flow from the computer into that data store, whereas activity 13 requires that we draw a flow from the data store. Finally, to depict the flow of data required to print the reports indicated in activities 16 and 17, we need to draw flows from both data stores into the computer. You may think that all the flows into and out of the data stores aren't necessary. Here is a guideline:

DFD guideline 5:

For clarity, draw a data flow for each flow into and out of a data store. You may, also for clarity and to help you determine that you have included all necessary flows, label each flow with the activity number that gives rise to the flow or with a description of the flow (e.g., "retrieve accounts receivable master data").

Compare it to your diagram and, before continuing, resolve any differences. You should notice that there is a data store of endorsed checks connected to the cashier. This file, not mentioned in the narrative, was added to show that the cashier must hold on to batches of checks until the deposit slip is printed on the computer terminal. This format leads to another guideline:

DFD guideline 6:

If a data store is logically necessary (that is, because of a delay between processes), include a data store in the diagrams, whether or not it is mentioned in the narrative.

Should we draw a data store to show that the remittance advice batches and batch totals are retained in accounts receivable until the computer reports are received? We could. You must use DFD guideline 6 carefully, however, so that you don't draw DFDs that are cluttered with files and are therefore difficult to read. You need to use your judgment. Does this guideline contradict DFD guideline 3? No. DFD guideline 3 tells you to include in your diagrams only those activities included in your narrative; while DFD guideline 6 tells you to describe those activities completely. So, if the narrative implies an activity or data store, include it in the diagrams. How about an example that would violate DFD guideline 6? Because they are outside the context of this particular system, the following activities are not described in the narrative and should not be included in the diagrams:

- The actual update of the general ledger data
- Cash receipts from cash sales
- Customer billing

Drawing the Current Logical Data Flow Diagram The current logical DFD portrays the logical activities performed within the system. Because level 0 DFDs depict a particular grouping of the logical activities, we start the level 0 DFD by enumerating the activities in the system; then, we group those activities. You already have a list of the activities to be included in the level 0 DFD. Do you know what that list is? The activities to be included in the level 0 DFD are the unmarked activities on the table of entities and activities, Table 2.1. Our list includes activities 2, 3, 4, 8, 9, 10, 12, 13, 14, 16, 17, and 18. Recall that, at this time, we don't consider any other activities because the other activities either are actions performed in other-than-normal situations, are actions that merely send or receive data rather than transform data, or are business process activities, such as picking goods off the shelf. Several guidelines will help us to group the activities remaining in our list:

DFD guideline 7:

Group activities if they occur in the same place and at the same time. For example, the clerk performs activities 2 and 3 in the mailroom as each payment is received.

DFD guideline 8:

Group activities if they occur at the same time but in different places. For example, the cashier performs activity 14 "immediately" after the computer prints the deposit slip in activity 13.

DFD guideline 9:

Group activities that seem to be logically related.

DFD guideline 10:

To make the DFD readable, use between five and seven bubbles. For very simple systems, such as those described in the narratives in this textbook, your solutions may have fewer than five bubbles.

To start preparing your logical DFD, try bracketing the activities in Table 2.1 as you believe they should be grouped (do not consider the marked activities). For example, if we apply DFD guideline 7 (that is, same time and same place), we could combine activities 2 and 3; activities 9, 10, and 12; and activities 16 and 17. Although this would provide a satisfactory solution, there would be eight bubbles, and there would be several bubbles containing only one activity. Since we prefer not to have too many single-activity bubbles until we get to the lowest-level DFDs, we proceed with further groupings.

If we apply DFD guideline 8 (that is, same time but different place) to the preceding grouping, we could combine activities 8 with 9, 10, and 12; 13 with 14; and 16 and 17 with 18. This solution is also fine, and is a little better than our first solution because we now have five bubbles and we have only one single-activity bubble. If we apply DFD guideline 9 (that is, logically related activities),we can combine activities 2, 3, and 4. Although this leaves us with only four bubbles, this solution is superior to the first two because we have no single-activity bubbles.

DFD guideline 11:

A data flow should go to a business operations entity square when only business operations functions (that is, work related functions such as storing goods, picking goods from the shelves, packaging the customer's order, and so on) are to be performed by that external entity. A data flow should enter an entity bubble if the business operations entity is to perform an information processing activity.

DFD guideline 12:

On a physical DFD, reading computer data stores and writing to computer data stores must go through a computer bubble.

DFD guideline 13:

On a logical DFD, data flows cannot go from higher- to lower-numbered bubbles.

Preparing Systems Flowcharts

This section describes steps for preparing a systems flowchart. The following guidelines outline our basic flowcharting technique.

Systems flowcharting guideline 1: Divide the flowchart into columns; one column for each internal entity and one for each external entity. Label each column.

Systems flowcharting guideline 2:

Flowchart columns should be laid out so that the flowchart activities flow from left to right, but you should locate columns so as to minimize crossed lines and connectors.

Systems flowcharting guideline 3:

Flowchart logic should flow from top to bottom and from left to right. For clarity, put arrows on all flow lines.

Systems flowcharting guideline 4:

Keep the flowchart on one page. If you can't, use multiple pages and connect the pages with off-page connectors. Do not glue, tape, staple, or otherwise "extend" your flowchart page to get the flowchart onto one page.

To use an off-page connector, draw the symbol at the point where you leave one page and at the corresponding point where you begin again on the next page. If you leave page 1 for the first time and you are going to page 2, then the code inside the symbol should be "P. 2, A" on page 1 and "P. 1, A" on page 2. That is, you point to page 2 from page 1 and you point back to page 1 from page 2. If you draft your flowchart on paper, discipline yourself to draw flowcharts on paper of limited size, as computerized flowcharting packages will print your flowcharts only on paper that will fit in your printer!

Systems flowcharting guideline 5:

Within each column, there must be at least one manual process, keying operation, or data store between documents. That is, do not directly connect documents within the same column.

This guideline suggests that you show all processing that is taking place. For example, if two documents are being attached, include a manual process to show the matching and attaching activities.

Systems flowcharting guideline 6:

When crossing organizational lines (i.e., moving from one column to another), show a document at both ends of the flow line unless the connection is so short that the intent is unambiguous.

Systems flowcharting guideline 7:

Documents or reports printed in a computer facility should be shown in that facility's column first. You can then show the document or report going to the destination unit.

Systems flowcharting guideline 8:

Documents or reports printed by a centralized computer facility on equipment located in another organizational unit (e.g., a warehouse or a shipping department) should not be shown within the computer facility.

Systems flowcharting guideline 9:

Processing within an organizational unit on devices such as a PC or computerized cash register should be shown within the unit or as a separate column next to that unit—but not in the central computer facility column.

Systems flowcharting guideline 10:

Sequential processing steps (either computerized or manual) with no delay between them (and resulting from the same input) can be shown as one process or as a sequence of processes.

Systems flowcharting guideline 11:

The only way to get data into or out of a computer data storage unit is through a computer processing rectangle.

Systems flowcharting guideline 12:

A manual process is not needed to show the sending of a document. The sending should be apparent from the movement of the document itself.

Systems flowcharting guideline 13:

Do not use a manual process to file a document. Just show the document going into the file.

Drawing Systems Flowcharts

We are now ready to draw the Causeway flowchart. The entities in our current physical DFD (Figure 2.11, page 45) should help us to set up and label our columns. Although we set up columns for each entity (systems flowcharting guideline 1), we do not have to include columns for the customer, the bank, or the general ledger office because these entities do not perform any information processing activities. Since accounts receivable and the cashier both interact with the computer, let's locate them on either side of the "Computer" column (see systems flowcharting guideline 2). So, from left to right, your columns should be "Mailroom," "Accounts receivable," "Computer," and "Cashier." We usually start a flowchart in the top left corner with a "start" symbol. Since we have eliminated the "Customer" column, we must start the flowchart with a start symbol labeled "Customer," followed by two documents labeled "Remittance advices" (RAs) and "Checks." To show that they are together, we can place the RAs and the checks on top of each other with the back document a little above and to the right of the front document. We place all these symbols in the "Mailroom" column because lines 3 and 4 of the narrative tell us that the customer "sends" checks and remittance advices. This technique makes it clear where the flowchart starts and the source of the document that starts the process. Draw this portion of your flowchart.

Lines 5 and 6 of the narrative tells us that the mailroom clerk "endorses" the checks, and lines 6 and 7 tells us that the clerk "writes" the amount paid and the check number on the RA. "Endorse" and "write" are manual processes that, being performed by the mailroom clerk, should be documented with a manual process symbol (or two symbols) placed in the "Mailroom" column. Systems flowcharting guideline 10 tells us that sequential processes may be documented in one or more process symbols. Because one action is directed at the checks and the other action at the RAs (and because our description of the actions would not fit in one process symbol), we'll use two processes. Draw these processes. In lines 9 and 10, we find a process—preparing the batch total— that is performed "periodically" by the mailroom clerk. So, still working in the "Mailroom" column, draw another manual process for the batch total preparation. Find the annotation symbol on Figure 2.6 (page 32) and annotate the batch total preparation process to describe the periodic nature of the process.

REVIEW QUESTIONS

1. Define data flow diagram. Explain its components
2. Describe rules to prepare data flow diagram in short.
3. Explain entity- relationship diagram and its components in detail
4. What is the requirement of E-R diagram, how it is helpful to the management
5. What is system flow chat? Explain its requirements.

FURTHER READINGS

- Information System Tecnology- Ross Malaga
- Information System Today-Leonard Jessup
- An Illustrated Information Technology-Alan Witchcomb
- Information Technology For Management Henry C.Lucas
- Information Technology in Business Management Dr. Mukesh Dhunna, J.B. Dixit

UNIT-3 DATABASE MANAGEMENT SYSTEMS

CONTENTS

Introduction

An organization engages in various business processes—such as hiring employees, purchasing inventory, and collecting cash from customers—and the activities that occur during execution of these business processes are referred to as **events**. **Event data processing** is the process whereby event-related data are collected and stored. This unit describes event data processing, discusses the major
approaches employed to capture, process, and store event data, and recounts the types of data collected in event data processing systems. After introducing the major types of events, the text describes a crucial element of the Information System—the data. You need to
know how data and databases will become an integral part of your day-to-day work. What data do we collect? How do we collect the data, store the data, and use the data?

Consider the importance of the groundwork laid in this unit. In Units 4 and 5, we focus on advanced techniques for managing data and speeding the delivery of information. In Units 6 and 7,
we emphasize techniques for developing good Information Systems that capture and deliver the right data. In Units 8 and 9, we focus on techniques to assure the reliability and security of data. Finally, in Units 10–14, we focus on how data are captured and processed across an organization's business processes. What's the moral to the story? If you can't access good, useful data, you can't make good business decisions.

Event Data Processing

In Unit 2, we studied several types of diagrams in which something happened (e.g., a customer order) that triggered a series of human and automated business activities. These business activities represent the occurrence of a business event. Every firm has a number of business events that link together to form a business process. The nature of a firm's business dictates the range of processes it can adopt to achieve its objectives. The firm's information system will collect, process, and store business event data in support of its business processes. Each of these business processes may be divided into components, or sub processes. Take, for instance, a merchandising firm. A **merchandising firm** is an organization (e.g., a store) that buys goods from vendors and resells those goods to customers. On the customer side, its business events within the Order-to-Sales process include:

• Capturing and recording of customer orders
• Shipment of goods and recording of sales
• Sending invoices for goods and recording the amount to be received
• Receipt and recording of payments
• Preparation and recording of purchase orders
• Receipt of goods into inventory and recording the receipt of inventory
• Receipt of vendor invoices and recording of the amount owed
• Preparation and recording of payments

There may be other business processes in a typical merchandising business, such as payroll processing, hiring new employees, and many more.

As another example, a **service firm** is an organization that sells services, rather than merchandise, to its customers. The business events for a service firm that parallel the Order-to-Sales process include:

• Recording of customer services performed
• Billing for services rendered
• Receipt and recording of payments

Because there is no physical exchange of goods in a service firm, its Order-to-Cash process would have a slightly modified set of events reflected in its corresponding information system,. Service firms also must record other business events, including the purchase of materials used in the performance of service engagements and payroll disbursements.

A **manufacturing firm** acquires raw materials, converts those materials into finished goods, and sells those goods to its customers. Its **production process** includes recording activities related to the manufacture of goods for sale. A manufacturing firm must also receive customer orders, record sales, send invoices, and receive customer payments. Its Order-to-Cash process is essentially the same as that of the merchandising firm in Figure 3.1. The events that make up these processes will be described in detail in Units 10–14. As each business event occurs, a firm must record at least a minimal set of data about the event so that it can maintain records and produce reports that help assess how well it is meeting its objectives. Today, virtually all of these records are maintained by a computerized Information System. An organization's Information System performs event data processing to support an overall business process and its component subprocesses. For example, we describe the Information System employed to prepare and send a bill to a customer as the "billing "portion of the Order-to-Sales process. Similarly, we describe the Information System that prepares and records a purchase order as the "purchasing" portion of the Purchase-to-Pay process.

Transaction Processing Approach

Throughout the preceding discussion of event data processing, the focus was on events that take place within various business processes. Once these events have been identified, data that describe the events are collected, organized, manipulated, summarized, stored, and made available for retrieval. Traditionally, computerized Information Systems were designed around particular events called **transactions**, those business activities that have an economic impact on the firm. These include sales, payroll, accounts payable, and other typical financial transactions. The data that are recorded by a **transaction processing system** reflect the minimal information needed to represent each transaction, and are stored in a file along with the records of all of the other transactions of the same type.

This transaction orientation led to the dominance of "file-centric" techniques for systems design, an approach discussed later in this unit. This traditional approach to transaction processing worked well when technology was expensive and record keeping was not as sophisticated as it is today.

Event-Driven Approach

As society progresses in the information age, users' expectations of the information they need at their fingertips has escalated dramatically. User information demands have highlighted several fundamental weaknesses in the traditional approach of transaction processing. First, in order for data to be in a format that can be easily summarized, only data related to classification (e.g., a customer account number or an inventory part number) and quantitative descriptions can be captured. Thus, only a very narrow view of the event is portrayed by the data we collect—for instance, maybe only a financial accounting assessment or a listing of available stock in the warehouse. Second, once transaction data have been summarized, descriptions of individual transactions may be lost, with only summary information available to users.

Event-driven systems capture a complete description of each event, regardless of its economic impact on the firm, and permanently store the individual descriptions of each event. There are many business events that carry no economic impact, which would not be reflected in traditional transaction-oriented systems. Two examples are a sales representative capturing contact information about a potential customer, and a warehouse clerk updating location information when inventory items are moved from long-term storage to a place where "pickers" can get easy access to them. Neither of these events shows up on financial reports, but both are important for running the business.

Of equal importance, however, is the focus on capturing a wider variety of data about each business event to meet the needs of multiple users. Transaction processing systems have historically been limited in the diversity of data they capture. This limitation is due to an initial focus on automating paper-driven financial processes. While these traditional systems may play an important role in meeting the financial information needs of an organization, they do not necessarily support the marketing, human resources, and manufacturing aspects of an organization very well. The nonfinancial aspects of business events are of great importance to hese varied users. Event-driven systems facilitate use by multiple information users with very different needs for information about the events that have occurred within business processes.

Storing data at the event level makes it much easier to retain data related to other nonfinancial and non quantitative aspects of an event. Ideally, in an event-driven system, the data captured during business processes will be sufficient for someone who was not a party to the event to reconstruct every important aspect of what happened— whether he or she is in marketing, human resources, financial management, manufacturing, or any other part of the organization.

Typically, this mandates that at a minimum data be collected and stored related to the four Ws:

• Who relates to all individuals and/or organizations that are involved in the event.

• What relates to all assets that exchange hands as a result of the event.

• Where relates to the locations in which (1) the event takes place, (2) exchanged assets reside before and after the event, and (3) the parties to the event are during the event and for any future correspondence.

• When relates to all the time periods involved in completion of the event—including future exchanges of assets (e.g., when will we need to pay a bill?) that result from the event.

Once the event data are collected and recorded, the data can be aggregated and summarized in any manner that a given user chooses. The key is that any aggregations and summaries are temporary and only for the user's application, but the event data remain available to other users in its original form. For applications such as the generation of financial and inventory reports that are frequently required in the same format, programmed procedures can be developed within computerized systems to generate such reports automatically. Thus, the same needs for financial information fulfilled by traditional transaction processing systems are fulfilled by event-driven systems, but with the latter systems a host of other users' needs can also be met more efficiently and effectively. Let us take, for example, a series of events that might take place during the course of capturing a customer's order, putting through a job order to produce the ordered goods, and delivering the goods to the customer. When setting up our event-based system, we will want to capture multifaceted data to track the progression of the process. To capture the sales order event, we need to record data related to the salesperson and customer (the who), the goods ordered (the what), the delivery location (the where), and the date of sale and promised delivery (the when). This information would then be linked with information already stored that relates to a selected supplier for goods. Based on the combined information, an order would be placed with the supplier. A purchase order becomes a link between the purchaser and the supplier (the who) already in the system, the goods (the what) that have already been entered, the location to which the goods will be delivered (the where), and the delivery date from the supplier to our company (the when).

Notice in our sales example that all of the traditional systems data are readily available. The data required for the Order-to-Sales, Purchase-to-Pay, and Business Reporting processes are all captured and available for processing. But, now if the supplier changes the delivery date, the salesperson can also have immediate access to the change and notify the customer. The salesperson can pull together the necessary data by using links between the changed order information, the sales order, and the customer, and narrow the search down to only the sales that he or she is handling. Very quickly, the salesperson can have the information needed to notify the customer immediately of any delay in shipment.

It is important to note that event-driven systems may appear no different to the average user than more traditional transaction processing systems for collecting business event data. Rather, the underlying data storage and management (that is unobservable to most users) differ, while at the same time new sets of users have access to more relevant information for business decision making. In subsequent sections of this unit, we will revisit these two approaches to Information Systems and discuss the underlying information technologies that enable their existence.

File Management Processes

File management comprises the functions that collect, organize, store, retrieve, and manipulate data maintained in traditional file oriented data processing environments. We have already noted that business event data processing systems collect, process, and store data. So, admittedly, there is an overlap between these two environments, for data used by the system must physically reside somewhere! This section concentrates on file management. We see how data are managed—particularly how data are stored and retrieved, knowing that part of file management is undertaken by Information Systems underlying Order-to-Cash, Purchase-to-Pay, and other business processes. Thus, file management supports the generation of reports associated with traditional transaction processing systems.

Managing Data Files

Let’s quickly review the hierarchy of data that may already be familiar to you. A **character** is a basic unit of data such as a letter, number, or special character. A **field** is a collection of related characters, such as a customer number or a customer name. A **record** is a collection of related data fields pertaining to a particular entity (person, place, or thing, such as a customer record) or event (sale, hiring of a new employee, and so on). A **file** is a collection of related records, such as a customer file or a payroll file. A **record layout** describes the fields making up a record.

Unit 1 introduced you to two types of data, master data (entity-type files) and business event data (event-type files). A business event data processing system may operate on one or more files. Some of these files are used to obtain reference information, such as the warehouse location of an item of merchandise. Other files are used to organize and store the data being collected, such as sales orders or inventory data. Some companies still rely on older, legacy systems that use file structures for data storage. A database approach is a superior data storage method. In a database approach, tables, not files, are used to organize and store data. For now, we want to discuss data management using well known terms and concepts associated with files; we'll get to tables later.

Second, the existence of the customer record—including the credit limit provides the basic authorization required to enter the customer order. Without the customer record, the computer would reject the customer order in Figure 3.4. It is important to separate authorizations for data maintenance activities from authorizations for business event data processing activities. This separation provides an important control, a topic explored in greater detail in Units 8 and 9.

Limitations of File Processing

Prior to the development of database concepts, companies tended to view data as a necessary adjunct of the program or process that used the data. As shown in part (a) of Figure 3.5, this view of data, based on the transaction processing approach to file management, concentrates on the process being performed; therefore, the data play a secondary or supportive role in each application system. Under this approach, each application collects and manages its own data, generally in dedicated, separate, physically distinguishable files for each application. For example, Figures 3.3, part (b) and 3.4 assumed a "transaction-centric" approach to file management. One outgrowth of this approach is the data redundancy that occurs among various files. For example, notice the redundancies (indicated by double ended arrows) depicted in the record layouts in Figure 3.6. Data redundancy often leads to inconsistencies among the same data in different files and increases the storage cost associated with multiple versions of the same data. In addition, data residing in separate files are not shareable among applications. Now let's examine how some of these redundancies might come about.

The data represented in Figure 3.6 have two purposes. The data (1) mirror and monitor the business operations (the horizontal information flows) and (2) provide the basis for managerial decisions (the vertical information flows).2 In addition to data derived from the horizontal flows, managers use information unrelated to event data processing. These data would be collected and stored with the business event related data. Let's look at a few examples to tie this discussion together.

We could provide several more examples from inventory, but by now we trust that we have made our point. All of these examples consist of business event data related to the selling of merchandise. The transaction processing approach leaves us with similar problems for standing data. Note in Figure 3.6 the redundancies among the three data files with respect to standing data such as customer number, territory, and salesperson. Could these redundant fields become inconsistent? Again, we would have to say yes. The database approach to data management solves many of these problems. We will return to Figure 3.6 and describe what these data might look like with a database, rather than separate application files.

Database Management Systems

A **database management system** is a set of integrated programs designed to simplify the tasks of creating, accessing, and managing data. Database management systems integrate a collection of files or data tables that are independent of application programs and are available to satisfy a number of different processing needs. A database management system is really the means by which an organization coordinates the disparate activities of its many functional areas. The database management system, containing data related to all of an organization's applications, supports normal event data processing needs and enhances the organization's management activities by providing data useful to managers. While in its strictest sense a database is a collection of files, we will use the term **database** synonymously with database management system since this has evolved as the normal meaning intended by the vast majority of computer users and developers.

Logical vs. Physical Database Models

The concept underlying the **database approach to data management** is to decouple the data from the system applications (i.e., to make the data independent of the application or other users). Therefore, as reflected in part (b) of Figure 3.5 (page 75), the data become the focus of attention. Several other aspects of part (b) are noteworthy:

• The database is now shared by multiple system applications that support related business processes, as shown at the left of Figure 3.5, part (b).

• In addition to being used by application programs, the data can also be accessed through two other user interfaces: (1) report generation, as shown in the upper-right portion of part (b), and (2) ad hoc user inquiries, i.e., queries handled through query language software, depicted in the lower-right portion of part (b)

• A "layer" of software called the database management system (DBMS) is needed to translate a user's logical view of the data into instructions for retrieving the data from physical storage. Some of the more technical design issues of database management systems are described in Technology Insight 3.1

• In many database management systems, report generation and queries may not be distinct functions.

The data from our three files are now stored in four relational tables:
CUSTOMERS (instead of customer master data),
INVENTORY_ITEMS (inventory master data), SALES_ORDERS, and SALES_LINES (i.e., the last two tables store the data from the sales order master data). These tables are logical views of data that are physically stored in a database. The **logical database view** is how the data appear to the user to be stored. This view represents the structure that the user must interface with in order to extract data from the database. The **physical database storage** is how the data are actually physically stored on the storage medium used in the database management system. It has little relationship to how the data appear to be stored (e.g., the logical view). The user can access the data in the tables (e.g., the logical view in a relational database) by:

1. Formulating a query, or
2. Preparing a report using a report writer, or
3. Including a request for data within an application program.

Overcoming the Limitations of File Processing

We discussed earlier some of the limitations of applications that rely on traditional file management. What are the advantages of the database approach?

• Eliminating data redundancy. With the database approach to data management, data need only be stored once. Applications that need data can access the data from the central database. there are multiple versions of the inventory master data, while in part (b) of that figure there is but one. Further, depicts the same data elements on more than one file, whereas Figure shows each data element only once. An organization using the applications-based file approach to data management must incur the costs and risks of storing and maintaining these duplicate files and data elements.

• Ease of maintenance. Because each data element is stored only once, any additions, deletions, or changes to the database are accomplished easily. Contrast this to the illustration in Figure 3.6, where a change in a salesperson, territory, or customer combination, for instance, would require a change in three different files.

• Reduced storage costs. By eliminating redundant data, storage space is reduced, resulting in associated cost savings. However, in most database installations, this savings is more than offset by the additional costs of DBMS software.

• Data integrity. This advantage, like several others, results from eliminating data redundancy. As mentioned earlier, storing multiple versions of the same data element is bound to produce inconsistencies among the versions. For instance, the salesperson and sales territory data might differ among their many versions, not only because of clerical errors but because of timing differences in making data maintenance changes. We could make similar comments about inconsistent data resulting from the timing differences that might occur during event data processing of the inventory master data by the sales and inventory applications. With only one version of each data element stored in the database, such inconsistencies disappear.

• Data independence. As illustrated in part (b) the database approach allows multiple application programs to use the data concurrently. In addition, the data can be accessed in several different ways (e.g., through applications processing, online query, and report writing programs). And, the access can be quickly changed by modifying the definition of the tables or views. With the traditional applications-based file approach, the programs would have to be revised to provide access to more or less data.

• Privacy. The security modules available through DBMS software can contain powerful features to protect the database against unauthorized disclosure, alteration, or destruction. Control over data access can typically be exercised down to the data element level. Users can be granted access to data for reading or updating (add, revise, delete) data. Other ways to implement security include data classification (i.e., data objects are given classification levels and users are assigned clearance levels) and data encryption.

Enabling Event-Driven Systems

Earlier we noted that file management approaches are often sufficient to support traditional transaction processing. Without question, database management systems can improve the efficiency
of processing data by eliminating data redundancies, improving data integrity, and so forth. However, the big change that database management systems have enabled is the realization of event-driven data processing systems. As noted earlier, event-driven systems are oriented toward the concept that complete data describing business events should be kept in its original form, where multiple users from throughout the organization can view and aggregate event data according to their needs.

At the heart of this movement toward event-driven systems is a fundamental shift in the view of information processing in business organizations. Traditionally, organizational Information Systems have been focused first on capturing data for the purpose of generating reports, and using the reporting function to support decision making. Increasingly, management is shifting to viewing the primary purpose of organizational Information Systems as decision support while reporting is secondary. This perspective leads to a focus on aggregating and maintaining data in an original form from which reports can be derived, but users can also access and manipulate data using their own models and their own data aggregations. In Unit 5, we will discuss Information Systems such as business intelligence and expert systems that are designed to improve decision making. If you look ahead to the figures in Technology Insights you will notice that both types of support systems generally require access to detailed data stored in databases.

The strategic shift toward event-driven systems is further embodied in two contemporary concepts that are driving new database management systems implementations: data warehousing and data mining. **Data warehousing** is the use of Information Systems facilities to focus on the collection, organization, integration, and long-term storage of entity-wide data. Data warehousing's purpose is to provide users with easy access to large quantities of varied data from across the organization for the sole purpose of improving decision-making capabilities. **Data mining** is the complementary action to data warehousing. Data mining refers to the exploration, aggregation, and analysis of large quantities of varied data from across the organization to better understand an organization's business processes, trends within these processes, and potential opportunities to improve the effectiveness and/or efficiency of the organization. The "warehouses of data" analogy makes sense as the software to support data storage is akin to physical warehousing approaches used to store and retrieve inventory—when an item needs to be restocked on the store shelf, there must be some system whereby the item can be located in the warehouse and retrieved.

Data warehousing and data mining opportunities are enabled and enriched through the use of event-driven systems focused on capturing data that provide comprehensive views of business events. However, neither effective event-driven systems nor data warehouses are possible without effective implementation of database management systems. Both objectives are dependent on the massive data integration and data independence made possible through database technology. Both warehousing and data mining may also be limited if well-designed database models that provide for future information needs are not effectively implemented. This process starts with the information requirements analysis and successful attainment of an understanding of all users' potential data and information needs.

Entity-Relationship (E-R) Modeling

Unit 2 described E-R diagrams and showed you how to read them. Before moving on to developing E-R diagrams (in Appendix A), you should expand upon your knowledge of E-R diagrams to ensure a solid understanding of entities and attributes. This knowledge aids in the development of solid data models that lead to effective database structures. Although the diagrams can appear complex at first, they provide a very useful high-level tool for understanding the complicated relationships that exist among data in typical firms. E-R diagrams permit users and/or developers to communicate with a common understanding of how different types of data relate, including data about entities and business events. This understanding also permits a decision maker to interpret reports and
analyses correctly based on extracts from a database.

Entities and Attributes

An **entity** is an object, event, or agent about which data are collected. As examples, objects could include such things as orders, sales, and purchases. Agents include people such as customers, employees, and vendors. Basically, an entity is anything that independently exists.

In order to understand which entity we are capturing in our database and, likewise, to be able to identify that unique entity when we retrieve the data, we need to describe the entity in detail. In a data
model, we describe entities by recording the essential characteristics of that entity that fully describe it. In other words, we record its attributes. An **attribute** is an item of data that characterizes an entity
or relationship. Figure 3.8 displays an attribute hierarchy for an entity CLIENT. Notice that to describe fully a CLIENT we need to record several attributes such as Name, Address, Contact_Person, and Phone_Number. Sometimes, attributes are a combination of parts that have unique meanings of their own. For instance, in Figure 3.8, Address might consist of several independent subattributes such as the Street_Address, City, State, and Zip_Code. Attributes that consist of multiple sub-attributes are referred to as composite attributes.

Relationships

Relationships are associations between entities. As we have discussed in the previous section, a database consists of several (or many) different types of entities. However, in order to make the data stored in these entities effective for users to reconstruct descriptions of various business events, the various entities must be logically linked to represent the relationships that exist during such business events. The ease with which a user can ultimately extract related data from a database is heavily dependent on the quality of the database's logical design—that is, effective identification of the relationships between different entities.

These relationships map and define the way in which data can be extracted from the database in the future. The mapping of the relationships between entities (i.e., development of the E-R diagram) provides a roadmap for getting from one piece of data in the database to another related piece of data. A three-step strategy is generally most effective in identifying all of the relationships that should be included in a model. First, consider the existing and desired information requirements of users to determine if relationships can be established within the data model to fulfill these requirements. Second, evaluate each of the entities in pairs to determine if any entity provides an improvement in the describing of an attribute contained in the other entity. Third, evaluate each entity to determine if there would be any need for two occurrences of the same entity type to be linked—e.g., identify recursive relationships. Appendix A describes the development of an E-R model in greater detail.

Basic Relational Concepts

Relational databases are often perceived to be a collection of tables. This is a reasonable perception in that the logical view of the data is a tabular type format referred to as a relation. A **relation** is defined as a collection of data representing multiple occurrences of an object, event, or agent. Similar to an entity, objects include such things as inventory, equipment, and cash. Events may include orders, sales, and purchases. Agents could include customers, employees, and vendors.

E-R Model Development

As we mentioned earlier, there is a three-step strategy to identify the relationships that should be included in a data model. First, it is very important that you study business events, and understand users' information requirements, in order to identify all of the ways in which different entities are related. This information will provide the foundation level of relationships required in the database model. The remaining two steps (i.e., evaluating each of the entities in pairs to determine if any entity provides an improvement in describing an attribute contained in the other entity, and evaluating each entity to determine if there would be any need for two occurrences of the same entity to be linked) enable you to refine and improve this foundation-level model.

The focus for our E-R model development will be on the client billing process generally used by service firms such as architecture, consulting, and legal firms. The nature of the process is that each employee in the firm keeps track of time spent working on each client's service, generally filling out a time sheet each week. The hours spent on a client are then multiplied by that employee's billable rate for each hour worked. The cumulative fees for all employees' work are used to generate the bill for the client. This way, the client only pays for the services it actually receives. The challenge here is capturing all of the information necessary to track employees' work hours and client billing information.

Desirable linkages between entities will often be fairly easy to recognize when the relationship appears to define an attribute more clearly. If our billing system requires that we know for which client an employee has worked, the entity representing work completed needs to include a client number. This client number would link the WORK_COMPLETED entity to the CLIENT entity that provides us with a full description of the attribute denoted by client number in WORK_COMPLETED. Obviously, CLIENT is a separate entity and not an attribute. At the same time, CLIENT does improve the description of an attribute for the work completed—the client for whom the work was performed. This descriptive value makes it apparent there should be a relationship between the CLIENT entity and the entity capturing the completed work. Hence, we can often identify the need for defining relationships (such as Works_For) by also looking at the prescribed entities as pairs (in this case, we jointly examined the pair CLIENT and WORK_COMPLETED) to identify logical linkages that would improve the description of an entity's attributes.

Let's look at another type of relationship that the relationship Supervises is referred to as a recursive relationship. A **recursive relationship** is a relationship between two different entities of the same entity type. For instance, there usually are relationships between two employees, such as one employee who supervises another employee. This relationship may be important in some decision-making contexts and, therefore, should be represented in our database. We represent this relationship using the technique demonstrated Consider the alternative: If we try to represent supervisors and their supervised employees as separate entities in our model, we end up with data redundancies when the supervisor is in fact supervised by a third employee. It is easier simply to create a recursive relationship to the entity, EMPLOYEE, whereby a link is created between one employee who is being supervised and another employee who is the supervisor. As shown in our sample diagram, the diamond is still used to represent the recursive relationship, Supervises, just as would be used to show any relationship (e.g., Works_For in part a).

Model Constraints

In this section we explore the various types of relationships that can occur and discuss the constraints that are used to specify such relationships. In Unit 2, we briefly explored three different relationship types: 1:N (one-to-many), M:N (many-to-many), and 1:1 (one-to-one). The connotations of these three relationships are what we refer to as cardinality. The **cardinality constraint** of a relationship relates to the specification of how many occurrences of an entity can participate in the given relationship with any one occurrence of the other entity in the relationship.

Entity Relationship (E-R) Diagrams

We have now worked our way through all the pieces necessary to develop effective E-R diagrams. If you have successfully gotten a handle on each of the concepts explored so far in this unit, you should be ready to start developing an integrated database model.

Mapping an E-R Diagram to a Relational DBMS

In this unit, we have discussed the development of E-R diagrams and the foundations for implementing well-constrained relational database models. It is now time to put these two concepts together. This process is referred to as mapping an E-R diagram into a logical database model—in this case a relational data model. We introduce here a five-step process for specifying relations based on an E-R diagram. Based on the constraints we have discussed in this unit, we will use this five-step process to develop a well-constrained relational database implementation.

1. Create a separate relational table for each entity. This a logical starting point when mapping an E-R diagram into a relational database model. It is generally useful first to specify the database schema before proceeding to expansion of the relations to account for specific tuples. Notice that each of the entities has become a relation To complete the schema, however, steps 2 and 3 must also be completed.

2. Determine the primary key for each of the relations. The primary key must uniquely identify any row within the table.

3. Determine the attributes for each of the entities. Note that a complete E-R diagram includes specification of all attributes, including the key attribute. This eliminates the need to expend energy on this function during development of the relations. Rather, the focus is on step 2 and now becomes simply a manner of determining how to implement the prescribed key attribute within a relation. With a single attribute specified as the key, this is a very straightforward matching between the key attribute specified in the E-R diagram and the corresponding attribute in the relation (e.g., Employee_Number in the EMPLOYEE entity3 and the EMPLOYEE relation For a composite key, this is a little trickier—but not much. For a composite key, we can simply break it down into its component subattributes. For instance, in the implementation of the WORK_COMPLETED relation, Employee_No, Date, and Client_No would be three distinct attributes in the relation, but would also be defined as the key via a combination of the three. The completed schema is presented in Figure Note the direct mapping between the entities and attributes in the E-R diagram and the relations and attributes respectively in the relational schema.

4. Implement the relationships among the entities. This is accomplished by ensuring that the primary key in one table also exists as an attribute in every table (entity) for which there is a Gelinas 3-53 relationship specified in the entity-relationship diagram.

With the availability of the full E-R diagram, the mapping of the relationships in the diagram with the relationships embedded in the relational schema is again fairly straightforward. References to the key attributes in one entity are captured through the inclusion of a corresponding attribute in the other entity participating in the relationship. However, the dominance of 1:N relationships in our model simplifies this process. Let’s take a quick look at how the different categories of relationships (i.e., cardinality constraints) affect the mapping to a relational schema.

• One-to-many (1:N or N:1) relationships are implemented by including the primary key of the “one” relationship as an attribute in the “many” relationship.

REVIEW QUESTIONS

1. Define event data processing. How it is helpful to the management of a manufacturing firm.
2. Define the process of managing data files. What are the limitations of file processing?
3. What is data base management system? Explain its applicationsto the management.
4. Explain the methods of vercoming the Limitations of File Processing
5. Describe the process of Mapping an E-R Diagram to a Relational DBMS.

FURTHER READINGS

- Information System Tecnology- Ross Malaga
- Information System Today-Leonard Jessup
- An Illustrated Information Technology-Alan Witchcomb
- Information Technology For Management Henry C.Lucas
- Information Technology in Business Management Dr. Mukesh Dhunna, J.B. Dixit

IMPORTANT NOTES

UNIT-4 E-BUSINESS

CONTENTS

Introduction

The power of computers in transforming society is perhaps most obvious today in the way communications have changed. Our society has evolved from one that relied on face-to-face communication, to one in which phones became the primary medium, to today's society that is increasingly dependent on e-mail and instant messages. In essence, the richness of older media has been sacrificed for efficiency and effectiveness. In other words, the phone took away the ability to detect emotions through an individual appearance, and e-mail took away the ability to detect emotions through voice inflection. The Internet expanded the impact on society since it can substitute for such a wide range of personal and commercial interaction. The power of the Internet to support the sales and marketing of products efficiently has led to incredible levels of Web activity to support electronic commerce (e-commerce). **E-commerce** is a commonly used term that describes the business events associated with the Order-to-Cash and Purchase-to-Pay business processes, which encompass electronically ordering goods and services, and often the associated electronic payments. Although frequently used interchangeably with e-business, e-commerce is really only one part of what e-business encompasses. As noted in Unit 1, e-business is the involvement of two (or more) individuals and/or organizations in the completion of electronically based business events (i.e., the partial or complete elimination of paper documentation and human intervention during business processes in favor of more efficient electronically based communication). These electronically based business events entail the interconnection of the underlying back-office processes of both organizations. Price waterhouse Coopers was one of the first firms to use the term e-business to broaden the narrower view of e-commerce as support of the sales process. In 1999, the firm's Web site included a statement in its discussion of e-business that recommended looking beyond the marketing aspects of a firm to see that e-business involves "optimizing business processes, enhancing human capital, harnessing technology, and managing risk and compliance." We use the term "e-business" to refer to any inter organizational business activities conducted by electronic means, including e-commerce. We will sometimes use the term e-commerce when specifically discussing Internet-enabled sales support.

The Changing World of Business Processing

For centuries, the basic manner in which commerce transpired changed very little. In the past, a merchant would meet with a customer or another merchant and form an agreement to provide goods to customers in exchange for cash or other goods and services. The merchant would then record these exchanges in books of accounts, and periodically consolidate the entries recorded in the books to determine how much various individuals owed the merchant, how much the merchant owed other people, and the excess cash and assets that the merchant owned. Over the past three decades, the relative change in business practice has been exponential. We have seen cottage industries springing up on the Internet where there are no personal contacts and face-to-face negotiations. We also see online catalogs that can be viewed through an Internet browser and where orders can immediately be placed and paid for over the Internet. Of course, the bookkeeping functions may be done much the same as the ancient merchant did them, but more likely the system will automatically trigger collection from the credit card company, automatically record the business event in the electronic database, and automatically update all of the related accounts. Indeed, many companies are using web development tools from their enterprise system vendors to build Web sites that from day one are linked into the enterprise system's processing and database. While it may sometimes appear that we have switched from an old way of doing commerce to a brand new way, both methods are actually used by many organizations. The evolution of information technology has simply provided for alternative channels supporting business processes and business event data processing that enable some organizations to become more efficient and effective by altering the traditional means by which they have done business. To understand fully how technology can enable an organization to reengineer its business processes and more effectively enter into commerce activities, you first must have a solid understanding of how business event data processing can be completed. Once you understand how processing is done, then the exploration of the technologies that enable improved efficiencies in business event data processing will be more meaningful. In this unit, we first examine the evolution of business event data processing. Doing so will help you to understand how we got where we are and to appreciate different stages of the e-business evolution—including many organizations that still operate using essentially the same processes used three or four decades ago! We might well view this latter method as a pre–e-business stage.

Automating Manual Systems

Ever since the earliest days of business, when fairly primitive manual approaches were the only available information systems, the cheapest and most efficient way to do data processing on large volumes of similar business event data was to aggregate (i.e., batch) several events together and then periodically complete the processing on all of the event data at once. The **periodic mode** is the processing mode in which there is a delay between the various data processing steps. Although technically not the same, the periodic mode is heavily dependent on the use of batch processing, and the two terms are often used interchangeably. **Batch processing** is the aggregation of several business events over some period of time with the subsequent processing of these data as a group by the information system.

Almost all manual systems use the periodic mode. In a computerized environment, the easiest approach to automating some business processes has been to simply mirror analogous manual batch processing systems.

Batch processing systems typically require four basic subprocesses to be completed before event data is converted into informational reports that can be used by decision makers. Follow along with Figure 4.1 (page 110)as we explain how each of these four subprocesses are typically completed.

• Business event occurs: At the point of occurrence for the business event, the information for the event is recorded on a source document (the activities of the sales department For example, if you think of one of the small businesses you might frequent, such as a used books and CDs shop, they may often have you bring the books and CDs you wish to purchase to a clerk at the front of the store. The clerk then writes down a description of the items purchased on a sales slip (prepared in duplicate) and totals the sale. He or she returns one copy to you (often a white copy) and stuffs the other copy (generally a yellow or pink copy) into a drawer of sales receipts.

• Record business event data: A batch of source documents is transferred to a data entry clerk (in the data processing department in Figure 4.1) who takes the information from the source documents and enters the data in a computerized format. The business event data are usually entered using an **offline** device (i.e., one that is not directly connected to the processing computer). The resulting computerized format becomes the event data store. In our used books and CDs store, the owner-manager or the employee closing up at the end of the day may take responsibility for keying all of the sales slips into a personal computer for storage on a disk. The personal computer becomes simply a data-entry device for keying in the sales data. Upon completing the entry, the copies of the sales receipts are clipped together and stored in a file for possible future reference.

• Update master data: After all of the data have been entered into the system, the data are then processed, and any calculations and summarizations completed (represented by the sales processing update symbol. This information is used to update the master data. In the sales example, this might include taking prior inventory totals and subtracting the items sold to derive the new inventory levels. The new inventory levels are accordingly written as the newly updated master data. The sales event data would also be stored in a more permanent data store. It would not be uncommon for the owner-manager of our used books and CDs store to either take the data stores home and process it on a computer at home, or perhaps take the information to a public accountant for processing.

• Generate outputs: After all of the calculations have been completed and the data have been updated, the system periodically generates the applicable reports (the report generator program in Figure 4.1). For our used books and CDs store, this might include such documents as a sales report and an inventory update report. For our small store, both reports would probably go to the owner-manager.

A disadvantage of periodic mode systems is that the only time the master data are up to date is right after the processing has been completed. As soon as the next business event occurs, the master data are no longer up to date. As a result, there is little reason to provide a query capability (as discussed in Unit 3) for data that are used in a periodic mode system. Usually, systems users will simply get a copy of the reports generated at the end of a processing run and use this information to make their decisions until the next processing run and a new set of reports is available. Only in rare situations will a query capability be provided, and then only to eliminate the needless printing of reports for occasional users of the information generated by the system.

Online Transaction Entry (OLTE)

Information technology improvements have provided a low-cost means for improving the efficiency of these traditional automated equivalents to manual systems. The most prevalent change has been the increasing use of online transaction entry to reduce redundancies in pure periodic mode processing In an **online transaction entry (OLTE)** system, use of data entry devices allows business event data to be entered directly into the Information System at the time and place that the business event occurs. These systems merge the traditional subprocesses of business event occurs (which includes completion of the source document) and record business event data into a single operation. At the point of the business event, a computer input device is used to enter the event data into the data entry system rather than onto a source document. Generally, the system automatically generates prices as the computer retrieves data from the system data stores. Such a system is considered **online** because the data entry device is connected to the processing computer. The input system usually also services a printer that then prints document copies to fill the still-needed role of source documents. As business events occur, the related data are usually accumulated on disk.

If we go back to our used books and CDs store scenario, it may be that you prefer to buy your books and CDs at one of the chain stores such as those found in shopping malls. When you take your books and CDs to the clerk at the counter in these types of stores, the clerk generally keys the purchase straight into the cash register. As noted in Figure 4.2, what is occurring at this point is that the sales items are being entered into a computer that is recording a log of the sales event, retrieving price list information, and generating duplicate copies of the sales receipt. One copy of the sales receipt is given to you (the customer), and the other is placed in the cash register drawer (for filing in the audit file). The manual recording process by the sales clerk becomes a computer entry process and the record input process becomes part of process sales. Other than these changes, the two flowcharts are the same. The use of OLTE eliminates the need to have one person enter business event data on a source document and then have a second person perform the data entry to convert the business event data to a computer-ready form. In an OLTE system, one person performs both operations. In many systems, this data entry will be completed using bar code readers or scanners. The use of such technologies eliminates the human error that can result from entering data manually. Thus, in many OLTE systems the only human impact on the accuracy of the input data is the necessity to scan items properly into the system. Various control procedures that assure data accuracy are discussed in detail in Unit 9.

It should be noted that the processing of the data is still completed on a batch of event data at a later point in time. In the case of many systems in use by businesses today, sales event data is aggregated by cash register terminals for the entire day; and then, after the store has closed, the data is electronically transferred to the computer system where the business event data is processed. This process is reflected by the communications line connecting the sale s log in the sales department with the program procedures in data processing. The processing is completed overnight (note the reference to third shift in the column heading for data processing) while all stores in a region are closed, and updated reports are periodically generated to reflect the sales event updates to the master data.

Periodic mode systems had long been the most common method for completing business event data processing, but in the last decade, they have become much less common for most activities. However, for some applications, periodic mode processing is almost always the preferred approach. For instance, payroll systems are a natural match with the batching of business event data, since all employees are generally paid on a periodic basis and all at the same time. It is almost unrealistic to think that such an application will eventually be processed using systems other than periodic mode.

Online Real-Time (OLRT) Processing

Among the many clichés that one hears in today's harried business environment is the phrase "time is money." While a cliché by its nature is worn out, this one is quite descriptive of the current demands on Information Systems. Traditional periodic mode systems that provide information primarily through periodic reports that are hours, days, or weeks out of date can put an organization's decision makers at a disadvantage if its competitors are using up-todate information to make the same decisions (e.g., recall the importance placed on timeliness and relevance in Unit 1). The pressures for timely information flows coupled with significant advances in available information technologies led to a rapid migration towards online real-time systems. **Online real-time (OLRT)** systems gather business event data at the time of occurrence, update the master data almost instantaneously, and provide the results arising from the business event within a very short time—i.e., in real-time. OLRT systems complete all stages of business event data processing in immediate mode. **Immediate mode** is the data processing mode in which there is little or no delay between any two data processing steps (as opposed to periodic mode, in which there is a significant delay between two or more data processing steps).

OLRT systems typically require three basic subprocesses to be completed before an event is converted into information that can be used by decision makers. Figure 4.3 illustrates each of these subprocesses.

• Business event occurrence and recording of event data: At the time of the business event, related data are entered directly into the system. Source documents are almost never used, as they significantly slow the process and remove some of the advantages of non redundant data entry. Notice that the data entry process where the sale is entered into the system is the same as in Figure 4.2 (other than the absence of an audit file). This process

is consistent with the use of online transaction entry (OLTE) for OLRT systems.

• Update master data: Each business event entered into the system is processed individually and any calculations and summarizations completed. This information is then used to update the master data. Note in Figure 4.3 that the processing is now being done on-site where the sales event data are entered.2 Because each business event is processed independently and immediately, the master data at any given time will be within seconds of being up to date. When your books and CDs store is entering your information into the computer, it may be using an OLRT system if it is important to the store to know whether a given book or CD title is in stock at a given time—perhaps to answer a customer's question.

• Generate reports and support queries: It is neither practical nor desirable that reports be generated after each business event is recorded and master data have been updated. Typically, applicable reports are generated by the system on a periodic basis. At the same time, however, these reports are usually instantaneously available through access to the system on an as needed basis, as demonstrated in Figure 4.3 with the communications links to the sales and inventory managers. One of the main advantages provided by many OLRT systems is an ability to check the current status of master data items at any given time. In the books and CDs store, it would allow the sales staff to check quickly whether a given book or CD is in stock. In many cases, rather than using pre-specified reports that may not necessarily provide information that decision makers need, these Information Systems users use a query language (as discussed in Unit 3) to create unique reports dynamically that provide the one-time information they need to make key decisions. For instance, the store manager may want to run a report on the inventory stock for the top-ten selling CDs and books. 2 This is one method of accomplishing OLRT that uses expensive, continuous direct communications to a remotely located central computer. Many organizations use a distributed processing mode that places the computer locally to avoid the costs associated with the continuous communications line; however, as in the case shown here, the need to process information centrally for multiple locations may warrant the communications line costs of continuous direct communication.

Online Transaction Processing (OLTP)

In an effort to reduce both the expense and delay of communicating business event data over what are sometimes great distances to complete business event data processing in real time, many entities are turning to **online transaction processing (OLTP)** systems. An OLTP system is a real-time system that performs all or part of the processing activities at the user's location. These systems use business event data processing machines that have the capability to manage data, run applications, and control communications with the central computer and data stores. By performing most of the processing at the user's location, delays caused from electronic communications between the user and the central computer are reduced or eliminated (see Figure 4.4), as is the cost associated with communicating to the central location during the processing of the business event. Only the results need be communicated. Two common applications for these systems have been automatic teller machines (ATMs) and computerized reservation systems. Note in Figure 4.4 that the electronic communication network in an OLTP system becomes even more complex as processing occurs at the user's end, but then data must be updated at all computers. For instance, in the case of an ATM, once an individual has withdrawn money from his or her account, the system needs to update the balance at all ATMs before additional withdrawals may be made. Many banks have only recently converted to OLTP technology. Note that in an OLTP system, the immediate updating of balances at the central location and the user locations is done with shadow data (e.g., copies of the master data used for real-time processing) which are duplicated at each site, but for control purposes, the actual master data are usually updated once a day using batch processing. While immediate mode-dominated systems are becoming the most prevalent method for new business event data processing applications, they are not necessarily the end-all solution for all applications. Both periodic mode and immediate mode approaches have distinctive characteristics that make each a preferable option for certain types of applications. If periodic processing were used for ATM processing, for example, a person might withdraw the entire balance from his or her account multiple times before the system processed the event data and updated the accounts—a significant losing proposition for a bank. Clearly, any given application should be matched with the best or most applicable processing method.

Advances in Electronic Processing and Communication

The key enabler of the transition from primarily periodic mode systems to primarily immediate mode systems has been communications technology. Similarly, communications technology has enhanced many of the remaining periodic mode systems through enabled approaches such as online transaction entry (OLTE). Many important recent advances have relied on image-based technologies. These technologies are discussed in this section as a precursor to exploring their application in early stage e-business systems. Communications-based systems that facilitate the processing, storage, and management of image-based data require the use of several related technologies. First are technologies that facilitate the effective capturing of data to support business information processing through the use of imaging technology. Second are communications-based systems that facilitate the storage and distribution of image-based data used in business processing and managerial decision making. Third, data communications networks are necessary for effective transmission and routing of data from the point of recording and storage to the processes or users needing the data. In this part of the unit we take a brief look at these key communications technologies.

Automated Data Entry

While there are a variety of methods for electronic data capturing, the interest here is in image-based technologies. Increasingly, optical-based technologies eliminate the need to key in data (a major source of data entry error) as well as voluminous files of paper documents by maintaining electronic copies. One commonly used technology is bar coding. **Bar code readers** are devices that use light reflection to read differences in bar code patterns in order to identify a labeled item. While the most common place consumers see bar code readers is in grocery and department stores, bar coding systems are also used extensively by warehouses for inventory tracking. Similarly, delivery and courier companies frequently use such coding systems to track inventory items and packages during shipping transfers. The next time you receive a delivery from Federal Express or United Parcel Services, notice the bar codes on the package that were used to track its delivery to you. Utility and credit card companies frequently ask customers to handwrite the amount of the payment on the remittance slip. In such cases, **optical character recognition (OCR)** is used—similar to the way bar code readers work—for pattern recognition of handwritten or printed characters. Both bar code readers and OCR are technologies designed to eliminate the need to key in data and reduce the accompanying risk of error.

A third optical input technology is the **scanner.** Scanners are input devices that capture printed images or documents and convert them into electronic digital signals (i.e., into binary representations of the printed image or document) that can be stored and manipulated on computer media. Scanners are key to the increased use of electronic digital imaging to drive business processes and facilitate management decision making.

Digital Image Processing

Digital image processing systems are computer-based systems for storage, retrieval, and presentation of images of real or simulated objects. In the typical business application, the images are usually documents.

After a document has been input, additional processing may take place. The user may enter additional data related to the document or that acts on data contained in, or associated with, the document. Recall that in Unit 3 we discussed the move toward object oriented databases that are capable of handling object data—such as images—and that we noted the move toward enabling object storage within relational databases. A major part of the demand for object capable databases is the management of a vast array of document images. Linkages of these images into the enterprise system can make accessibility much easier as information can readily be distributed throughout the organization. In many advanced digital imaging systems, the content of the digital image may subsequently be manipulated as if it were directly entered into an application or retrieved from a database. For example, a scanned word processing document could be edited directly, or a purchase order changed to reflect the receipt of a backordered item. This is not always a desirable feature, as some business documents (e.g., contracts) should not be manipulable once they are digitally recorded.

Communication Networks

The key component for electronic communication systems is the network that provides the pathways for transfer of electronic data. Communication networks come in several different levels: from those designed to link a few computers together to the Internet, which links all publicly networked computers in the world together. Within organizations, a major focus of network computing has been on client-server technology. **Client-server** technology is the physical and logical division between user-oriented application programs that run at the client level (i.e., user level) and the shared data that must be available through the server (i.e., a separate computer that handles centrally shared activities—such as databases and printing queues—between multiple users). The enabling networks underlying client-server technologies are **local area networks (LANs)** and **wide area networks (WANs)**. LANs are communication networks that link together several different local user machines with printers, databases, and other shared devices. WANs are communication networks that link distributed users and local networks into an integrated communications network. Such systems have traditionally been the backbone of enterprise system technology, but recent advances in communications technology are rapidly changing the underlying infrastructure models to rely more on the Internet.

Network technologies are driving the evolution of e-business. These technologies allow for more simplified user interactions, and empower users to access broad arrays of data for supplementing management decision making as well as opening new avenues for direct commerce. The leading technology in this arena is the **Internet,** the massive interconnection of computer networks worldwide that enables communication between dissimilar technology platforms. The Internet is the network that connects all of the WANs to which organizations choose to have access. To simplify access to the vast arrays of data that have suddenly become available via the Internet, Web browsers were developed by several vendors. **Web browsers** are software programs designed specifically to allow users to search through the various sites and data sources available on the Internet. The advent of this easy-to-use software has rippled back through organizations and caused a rethinking of how companies can set up their own networks. The result has been the development of **intranets,** which are essentially mini internal equivalents of the Internet that link an organization's internal documents and databases into a system that is accessible through Web browsers or, increasingly, through internally developed software. For instance, the use of an intranet by PricewaterhouseCoopers' TeamMate system to support teams of auditors will be discussed in Technology Application 5.1 (page 147). **Extranets** serve the same purpose as a WAN, in that they link together a set of users (usually from the supply chain of a single company, or a professional organization), but use the Internet instead of a private communication network. Access to the extranet is restricted, so that private activities using internal data can be securely supported as part of the organization's business processes. The by-product of the expansion in intranets, extranets, and the Internet is a rich media for e-business. These networks provide the foundation for what has been exponential growth in e-business— both at the resale level and in supplier-buyer relationships.

Stages of E-Business

To this point the discussion has focused on the modes of business event data processing and related communication technologies that underlie the ability of organizations to enter into e-business. Now the discussion moves to specific methods for conducting e-business and how these methods use alternative modes of business event data processing and available communication technologies. The three stages of e-business discussed here are fairly diverse. First is electronic document management (EDM). Some might not consider EDM part of e-business because the majority of such applications support non-e-business events, but it has an integral role in supporting the last two stages. Electronic data interchange (EDI) is the second area discussed. It currently represents the predominant form of e-business in transactions between two businesses. The third stage is e-commerce, which comprises the fastest-growing segments of e-business, and where EDI is slowly being replaced by XML.

Electronic Document Management

Electronic document management (EDM) is the capture, storage, management, and control of electronic document images for the purposes of supporting management decision making and facilitating business event data processing. Capturing and storing document images typically relies on the digital image processing approaches discussed earlier in the unit. The added dimensions of management and control are critical to maintaining the physical security of the documents while at the same time assuring timely distribution to users requiring the information. Technology Application 4.1 discusses some general uses of EDM.

In general, business applications of EDM fall into two categories:

1. Document storage and retrieval. For example, mortgages, deeds, and liens are archived and made available to the public for such uses as title searches.
2. Business event data processing. For example, loan and insurance applications must pass through several stages, such as origination, underwriting, and closing. The EDM system can manage the workflow and route the documents to the appropriate people—even if these people are geographically dispersed.

EDM systems provide a relatively inexpensive alternative to paper documentation. The ability to access and manipulate real images of business documents offers great opportunities for improving the efficiency and effectiveness of many business applications and can create significant competitive advantages for an organization. For instance, fast access to imaged documents often can translate into faster and better customer service and result in increased customer loyalty—themes we explore in some depth in Unit 10. The typical benefits include:

- Reduced cost of handling and storing paper.
- Improved staff productivity.
- Wider use of geographically distributed virtual teams.
- Superior customer service.
- Enhanced management of operational workflow.
- Faster processing.

Electronic Data Interchange

Computer and communications technology have been successfully applied by organizations to improve accuracy and control and to eliminate paper within their Information Systems applications. However, direct, paperless business communication between organizations had been slowed by a lack of transmission and presentation standards. What this often meant was that an organization used its computer technology to prepare a purchase order (PO), for example, completely without paper and human intervention—an efficient, fast, and accurate process. But, the PO had to be printed and mailed or faxed to the vendor. Then, at the vendor, the PO had to be sorted from other mail in the mailroom, routed to the appropriate clerk, and entered into the vendor's computer. The efficiency, timeliness, and accuracy gained by the automated purchasing process at the originating organization were lost through the mailing and re-entry of the data at the vendor. One technology that permits streamlining data communication among organizations is that of electronic data interchange (EDI).

Electronic data interchange (EDI) is the computer-to-computer exchange of business data (i.e., documents) in standardized formats that allow direct processing of those electronic documents by the receiving computer system. Technology Application 4.2 describes some general uses of EDI, and Figure 4.5 (page 123) depicts typical EDI components. The numbers in circles are cross-references to corresponding locations in the narrative description.

Application Software (circles 1 and 7) An originating application prepares an electronic business document, such as a purchase order (PO). At the destination organization, an application processes the business data. For example, the originating application's PO would be processed as a customer order in the destination organization's Order-to-Cash process.

Translation Software (circles 2 and 6) An application's electronic business document must be translated to the structured EDI format that will be recognized by the receiving computer. depicts the translation process. The figure shows a specimen PO as it might appear as a conventional paper document and then illustrates how the PO is transformed into an EDI transaction standard, referred to as transaction

set 850. Translation sets are the generally accepted representation standard for EDI and are described in Appendix A. **Communications Network (circles 3 and 5)** One method for communicating electronic messages between business partners would be to establish a direct computer-to-computer link between the origination computer and one or more destination computers. This kind of interface could be accomplished through a leased or dedicated communication line with each trading partner, or through a communications network in which one of the partners—let's say a large manufacturer—serves as the "hub" of the network, and its suppliers and other trading partners are the network "spokes." However, communications system incompatibilities may require that
one partner or the other purchase communications hardware or software, making this a costly option. Further, agreeing on such details as what time of day to send and receive data from trading partners makes this option difficult to manage. An alternative is to use an EDI service bureau—an organization that acts as an intermediary between a large hub company and its suppliers. The EDI service bureau generally works with smaller suppliers reluctant to acquire in-house translation and communications software. In such a case, the translation software and communications software reside on the service bureau's computer system. For a fee, the service bureau takes EDI messages from the hub, translates the messages into formats that are usable by the suppliers' computer applications, and forwards them to the suppliers. In the other direction, the bureau translates suppliers'
paper documents—such as shipping notices or invoices—into EDI format and sends the electronic documents to the hub. Service bureaus are declining in use due to easily accessed and relatively inexpensive Internet-based options.

Value-Added Network (VAN) Service (circle 4) Rather than connecting to each trading partner, an organization can connect to a **value-added network (VAN)** service. A VAN service acts as the EDI "postman." An organization can connect to the VAN when it wants, leave its outgoing messages and at the same time, pick up incoming messages from its "mailbox." A VAN is a network service that provides communications capabilities for organizations not wishing to obtain their own communications links. VANs are also dropping in popularity due to Internet-based options for EDI.

EDI and Business Event Data Processing If we consider the implications of EDI for business event data processing, one of the main advantages is the significant reduction in need for interaction between purchasers and salespeople, coupled with the standard implementation of online transaction entry (OLTE). With EDI, both source document capture of business event data and subsequent keying in of the source document are eliminated for the selling organization as OLTE activities are initiated and completed by the linking purchaser. This eliminates any risk of erroneous data entry from within the selling organization. Keep in mind that EDI may be completed through traditional modes using dedicated communications lines, but are increasingly moving to the Internet. You should be careful, however, not to make assumptions as to the mode of business event data processing. You will recall from our earlier discussion that OLTE can be used with both periodic and immediate modes of processing. The same holds true for the core business processing activities in an EDI environment. The business event data are frequently processed using an online real-time system, but many organizations also choose to do the bulk of the processing steps using periodic mode as well—particularly with batching of business event data for more efficient processing. It is worth noting also that particularly when batch processing is being used, there may be the need for online transaction processing (OLTP) approaches to handle order and payment confirmation activities during acceptance of the externally generated OLTE transmission—in other words, the customer may need an immediate confirmation that the order has been accepted and the business event will be completed by the vendor.

When trading partners communicate with each other electronically, they also discover that they have to communicate internally in new ways to achieve the full benefit of EDI. That is, EDI forces an organization to assume that all information flows, both internally and externally, are instantaneous. Accordingly, for many, EDI—along with other enabling technologies such as electronic document management—has been the catalyst for change in a firm's basic business processes.

Internet Commerce

A mere decade or so ago, e-business basically meant EDI. The Internet has radically changed the nature of e-business so that it has become the dominant platform for not only e-business, but EDI as well. Does this mean EDI is dying? Well, not exactly. Many experts believe EDI is here to stay and currently EDI volume continues to grow at a rate of about 15% per year. Still, the Internet shows far more potential growth—primarily from the potential seen in the emerging replacement language for EDI on the web, XML (eXtensible Markup Language).3 XML is described in Technology Insight 4.2 (page 128). 3 Carol Sliwa, "Firms Wait on XML, Increase Use of EDI," Computerworld Online (May 1, 2000).

There are two primary categories of e-business over the Web: (1) business-to-consumer, or B2C (e.g., Lands' End), and (2) business to-business, or B2B. Figure 4.7 depicts a typical type of secure B2B arrangement. Note that the numbers in the circles are cross references to corresponding locations in the narrative description. **Client-Server Relationship (circles 1 and 7)** The connection created between the customer and the vendor is a Web-enabled extended form of client-server applications. The customer (circle 1) is the client node—dictating that during connection, the customer computer environment should be secure and essentially inaccessible via the network. The vendor (circle 7) is the server node and therefore must have the capability to receive the customer's transmission and translate that transmission into processable data for use in the vendor's application programs. This translation is made through common gateway interface (CGI) software. The vendor, acting as the server part of the relationship, then provides the necessary correspondence back to the customer (client) in an understandable format (i.e., an Internet-based language such as Java or XML). To use the

Lands' End example again, when you place your order, your computer should be inaccessible (i.e., secure) over the Internet, and the type of computer and software you are using will be unknown on the system. The Lands' End computer receives your order and uses CGI to translate your message into a form their program can understand and process. Similar to EDI environments, once the business event data have been collected by the vendor, applications can be completed through any of the modes of business event data processing. For instance, Lands' End used a periodic mode approach to process batches of sales several times an hour. Lands' End, "Security on the Lands' End Web Site,"

Network Providers (circles 2 and 5) As with EDI, to participate in the business event, both parties must have the capability to communicate over the Internet. For many companies and organizations (as well as some individuals), this access comes through a direct connection between the entity's computer networks (or a single server) and the Internet. For other companies and organizations, as well as the vast majority of individuals, it will be more desirable to gain access through a network provider.

Network providers are companies that provide a link into the Internet by making their directly connected networks available to fee-paying customers. Most network providers bring a host of other benefits along with Internet access. Common benefits include e-mail access, electronic mail boxes, space allocation for personal Web pages, and remote connection to other computer sites (e.g., telnet and FTP connection). Many organizations will also use network providers to run their servers when assuming that role in the client server relationship. In Figure 4.7, circle 5 denotes a network provider who would be providing server management services for the CPA or CA firm denoted by circle 6. Hence, when the business event is being completed between the customer and the vendor, information from the accounting firm would be acquired from a server operated by the firm's network provider.

Assurance Providers (circles 4 and 6) A major concern for most organizations and individuals participating in e-commerce has been Internet security. Security is the most critical factor that has hampered the growth of e-commerce. One early survey showed that 90% of Internet users felt increased security was necessary before they would transmit personal information (e.g., credit card information) across the Internet.5 Many stories have circulated about the risk of credit or debit card information being pirated off the network, with large sums of money being expended by unauthorized users. Additionally, the Internet has spawned a whole array of cottage industries that have no physical storefronts, but rather are operated completely from Internet server-supported Web pages. Many Internet users are rightfully concerned about the possibility that a company may be fictitious, with the electronic storefront merely being a means by which to gather credit card and debit card information for illicit use.

These concerns over security have spurred the development of a new line of business—Internet assurance services. **Internet assurance** is a service provided for a fee to vendors in order to provide limited assurance to users of the vendor's Web site that a site is in fact reliable and data security is reasonable. Technology Application 4.4 provides a more detailed discussion of Internet certification programs and assurance services.

Web page, he or she can click on the WebTrust symbol to assure it continues to be applicable. Clicking on the WebTrust symbol executes a link to the VeriSign server (circle 4) for verification of the authorized use of the symbol. VeriSign verifies the symbol's appropriate use by sending a message to the customer (circle 1). The customer can also get a report on the level of assurance provided with the certification by clicking on the Web link (contained on the vendor's web page) for the accounting firm. Clicking this link connects to the accounting firm's (circle 6) server—provided by its network provider in this case (circle 5)—and the auditor's Internet assurance report for the vendor displays on the customer's computer.

Internet Connection (circle 3) To obtain an Internet connection you must have a link to one of the networks that connect to the Internet and indicate the Internet site with which the client wants to connect. A connection is then made between the client and the desired site— the server. A couple of other issues related to the organization of the Internet and its impact on e-commerce should be noted. First, the nature of the Internet as a public network-based infrastructure has greatly leveled the field in e-business. Only fairly large businesses could

afford EDI's communications hardware and software. The creation of a public network and the subsequent creation of XML and relatively inexpensive (or even free) software for using the network have brought the costs of e-business within the ranges of economic feasibility for most small- and medium-sized entities. This change in cost structure and ease of use are the two forces driving the strong growth in e-commerce.

REVIEW QUESTIONS

1. Differentiate E-business and E- commerce. What is its usefulness to the current business world?
2. What are the basic requirements of E-Business? Explain its advantage.
3. What are the benifits of Electronic Document Management?
4. Define Internet commerce also explain its categories.
5. What is the relation between EDI and Business Event Data Processing

FURTHER READINGS

- Information System Tecnology- Ross Malaga
- Information System Today-Leonard Jessup
- An Illustrated Information Technology-Alan Witchcomb
- Information Technology For Management Henry C.Lucas
- Information Technology in Business Management Dr. Mukesh Dhunna, J.B. Dixit

UNIT-5 BUSINESS INTELLIGENCE AND KNOWLEDGE MANAGEMENT SYSTEMS

CONTENTS

Introduction

In Unit 1 we defined the Information System as a system " . . . established to facilitate an organization's operational functions and to support management decision making by providing information that managers can use to plan and control the activities of the firm." Let's pursue the meaning and importance of one of the key concepts within that definition. Very simply, **decision making** is the process of making choices. It is the central activity of all management. Managers make decisions or choices, such as what products to sell, in which markets to sell those products, what organizational structure to use, and how to direct and motivate employees. Herbert A. Simon, a Nobel-prize-winning economist, described decision making as a three-step process. His three stages have been adopted over the years as the "classic" view of decision making:

1. Intelligence: Searching the environment for conditions calling for a decision.
2. Design: Inventing, developing, and analyzing possible courses of action.
3. Choice: Selecting a course of action.

Information from and about the environment and the organization is needed to recognize situations or problems requiring decisions. For example, information about economic trends, marketing intelligence, and likely competitor actions help management recognize opportunities for new markets and products. Information about inefficient or overworked processes in the organization focus management's attention on problems in the organization. Managers use information from within and from outside the organization to design courses of action. For example, information about human resources, production capacity, and available distribution channels help management to develop alternative methods for producing and distributing a new product. Finally, a manager requires information about possible outcomes from alternative courses of action. For example, to choose from among alternative production options, a manager needs information about the costs and benefits of the alternatives and about the probability of success of each option.

Once a course of action is in place, the decision needs to be implemented and the results communicated. Many people find that the most important step in the decision making process is how well it is implemented. Effective communication is a key component of this success. Technology Insight 5.1 describes the effective presentation of information in technical communications.

Management Decision Making

The nature of the information required by managers varies by management level.2 Strategic level managers require information that allows them to assess the environment and to project future events and conditions. Much of the information comes from outside the organization and is used infrequently. Tactical management requires information that is focused on relevant operational units. Some external information is required, as well as information that is more detailed and accurate than is the information used at the strategic level. Operational management needs information that is narrower in scope, more detailed, more accurate, and that comes largely from within the organization.

The kind of information required to make a decision is also heavily influenced by the decision's structure or lack thereof. Structure is the degree of repetition and routine in the decision. Structure implies that we have seen this very decision before and have developed procedures for making the decision. We can use the degree of structure inherent in each decision-making step to categorize the decisions as structured or unstructured. We define**structured decisions** as those for which all three decision phases (intelligence, design, and choice) are relatively routine or repetitive. In fact, many decisions are so routine that a computer can be programmed to make them. For example, many organizations have automated the decision of when and how much credit to grant a customer when an order is received. At the time the customer's order is entered, the computer compares the amount of the order to the customer's credit limit, credit history, and outstanding balances. Using this information, the computer may grant credit, deny credit, or suggest a review by the credit department. We cover this procedure in more detail in Unit 10.

Information Qualities and Decision-Making Level The level of the decision maker and the type of decision to be made determines the preeminence of certain information qualities. For example, strategic management may require information high in predictive value. Information used for strategic planning should help managers "see" the future and assist them in formulating long-term plans. The strategic level manager may not be as concerned with timeliness or accuracy and would therefore prefer a quarterly sales report to a daily report containing several quarters of information so that trends could be detected more easily. Operations management must make frequent decisions, with shorter lead times, and may therefore require a daily sales report to be able to react in a timely manner to recent changes in sales patterns. Operations management may require more timely and accurate information and may not be concerned about the predictive value of the information. Without a certain level of accuracy, however, even the largest data warehouse will not be useful for forecasting or analysis of historical data.

Conclusions About Management Decision Making Information needed for decision making can differ in degree of aggregation and detail, in source, and in fundamental character. We have also seen that the required qualities of information differ by decision type and level of management. Within the organization, managers can secure inputs to their decisions directly: from the environment or from direct observation of operations. Managers can also receive information indirectly through the IS, which retrieves and presents operational and environmental information. Environmental information is now widely available, given the ease of searching for and sharing information over the Internet. As we understand more about the decisions to be made and can better anticipate the data needed to make those decisions, the IS can be designed to provide more of the required information. Because data requirements for structured decisions are well defined, we strive to improve our understanding of decisions so that we can make more decisions more structured, anticipate the data needed for those decisions, and regularly provide those data through the IS.

Systems For Aiding Decision Makers

As mentioned above, the IS supporting a firm's business processes focuses on information requirements that can be identified in advance: information for well-structured decision situations in which the typical information requirements can be anticipated. Perhaps we make this sound simple. However, providing information to help managers make decisions is a rather daunting task. Figure 5.3 (page 148) gives you some idea of the roadblocks facing managers when they must make decisions. This section discusses some of the information tools designed to help decision makers:

As we discussed in the preceding section, many decisions— particularly important decisions made by high-level management— are predominantly unstructured. There are four levels of expertise that can be applied to these decision situations:

• A manager can make the decision without assistance, using his or her own expertise.

• The decision maker can be assisted by problem-solving aids such as models, manuals, and checklists.

• The decision aid (e.g., models, checklists, and manuals) might be automated.

• The system itself can replace the decision maker, as when an expert system monitors the activity in a production line and adjusts the machinery as required.

Business Intelligence Systems, OLAP, and Group Support Systems Automated tools can assist or replace the decision maker. Technology Insight 5.2 describes Business Intelligence systems (BI) and Online

Analytical Processing (OLAP) systems. BI assists the decision maker by combining current and historical facts, numerical data, and statistics— from inside and from outside the organization— and by converting these data into information useful in making the decision. BI is a broadly defined approach to supporting decision makers, and many software products provide this capability in conjunction with data warehouses and other large-scale database products. OLAP tools are software products that focus on the analytical needs of decision makers. Frequently software vendors sell OLAP tools to provide business intelligence within the client firm. We will use these terms almost interchangeably in this unit, as they are so closely related.

Let's see how a manager uses BI. A decision maker might create a spreadsheet to identify changes in sales for several product lines and to compare them to similar figures from a previous period. This information might help the manager to determine if sales quotas have been attained for this period and if current performance is consistent with past experience. With the spreadsheet, the decision maker prepares a report in a format that is suitable for this decision at this point in time.

With a more complex BI system, screen reports could have been programmed in advance. For example, when an executive turns to her computer each morning, a screen appears containing a "dashboard"—a visual display of the company's key performance indicators. Imagine that the executive wants to examine sales trends. She might click on a "sales trends" graph. To determine what to do about a potential problem observed in the graph, the manager might successively request more detailed information, a process known as "drilling down." This sales trend information might alert the manager to some problem, i.e., the intelligence step in a decision. OLAP tools could then be used to analyze the trends to determine if the problem resulted from a manufacturing problem, a sales forceissue, or improvements in a competitor's product.

Once the data have been identified, the users must ensure that the data provided are relevant, timely, accurate, valid, and complete. Managers unable to identify and provide such data risk irrelevance and obsolescence in their organizations. BI systems do not suggest to the decision maker what to do; they simply provide views for interpreting information. With BI, the knowledge and experience required to analyze information, to make judgments, and to take required actions reside with the decision maker. BI systems help managers, who are typically working alone, to make decisions. **Group support systems (GSS),** commonly called **groupware,** are computer-based systems that support collaborative intellectual work such as idea generation, elaboration, analysis, synthesis, information sharing, and decision making. GSS use technology to solve the time and place problems associated with group work. That is, a GSS creates a "virtual meeting" for a group. While "attending" this meeting, members of the group work toward completion of their task and achievement of the group's objective(s). Groupware focuses on such functions as e-mail, group scheduling, and document sharing. Technology Application 5.2 describes PricewaterhouseCoopers' use of distributed database technology to facilitate audit team work.

Artificial Intelligence Many decision-making situations require a high level of expertise in a deep or complicated problem area. Artificial Intelligence (AI) facilitates the capture of expertise in many ways. In this section, we discuss three AI techniques, expert systems, neural networks and intelligent agents.

• Decisions are extremely complex.

• Consistency of decision making is desirable.

• The decision maker wishes to optimize the decision. That is, the decision maker wants to minimize time spent making the decision while maximizing the quality of the decision.

• There is an expert decision maker, and his or her knowledge can be efficiently captured and effectively modeled via computer software.

To increase competitiveness, businesses are increasingly using AI. Three trends are indicative of this increased use. First, in the process of downsizing a large percentage of an organization's experience is lost. The targets of early retirement programs are the people with the most seniority and the highest pay. These are the same people who have accumulated knowledge about the business and whose expertise will be greatly missed. The second trend is the increasing complexity of business organizations and operations. The third trend is the decentralization of business. All three explain the need for AI systems to help maintain expertise and increase a

company's ability to share it among many employees. Technology Insight 5.4 describes one of the most common contemporary development approaches in AI, called neural networks (NN), and Technology Application 5.4 (page 156) provides real world examples of neural networks. The ability of NN to discover patterns in large quantities of data makes them useful in decision making, performing well in areas that can't be reached by ES or BI. Picture a neural network poring through reams of internal and external data and notifying an executive that there may be something that requires attention. For example, the NN might predict that, because ratios A, B, and C are down, there will be a decline in income next year. It might go on to tell the executive what to do to prevent the decline. An expert system could perform a similar function, but only if an expert had found the relationship between ratios A, B, C, and income and someone had entered that relationship into the knowledge base.

What stops us from using AI in every decision-making situation—what's the downside? If we do use AI, what does a good manager need to consider? The benefits derived in terms of increased productivity, improved decision making, competitive advantage, and so on, must exceed the costs of development and maintenance of the system. And, for ES in particular, we must be able to identify and extract the expertise required and to enter that expertise into our knowledge base. Therefore, we must carefully choose the areas in which we will apply AI technology. Perhaps the area of greatest recent growth in decision-aiding systems is the development and application of intelligent agents. An **intelligent agent** is a software component integrated into a BI system, Web search engine, or software productivity tool (such as word-processing, spreadsheet, or database packages) that provides assistance and/or advice to the user on use of the software, decision-making attributes, or supplying of common responses by other users. Most intelligent agents are designed to learn from the actions of the system's user and to respond based on the user's responses or usage patterns. Technology Application 5.5 discusses the use of intelligent agents in a tax preparation software package—TurboTax.

Much of the demand for intelligent agents has arisen from two realities in the workplace. First, as productivity software (i.e., word processing, spreadsheets, and presentation software) and data warehousing continue to increase in power—and therefore complexity—these agents become critical to explaining to many users how to use certain features. For instance, Microsoft Word analyzes your text input, recognizes if you are trying to write a letter, and offers to help format the letter. The program can analyse grammar and automatically flag errors, providing recommended corrections as well. Agents are increasingly being embedded in BI software for a host of things such as facilitation of data mining approaches with use of data warehouses. The second driver is the sudden information explosion coming from the use of the Internet. The vast volumes of information have made it difficult for users to find information germane to their given interest. The result has been extensive work in embedding intelligent agents into browsers to recognize users' search patterns and to provide advice on searches. Many of these tools, by learning the user's behavioral patterns, facilitate the rapid access and filtering of information to provide precise searches on applicable information. Such use of intelligent agents holds the greatest promise for the future of AI-based systems.

Let's summarize what we have learned regarding systems that provide intelligence-based assistance to the management decision maker.

• To overcome the roadblocks to quality decision making, managers use Business Intelligence systems (BI), group support systems (GSS), expert systems (ES), neural networks, (NN) and intelligent agents.

• A BI system structures available data to provide information about alternative courses of action without offering a solution. BI works well with unstructured (or semi-structured, i.e., having only some structured components) problems that have a quantifiable dimension.

• A GSS facilitates group interaction and group consensus building.

• An ES applies expertise—modeled after that acquired from an expert—to provide specific recommendations on problem resolution.

• Both BI and ES can assist a user in problem solving, but in different ways. A BI system is a passive tool; it depends on the human user's knowledge and ability to provide the right data to the system's decision model. OLAP tools expect the user to know when and how to apply analytical expertise. An ES, on the other hand, is an active teacher or partner that can guide the user in deciding what data to enter, and in providing hints about further actions that are indicated by the analysis to date. • Neural networks supplement the expert system in areas where expertise has not yet been captured. By examining the data, the NN can identify and replicate the patterns that exist.

• Expert systems can automate portions of decision making. They can function independently and actually make the decision. Alternatively, an

ES can merely assist the decision maker and recommend a course of action. One final comment: We are not talking about replacing people with ES. These systems make it possible for valuable expertise to be available in multiple locations. The systems supplement managers in a timely manner to facilitate important decisions for maintaining an organization's competitive edge.

• Intelligent agents can provide smart assistants that simplify and/or improve effective use of software systems. Intelligent agents can adapt to the user's specific situation and provide guidance on potential errors and suggest alternatives.

Knowledge Management

In a recent interview, Susan O'Neill, deputy chief knowledge officer of PricewaterhouseCoopers, noted, "Knowledge is what we're all about. All of our profitability and viability is about how good we are at leveraging the intellectual assets of our people and making that available to our clients." Indeed, a survey of 200 IT managers by InformationWeek shows that 94 percent of companies consider knowledge management strategic to their business or IT processes and that these companies are in the early stages of their knowledge management efforts. Additional results reveal that on average companies are capturing only 45 percent of their intellectual capital. A manager at Ernst & Young referred to knowledge management as the biggest problem faced by the firm in trying to maintain the quality of service expected by its customers.

Knowledge management is the process of capturing, storing, retrieving and distributing the knowledge of the individuals in an organization for use by others in the organization to improve the quality and/or efficiency of decision making across the firm. The primary enabler of knowledge management efforts is the power of contemporary information technologies.

Effective knowledge management means that an organization must be able to connect the knowledge of one individual (e.g., capturing) with other individuals in the firm (e.g., distributing) who need the same knowledge. Distribution dictates the use of electronic communications technology—namely groupware systems. Advanced database management systems and AI systems technologies for orderly storage and retrieval of the captured knowledge are also critical.

Gathering Knowledge with Groupware

All of the capabilities of groupware, as discussed earlier in this unit, are key to supporting knowledge management for organizations of virtually any size. Even the simplest components such as e-mail and document sharing are vital components. Add to these the capability of Electronic Document Management systems, and the information content of the electronically distributed messages vastly increases. Indeed, many people consider the roots of knowledge management to be in the development of Lotus Notes, a widely used groupware system specifically designed to facilitate sharing of documents, e-mail, and group communication. Technology Insight describes a new approach to groupware that provides Notes-like capabilities anywhere on the In many organizations, when an individual is faced with a problem and is unsure of the solution, he or she will post the problem to an electronic blackboard maintained by the groupware system. Other individuals in the organization who have the knowledge to resolve the issue will note the query on the blackboard and e-mail their suggested solution approach to the original individual posting the issue—hence, sharing their knowledge. The document component becomes a means of making the process even more efficient by having individuals within the organization transfer documents detailing their resolution to a given problem to a central repository. the document is transmitted by the user through the groupware system and is transferred to the knowledge management system for storage.

Storing Knowledge in Data Warehouses

At the heart of most knowledge management systems is a series of interconnected data management systems. these databases of information and knowledge are generally best managed by using contemporary data warehousing technologies. Data warehousing technology enables the information needed for effective support of decision making to be integrated into a searchable warehouse of knowledge. The need for data warehousing technology is driven by the vast amounts of information typically required for effective knowledge management. Not all of this so-called “knowledge” is that sophisticated. Much of the “knowledge” in such systems is what is frequently referred to as “three-ring binder knowledge” consisting of items such as standard operating procedures manuals, employee resumes, troubleshooting guides, regulatory guidelines (such as tax laws), and corporate codes (such as codes of conduct or ethics). Other documentation might include memoranda and letters written by various people within the organization. These memoranda and letters are often the best documentation of problem resolution provided customers or clients.

Given the volume of document-driven knowledge included in such systems, it should be apparent that electronic document management technologies can greatly enhance the efficiency and usability of most knowledge management systems. The most prevalent problem with such systems, however, is finding the document that has the answer to your problem. Intelligent systems are increasingly being used to help with this dilemma.

Intelligent Agents for Knowledge Retrieval

Intelligent agents (as discussed earlier in this unit) have greatly improved the usability and efficiency of knowledge management systems. Many organizations have found electronic blackboards embedded in groupware to be somewhat inefficient because experts in their organizations end up spending unproductive time reviewing questions on blackboards placed by other employees. A more efficient approach has long been thought to be the centralized storage of documents such as memoranda and letters that explain problem resolutions and may be reusable with other customers and clients. The problem is how to find the right document for your problem.

Intelligent agents come to the rescue by providing software agents that learn about an individual’s work tasks and search behavior to better understand the information the user is likely to be seeking. The intelligent agent is then able to better refine the search and filter out much extraneous information that may be retrieved. The intelligence in these agents generally decreases search time, and so knowledge management systems end up getting used more frequently, as information is identified easily and quickly and with reduced frustration over mounds of unrelated information. While intelligent agents tend to be the dominant form of AI used for knowledge management, you should certainly recognize that other AI components are used in knowledge management systems.

Neural networks can be very helpful in recognizing patterns within the information stored in the vast knowledge warehouses. Further, such technologies can help pull together associated documents to recognize the common threads of information between different documents and pieces of information that have been stored. Additionally, expert systems and business intelligence systems are increasingly finding a home as integrated components of the knowledge management system.

Creating A Knowledge Culture

A major challenge faced in developing effective knowledge management systems is a cultural issue. Knowledge enters the knowledge management system only if individuals within an organization develop the necessary habit of entering information into the system. There are two primary reasons that knowledge is often slow to enter such systems: (1) a reluctance to give up the power associated with being the keeper of some knowledge or expertise and (2) the failure to remember to enter information into the system when key problems have been resolved. In many organizations, the key to success is to know more about the nature of the organization, its work, or its clients than anyone else. For some who were promoted based upon what they know and whom they know, sharing information freely is a relinquishment of power. Entering information into a knowledge management system is a formal extension to sharing—and far more of an individual's peers will have access to the information. The organization must adjust its criteria for rewarding and promoting employees to reflect the change to a shared knowledge environment. This change in compensation criteria encourages individuals within their organization to participate.

The other problem is getting employees into the habit of entering information into the knowledge management system. Some organizations have moved to the practice of recording participation in the knowledge management system and making participation a part of employees' annual personnel review. This practice provides an extrinsic reward that encourages participation, generally successfully, but also may formalize the knowledge management culture, which can actually inhibit the free flow of information among an entity's employees.

Informal organizations are frequently the most effective at knowledge management, but creating a culture of knowledge sharing remains the difficult part of making such structures work. Perhaps the greatest factor in the failure of organizations to achieve effective knowledge management is the concurrent failure to have addressed behavioral issues surrounding implementation of knowledge management systems. The company in Technology Application 5.6 tackled this problem head on and succeeded in getting its employees to participate.

As organizations continue to struggle with knowledge management issues, one thing that is clear is that organizations cannot afford to ignore cultural issues. Knowledge management is but one of many choices faced by organizations as they attempt to implement information technologies that support their strategic mission. The challenge is in determining a logical plan for the development of intelligent technologies that provide maximum
support for the strategic mission of the organization.

Conclusions

Business organizations must be successful in increasingly competitive international markets. Not-for-profit organizations— such as those in health care, education, and government—must deliver high-quality services at a cost that is acceptable to their customers and constituents. Effectively analyzing internal data and business trends gives each organization the understanding it needs to plan for its success in the future.

As we study IS, we find that the Information System and the effective use of information by all members of the organization are central issues for organizations. Advanced information technologies and intelligent systems—such as groupware and intelligent agents— must be successfully integrated with existing Information Systems.

Investigation of business intelligence systems, knowledge management systems, and other methods of assisting the management decision maker can lead to Information Systems that drive the long-term success of an organization. Developing your knowledge of decision making, information processing, and advanced technology will allow you to play an important role in the effective application of advanced technologies in your own company.

REVIEW QUESTIONS

1. Explain decision-making. What are the requirements of effective decision-making?
2. Define Knowledge Management. What are its Applications?
3. What are the benefits of Knowledge management?
4. How can we develop a better Knowledge culture.
5. What is Business Intelligence Systems? Define in detail.

FURTHER READINGS

- Information System Tecnology- Ross Malaga
- Information System Today-Leonard Jessup
- An Illustrated Information Technology-Alan Witchcomb
- Information Technology For Management Henry C.Lucas
- Information Technology in Business Management Dr. Mukesh Dhunna, J.B. Dixit

UNIT – 6 SYSTEMS ANALYSIS

CONTENTS

Introduction

This unit introduces the systems development process, which comprises four distinct phases: systems analysis, design, implementation, and operation. Because your involvement in the systems development life cycle (SDLC) typically will be that of a user or manager, discussions in this and the next unit emphasize participating in, rather than conducting, systems development. Our introduction to the systems development process begins with a definition of systems development and an assessment of how well organizations achieve their systems development objectives. Then we consider management processes (i.e., controls) that can advance the achievement of systems development objectives. Third, we discuss business process engineering, a phenomena that has been the source of many systems development initiatives. We conclude with a brief discussion of change management, a process to increase acceptance of new systems by an organization’s personnel. After this introduction, we examine the first phase in systems development: systems analysis. Organizations conduct the first step in systems analysis, the systems survey (often called a feasibility study) to decide what, if any, systems development efforts will be undertaken to solve an Information Systems problem. Organizations conduct the second step in the systems analysis phase, called structured systems analysis, to define the systems development problem and develop specifications for an Information System that will solve the problem.

Definition and Objectives of Systems Development

Organizations exist in a dynamic environment, and thus, they regularly experience changes in their

• Legal requirements, such as government reporting.

• Level and kinds of competition.

• Technologies, such as data entry devices, bar codes, and radio frequency identification (RFID) tags used to record and process information.

• Lines of business or kinds of business activities.

• Management desire for better access to information and improved management reporting.

All of these challenges at varying times necessitate changes to organizations' Information Systems. These changes may either require the creation of new Information Systems or significant modifications to existing Information Systems. **Systems development** comprises the steps undertaken to create, modify, or maintain an organization's Information System. These steps, along with the project management concepts discussed below, guide the in house development of Information Systems (i.e., make), as well as the acquisition of systems solutions (i.e., buy). A term often used synonymously with systems development is systems development life cycle or SDLC. The term **systems development life cycle (SDLC)** is used in several ways. It can mean:

1. A formal set of activities, or a process, used to develop and implement a new or modified Information System (referred to below as a systems development methodology.)

2. The documentation that specifies the systems development process referred to as the systems development standards manual.

3. The progression of Information Systems through the systems development process, from birth through implementation to ongoing use.

The "life cycle" idea comes from this last view and is the definition that we use in this text. Systems development is also an important—sometimes dominant—component of more comprehensive organizational change via business process reengineering. These terms as well as "systems life cycle" and "systems analysis and design" are also used to refer to the systems development process.

We propose the following systems development objectives: • To develop information systems that satisfy an organization's informational, operational, and management requirements. Note that this objective relates to the system being developed.

• To develop information systems in an efficient and effective manner. Note that this objective relates more to the development process than to its outcome.

Systems Development Methodology A systems development methodology is a formalized, standardized, documented set of activities used to manage a systems development project. It should be used when information systems are developed, acquired, or maintained. Exhibit 6.1 describes the characteristics of an SDLC. Following such a methodology helps ensure that development efforts are efficient and consistently leads to Information Systems that meet organizational needs.

Systems Development Phases, Steps, Purposes, and Tasks. The right side of the figure depicts the four development phases: systems analysis, systems design, systems implementation, and systems operation. The bubbles in Figure 6.1 identify the seven development steps undertaken to complete the four phases of development. Arrows flowing into each bubble represent the inputs needed to perform that step, whereas outward-flowing arrows represent the product of a step.

In the past it often took a new system years to move through the initial steps (i.e., bubbles 1 through 5 in Figure 6.1) in the life cycle. Now business moves at "Internet speed" and must develop B2B (business-to-business) and other business infrastructure systems in 90 to 180 days. If they don't, they may be put out of business or absorbed by organizations that can.

Systems development does not always proceed in the orderly, sequential course suggested by Figure 6.1. Some subset of steps may be repeated over and over until a satisfactory result is achieved. Or, we may undertake certain steps out of sequence. Finally, systems development may be outsourced to consultants or vendors, and personnel from within the organization will be part of the development team to serve as business process experts. The presentation in Units 6 and 7 assumes that systems development will be performed by an organization's own systems development personnel, proceeding. In Technology we briefly describe some alternative approaches that may be used. The alternatives discussed there include who will develop the system and how the SDLC might be altered. We also discuss alternative focuses for analysis and design—namely, data, functions, and objects.

Controlling the Systems Development Process

Would it surprise you to learn that many organizations are not successful at developing information systems? Unfortunately, this is true. Indeed, one report said one in four enterprise systems projects went over budget, 20 percent were terminated before completion, and 40 percent fail to achieve business objectives one year after completion. Summarizes a few reasons why organizations fail to achieve their systems development objectives.

To overcome these and other problems, organizations must execute the systems development process efficiently and effectively. The key to achieving these objectives is to control the development process. Apparently, that is not an easy chore, or more organizations would be successful at it. We can understand the complexity of the systems development process by comparing it to a construction project. Assume you are in charge of the construction of an industrial park. What problems and questions might you encounter? First, you might want to know how much of the project is your responsibility. Are you to handle legal and financial matters? Who obtains the building permits? Are you to contact the tenants/buyers to determine special needs? The project's size and duration cause another set of problems. How will you coordinate the work of the carpenters, masons, electricians, and plumbers? Or, how will you see that a tenant's special needs are incorporated into the specifications and then into the actual construction?

Information Systems developers encounter similar problems. Given such problems, they have concluded that systems development must be carefully controlled and managed by following good project management principles and the organization's quality assurance framework embodied in its systems development life cycle methodology. These are described in the following subsections.

Project Management

A recent survey of IS audit and control professionals found the following project management items associated with failed projects:

- Underestimation of the time to complete the project
- Lack of monitoring by senior management
- Underestimation of necessary resources
- Underestimation of size and scope of the project
- Inadequate project control mechanism
- Changing systems specifications
- Inadequate planning.

To manage projects well, organizations should adopt a framework for project management that includes the elements enumerated in Exhibit 6.3. The project work plan, including phases, work to be accomplished in each, times, and cost, are often documented using a project management tool such as Microsoft Project. Project management—particularly the planning process and establishing the project schedule—ultimately can determine the success of the project.

Quality Assurance

Project management frameworks apply to any project. To ensure that Information Systems will meet the needs of customers, projects involving the creation or modification of Information Systems must include elements that specifically address the quality of the system being developed. **Quality assurance (QA)** addresses the prevention and detection of errors, especially defects in software that may occur during the system development process. By focusing on the procedures employed during the systems development process, QA activities are directed at preventing errors that may occur. QA activities are also directed at testing developed systems to eliminate defects—to ensure that they meet the users' requirements—before systems are implemented. Two prominent sources of guidance for QA are ISO 9000-3 and the Capability Maturity Model (CMM)developed by the Software Engineering Institute (SEI) at Carnegie Mellon University. **ISO 9000-3** **ISO 9000-3** is a set of standards developed by The International Organization for Standards (ISO), that describe what an organization must do to manage their software development processes. The assumption, as with all ISO standards, is that if the ISO 9000-3 standards are followed, the development process will produce a "quality" software "product." ISO defines a quality product as one that conforms to customer requirements. Notice that the ISO concepts of quality "products" and "processes" parallel our two systems development objectives. Exhibit 6.4 contains examples of the ISO 9000-3 standards. Review those examples and identify the elements that are common among project management, a systems development methodology, and the ISO standards.

Capability Maturity Model The **Capability Maturity Model® for Software (SW-CMM)** is a model that helps organizations evaluate the effectiveness of their software development processes and identifies the key practices that are required to increase the maturity of those processes. Exhibit 6.5 describes the five SW-CMM maturity levels and the key principles and practices for each. Notice, for example, that project management is a key indicator that an organization has attained level 2. The Software Engineering Institute believes that predictability, effectiveness, and control of an organization's software processes improve as the organization moves up the five levels. However, moving from level 1 to level 2 may take an organization 2 years or more. Moving from level 2 to 3 may take another 2 years.

A recent study found that achievement of a Level 3 SW-CMM maturity by an organization, along with the implementation of a structured systems development methodology, contributes to the quality and cost-effectiveness of the software development process. In fact, there was significant improvement on 11 of 14 measures after Level 3 was attained. Improvements included communication and teamwork, lower maintenance costs, and lower levels of system defects.

Involvement in Systems Development

The ways managers and other Information Systems users can become involved in systems development. You should keep these categories in mind because in this and the next unit, your participation is discussed in terms of these categories.

Business Process Reengineering

So far we have introduced systems development, systems development objectives, and means for controlling the systems development process to ensure achievement of systems development objectives. Now we turn to discussion of an activity that has driven much of the systems development activities undertaken in organizations. Business process reengineering is an activity larger in scope than systems development, as it addresses all of the processes in the organization, including the information systems processes. Rapid developments in the capabilities and applications of IT, such as e-business, present organizations with increasingly difficult business opportunities/challenges. They are being asked—sometimes being forced in order to ensure their very survival—to abandon long held business beliefs and assumptions and to rethink what they are attempting to accomplish and how they are trying to accomplish it. Business process reengineering has been likened to presenting an organization's management with a blank piece of paper and asking them to reinvent the organization from scratch. Why would management ever be motivated to engage in such an undertaking? In many cases, they have no alternative. Experiencing the harsh realities of an increasingly competitive environment, they recognize that their companies must make mega-changes in how they operate, or face extinction.

Business process reengineering (BPR) (or simply reengineering) is "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical contemporary measures of performance, such as cost, quality, service, and speed."5 The emphasis on four words in this definition focuses on those four key components of BPR.

1. Fundamental rethinking of business processes requires management to challenge the basic assumptions under which it operates and to ask such rudimentary questions as “Why do we do what we do?” and “Why do we do it the way we do it?” Without fundamental rethinking, technology often merely automates old ways of doing business. The result is that what was a lousy way of doing a job became simply a speeded-up, lousy way of doing the job.

2. Radical redesign relies on a fresh-start, clean-slate approach to examining an organization’s business processes. This approach focuses on answers to the question, “If we were a brand-new business, how would we operate our company?” The goal is to reinvent what is done and how it is done rather than to “tinker” with the present system by making marginal, incremental, superficial improvements to what’s already being done. Achieving the goal requires forward-looking, creative thinkers who are unconstrained by what now exists.

3. Achieving dramatic improvements in performance measurements is related to the preceding two elements. The fundamental rethinking and radical redesign of business processes are aimed toward making quantum leaps in performance, however measured. We are not talking about improvement in quality, speed, and the like that is on the order of 10%. Improvement of that order of magnitude often can be accomplished with marginal, incremental changes to existing processes. Reengineering, on the other hand, has much loftier objectives. For example, the Ford Motor Company reengineered their procurement process and reduced the number of persons employed in the process by 75%.

4. Reengineering focuses on end-to-end business processes rather than on the individual activities that comprise the processes. BPR takes a holistic view of a business process as comprising a string of activities that cut across traditional departmental or functional lines. BPR is concerned with the results of the process (i.e., with those activities that add value to the process).

As an example, let’s look at the discrete activities that may be involved in completing a sale to a customer. These activities might include receiving and recording a customer’s order, checking the customer’s credit, verifying inventory availability, accepting the order, picking the goods in the warehouse, packing and shipping the goods, and preparing and sending the bill. Reengineering would change our emphasis by breaking down the walls among the separate functions and departments that might be performing these activities. Instead of order taking, picking, shipping, and so forth, we would examine the entire process of “order fulfillment” and would concentrate on those activities that add value for the customer. Instead of assigning responsibility for these activities to multiple individuals and organizational units, we might assign one individual to oversee them all. And, just as important, we might change measurement of performance from the number of orders processed by each individual to an assessment of customer service indicators such as delivering the right goods, in the proper quantities, in satisfactory condition, and at the agreed upon time and price. Having reviewed the core elements of BPR, let's look at howthese elements were applied in a real-world implementation. The late 1990s saw the rapid growth (and decline) of many Web-enabled e-business ventures. One of the more visible ones was Peapod, Inc., an online grocery superstore. "Peapod is America's largest Internet shopping and delivery service with about 100,000 customers. We have fulfilled over 1,000,000 orders and sold over 45,000,000 products to our customers in Chicago.

Peapod's business model is built on the following propositions. First, Peapod uses a distribution model with two formats. In large metropolitan areas, Peapod uses a freestanding distribution center while in their smaller areas, they use fast-pick centers in the supermarkets owned by Ahold. The relationship with Ahold, the "bricks" element of their business model, combined with distribution centers used just for online orders, the "clicks" element of their business model, gives Peapod a lower cost of entry and stronger buying power, allowing Peapod to cut merchandise costs between 5 and 7 percent. The second element of Peapod's success is their process for picking, packing, and delivering customer orders. Orders pulled off the Web site go immediately into Peapod's routing system, customized software that uses maps and travel time to determine how many stops each vehicle can make. Meanwhile, a professionally trained Peapod Personal Shopper handpicks and packs the orders. Peapod makes use of zone and batch picking. Some employees pick perishables while others pick dry goods. If the customer orders produce, a Produce Specialist makes sure that the freshest produce available is chosen for the order, and the Quality Control Specialist ensures that the order is complete and that the groceries are expertly packed.

The Peapod inventory and delivery model was a fundamental rethinking and radical redesign of the traditional grocery store model. Peapod's business model is predicated on dramatic performance improvements for personnel and infrastructure. The Peapod model focuses on the end-to-end business process, getting the groceries to the customer and improving the customer's experience! For example, Peapod's prices are tied to the current offline prices of their partnering retail stores, giving their customers the weekly advertised sale prices. Peapod's customers also get personalized and online coupons, the ability to create and save personal shopping lists, browse aisles, search for specific items, brands or flavors, and the ability to view nutrition labels. Finally, Peapod customers get a choice of delivery times and formats, minimal (and decreasing) time between ordering and delivery, and up-to-the minute information on order status. Peapod is a good example of a successfully reengineered business model. When asked to identify the critical success factors for reengineering projects, a group of Chief Information Officers (CIOs) cited strong project management, a visible and involved executive sponsor, and a compelling case for change.8 Organizational resistance to change, inadequate executive sponsorship and involvement, inadequate project management, and the lack of an effective change management program were described as significant barriers to change by this same group of CIOs. The following section describes methods that can overcome resistance to change.

Change Management

The modern business organization lives or dies by its ability to respond to change. It must embody a spirit of adaptation. However, most humans resist change. The introduction or modification of an Information System is one of the most far-reaching changes that an organization can undergo, especially when these changes are accompanied by, or driven by, business process changes. To reap the full benefits of a new system, management must find ways to overcome dysfunctional behaviors brought on by the implementation of a new Information System. Experience has shown that resistance to change can be the foremost obstacle facing successful system implementation. People's concerns regarding IT and business process changes center on actual and perceived changes in work procedures and relationships, corporate culture, and organizational hierarchy that these changes bring. To address these fears, systems professionals and users must collaborate on the design and implementation of the new system. This collaboration must include the system itself and the process that will be followed during its development and installation. The change must be managed, but not directed. Rather, users must participate in the development and change processes. Research and practice provide guidance to help us achieve successful change. A recent research study found that users who effectively participated in a systems change process were able to affect outcomes, and had a more positive attitude and a higher involvement with the new system. And, the system was more successful.9 In practice, we find that successful, large IT change projects—especially those involving enterprise systems—must be driven by the business processes and managed by the business process owners. In these cases, IT assists with, but does not drive, the change process.

Technological change is not welcomed if it comes as a surprise. Users at all levels must be brought into the process early in the SDLC to encourage suggestions and discussion about the change. Users involved from the start and given a say in redesigning their jobs tend to identify with the system. As problems arise, their
attitude is more likely to be, "We have a problem," rather than, "The system makes too many mistakes."

In engineering a systems change, it is crucial to consider the human element. Resistance should be anticipated and its underlying causes addressed. User commitment can be enlisted by encouraging participation during development and by using achievement of business objectives, rather than IT change, to drive the process. Potential users must be sold on the benefits of a system and made to believe that they are capable of working with that system. A policy of coercion will lead to substandard performance.

Systems Survey

This section discusses the systems survey, the first step in the development of a system. The systems survey is conducted to investigate Information Systems problems and to decide on a course of action. One course of action will be to proceed with development. However, initial investigation may find that there is no problem and broader analysis is not warranted. We must be careful in reaching conclusions, because problems may be ill defined and not appropriately identified by users.

Triggering Systems Development

A systems survey is initiated when the organization's IT strategic plan prescribes the development or when a user requests the development or modification of a new system. In planned reviews, systems analysts may not be aware of any particular problems (other than those identified in preparing the strategic plan). In such cases, they conduct the systems survey to see whether information processing problems exist or if they can improve an Information System. Planned systems development determines whether:

• A system still satisfies users' information needs.
• New design ideas can be incorporated.
• Evolving environmental changes, such as competition, require system changes.
• New types of business by a firm require system changes.

The user requests systems development when a system no longer efficiently and effectively meets their goals. User-requested systems development may occur when:

• Government regulations require new or modified reports.
• Current reports do not meet decision-making needs.
• Erroneous system outputs occur.
• Escalating customer or vendor complaints are received.
• The information system causes delays that slow a business process.

Notice that many of those reasons are rooted in a desire to leverage new technology for competitive advantage.

The organization should have a formal process for selecting projects to ensure that they are consistent with the organizational goals and strategies identified in the strategic plan for IT. Potential projects should be prioritized and approved by the IT steering committee to ensure that:

• Efficient and effective use is made of existing IT resources.
• IT resources are directed at achieving organizational objectives.
• Information services are used consistently throughout the organization.

Definition and Goals

The **systems survey**, often called a **feasibility study** or **preliminary feasibility study**, is a set of procedures conducted to determine the feasibility of a potential systems development project and to prepare a systems development plan for projects considered feasible. Refer to Figure 6.1 (page 172) to see the system survey's place in the SDLC (first), its inputs (request for systems development and miscellaneous environmental information), and its outputs (approved feasibility document).

Each step in the SDLC has goals that support the systems development objectives (to develop Information Systems that satisfy the organization's needs and to develop Information Systems efficiently and effectively). An organization conducts a systems survey to determine whether it is worthwhile to proceed with subsequent development steps. The systems survey goals are as follows:

• Identify the nature and the extent of systems development by determining for each reported problem the problem's existence (i.e., does a problem really exist?) and nature (i.e., what is causing the problem?).
• Determine the scope of the problem.
• Propose a course of action that might solve the problem.
• Determine the feasibility of any proposed development. Is there a technically, economically, and operationally feasible solution to the problem?
• Devise a detailed plan for conducting the analysis step.
Determine who will conduct the analysis, who will head the project team, what tasks are required, and what the development timetable is.
• Devise a summary plan for the entire development project.

Gather Facts

The first task in the systems survey is to gather facts. In the systems survey, the analyst gathers facts to achieve the systems survey goals. That is, facts are gathered to determine the nature and scope of the reported problem, to perform the feasibility study, and to plan the development project. The analyst tries to determine what the system does now (the "as is") and what we would like for it to do (the "to be"). To determine what the system is doing, we look at the system's documentation and examine the system's operation. To determine what the system should be doing, we obtain information from users and authoritative sources.

The extent of fact gathering must be consistent with cost and time constraints imposed on the systems survey. That is, the systems survey must be conducted as quickly and as inexpensively as possible, yet still accomplish its goals. If the project goes beyond the systems survey, additional, more detailed facts will be gathered during structured systems analysis.

Systems developers use a number of tools to gather facts. In Appendix 6A, we define and describe those fact-gathering tools typically used in systems development. Some of those tools may be used to gather facts during the systems survey.

Having completed the task of gathering and documenting facts, an analyst knows what the new system should do and what the present system or process actually does. The analyst undertakes the second systems survey task, the preliminary feasibility study, to determine whether we can solve the problem and whether we can do so at a reasonable cost. There are three aspects of feasibility:

• **Technical feasibility.** A problem has a technically feasible solution if it can be solved using available (already possessed or obtainable) hardware and software technology.
• **Operational feasibility.** A problem has an operationally feasible solution if it can be solved given the organization's available (already possessed or obtainable) personnel and procedures. In assessing this aspect of feasibility, the analyst should consider behavioral reactions to the systems change. Projects that include reengineering of existing business processes may face strong resistance because personnel may envision shifts in power, changes in day-to-day activities, and layoffs. Timing and scheduling may also be factors. An organization may have

the available resources but cannot or will not commit them to a particular project at this time. The organization may wish to scale down a project, take an alternative course of action, or break the project into smaller projects to better fit scheduling needs.

• **Economic feasibility.** Determining economic feasibility can be a bit more complex. A problem has an economically feasible solution if:

• Costs for this project seem reasonable. For example, the benefits exceed the costs.

• This project compares favourably to competing uses for the organization's resources.

Determining the costs and benefits for information systems is difficult at best. And, estimating project costs and benefits this early in the SDLC might seem premature. After all, we have done very little work on the development and know very little about the new system. But, management must decide now whether to proceed. Therefore, management must know the estimated costs and benefits of the development, no matter how roughly estimated.

Devise the Project Plan

As described earlier in the unit, project management is an important mechanism for controlling a systems development project. Control of a project becomes more important as the risks of failure increase. These risks, many of which are discovered during the feasibility study, include:

• Project size—both absolute and compared to other IT projects—as measured by staffing, costs, time, and number of organizational units affected. Projects that involve reengineering and/or the installation of an enterprise system are normally larger than those that do not.

• Degree of definition. Projects that are well defined in terms of their outputs and the steps necessary to obtain those outputs are less risky than those that require user and developer judgment.

• Experience with technology. Risk increases as the organization's experience with the relevant technology decreases.

• Organizational readiness. This aspect of operational feasibility addresses the organization's experience with management of similar projects, as well as management and user preparation for and commitment to this project. Although project management cannot address all of these risks, it is an important element in minimizing their impact. If the preliminary feasibility evaluation indicates that further analysis of the problem is warranted, the analyst devises a project plan.

A **project plan** is a statement of a project's scope, timetable, resources required to complete the project, and the project's costs. The systems survey's planning aspect is so important that the systems survey is often called "systems planning." The project plan includes a broad plan for the entire development, as well as a specific plan for structured systems analysis—the next development step.

We develop a project plan:

• To provide a means to schedule the use of required resources. What personnel and funds will be required and when?

• To indicate major project milestones to monitor the project's progress. Is the project on schedule? Has the project provided the required deliverables?

• To forecast the project budget, which is used to authorize project continuation. Given the project's progress to date, should additional funds be expended for this step? For the next step?

• To furnish guidelines for making a go or no-go decision. Are the costs and benefits as projected? Is the utilization of these resources (monetary and personnel) in the best interest of the organization at this time?

• To offer a framework by which management can determine the reasonableness and completeness of the project's steps. Is there a complete list of tasks, and are these tasks properly matched with the required skills? Are the proper information sources being investigated?

We use a combination of diagrams, schedules, and other project management tools to develop and document the project plan.

Obtain Approvals

Prior to completing the systems survey, the analyst must obtain approvals (signoffs). As mentioned earlier, signoffs signify approval of both the development process and the system being developed. Obtaining systems survey approvals ensures that the feasibility document's contents are complete, reasonable, and satisfactory to the major development participants. Obtaining agreement on the document's contents is a key element in the development process because such agreement paves the way for cooperation as the project progresses.

These approvals fall into two categories: approvals from users/participants and management control point approvals. User/participant approvals verify the accuracy of any interviews or observations and the accuracy, completeness, and reasonableness of the survey documentation and conclusions. Such approvals reduce resistance to the project and pave the way for accepting the effectiveness of the new system. The second type of signoff, called a **management control point**, occurs at a place in the systems development process requiring management approval of further development work (i.e., a go/no-go decision). Upper management control points occur at the end of each development phase (systems survey, analysis, etc.); IT management control points occur within phases; project management control points occur at the completion of individual work units. These ensure management commitment to the project and the resources required to bring the project to closure.

Structured Systems Analysis

As a result of decisions made in the systems survey, we know if and how to proceed with systems development. If we have decided to proceed, we perform the second step in systems development, structured systems analysis. We must perform the procedures in this step well to have any chance of achieving the first of our systems development objectives—to develop systems that meet user needs— because it is during systems analysis that we determine those needs. Without a well-understood and documented target (i.e., user requirements) we cannot hope to have a successful development process.

At one point or other in your professional career, you may be asked to take on both roles in this process. You will be a system user or business process owner articulating your needs or you will be a member of the development team that must determine and document those needs.

Neither process is easy. The tools and techniques described in this unit should help in the documentation of user requirements.

Management (or the IT steering committee) bases the decision about whether and how to proceed on information gathered in the systems survey and on other information. Management might decide to reduce the suggested analysis scope in order to reduce short-term development costs. Or management might cancel, postpone, or modify future systems work because a major modification is preferred to the maintenance approach being suggested (or vice versa).

In the case of reengineering and enterprise systems, management faces some challenging decisions. For example, an organization might decide early in the development process (e.g., during the systems survey) that the installation of an enterprise system would solve its Information Systems problems. To ensure a successful installation of an enterprise system, organizations must reengineer their business processes to make them compatible with the enterprise system. Management must decide how much analysis to undertake before and after purchasing the system and how much to change their business practices (versus attempting to change the enterprise system).

• Interfaces: build interfaces among the many systems that existed at their worldwide affiliates.

• Standardize on one: implement at all of the worldwide affiliates the set of applications in use at one of those affiliates.

• Build it: build their own system by writing the necessary applications software.

• Best of breed: select the best system available for each application or business process.

• EBS (Enterprise Business Solution): Select an integrated software package (in their case, SAP R/3) to provide the processing functionality for all applications. Implement that package worldwide. The development options summarize the typical choices from which organizations may choose. In the systems survey we begin the get some sense of these alternatives and which one looks best at the time. In the analysis step of systems development, we must examine each alternative and gather enough information to make a choice to proceed with development along one of the alternative paths.

Structured systems analysis is a set of procedures conducted to generate the specifications for a new (or modified) Information System or subsystem. its inputs (approved feasibility document and miscellaneous environmental information) and its
outputs (physical requirements and logical specification).

Definition and Goals

Before we begin this section, let’s define and clarify a few terms. First, **systems analysis** is the methodical investigation of a problem and the identification and ranking of alternative solutions to the problem. Systems analysis is often called structured systems analysis when certain “structured” tools and techniques, such as DFDs, are used in conducting the analysis. To simplify our discussions, we will refer to “structured” systems analysis as simply systems analysis.

The systems survey assists management in determining the existence of a problem and in choosing a course of action (i.e., to continue systems development or to cancel it). Systems analysis provides more information than was gathered in the systems survey. The additional information describes and explains the problem fully. Solutions are developed and evaluated so that management can decide whether to proceed with development and, if so, which potential solution should be developed.

To understand systems analysis, we'll return to the analogy presented earlier in the unit, in which we compared systems development to building an industrial park. Compare the architect's role for the industrial park to the analyst's role for systems development. In the preliminary stages of the industrial park project, the architect learns the general purpose of the industrial park (light manufacturing, warehousing, etc.). The architect also learns the approximate number of buildings and the size of each. From that information, the architect "sketches" a proposed park. From that sketch, the accompanying general specifications, and the estimated costs and estimated schedule, the developer decides whether or not to proceed with the proposed project at this time. This process is similar to that followed in the systems survey, with the systems analyst assuming the architect's role and the organization's management (or the IT steering committee) replacing the developer. If the developer approves the continuation of the project, the architect must conduct a detailed study to determine each building's

specific use, required room sizes, electrical and plumbing requirements, floor load weights, private versus public areas, number of personnel who will occupy the completed buildings, technical requirements, and so on. During this detailed study, the architect develops a functional model of the proposed project. The detailed study by the architect is similar to systems analysis, and the logical specification (one of the outputs of the analysis step) is the model for the new system. Systems analysis goals are as follows:

• Define the problem precisely. In systems analysis, we want to know and understand the problem in enough detail to solve it.

• Devise alternative designs (solutions). There is always more than one way to solve a problem or to design a system, and we want to develop several solutions from which to choose.

• Choose and justify one of these alternative design solutions. One solution must be chosen, and the choice should be justified using cost/effectiveness analysis or some other criterion, such as political or legal considerations (e.g., government reporting requirements).

• Develop logical specifications for the selected design. These detailed specifications are used to design the new system.

• Develop the physical requirements for the selected design. For example, we want to define such requirements as data storage, functional layouts for computer inquiry screens and reports, and processing response times, which lead to equipment requirements.

• Develop the budget for the next two systems development phases (systems design and systems implementation). These budgets are critical in determining development costs and controlling later development activities.

The logical specifications and physical requirements become the criteria by which the user will accept the new or modified system. The better we perform systems analysis, the more likely that the system will meet user requirements and be accepted, implemented, and used effectively. There are two issues here. First, as we see in Figure 6.3, the opportunity for errors is much higher in earlier phases of systems development. A typical early error is failure to define user requirements completely. Second, as we see in Figure 6.4, the later in the development process that an error or oversight is discovered, the more costly it is to fix. For example, if we fail to determine during analysis that the user needs a certain piece of data on an output screen, this data may not be easy to add to the database during the implementation phase.

It is especially imperative to perform a top-quality analysis when we are introducing an enterprise system. It is during the analysis step that we model the business processes and determine the process changes (i.e., reengineering) that will be required. Business process owners and system users must understand and accept these changes for successful implementation. Otherwise there may be strong resistance to the implementation that could lead to the failure of the new system. As mentioned earlier, business processes must be reengineered to fit the enterprise system's processes.

Determination of user requirements in the analysis step can be more difficult in an e-business implementation. In such an implementation we must determine user requirements inside and outside the organization. We must consider the functional needs of customers and business partners, as well any requirements for infrastructure to connect our internal systems to the outside users (e.g., customer, business partners).

Define Logical Specifications

The first step the analysis team performs on the road to defining the logical specification is to study and document the current physical system. The team wants to build on the information available in the approved feasibility document and understand completely the current system operations. The team answers such questions as these. Given the system's goals, what should the system be doing? Should the order entry system be supporting customer inquiries? What are the reasons the system is operating as it is? Why are there errors?

After the current system has been documented with a physical data flow diagram, the team derives the current logical equivalent while removing all the physical elements from the diagram to produce a current logical data flow diagram, a description of the current logical system.

Working with the current logical system, the analysis team models the future logical system. Like the current logical DFD, the future logical DFD describes a system's logical features. However, unlike the current diagrams, the future diagram describes what a system will do rather than what it presently does. To model what the new system will do, the team adds new activities, remodels existing activities, and adds or changes control activities. For example, in developing the Information System for the reengineered processes at Peapod, the development team would have modeled future processes such as those that track the movement of groceries into and out of the distribution centers.

Design Alternative Physical Systems

We are now at the point to describe how the new system will operate. Working with the future logical system, an analysis team could devise several physical alternatives.

1. The first step in developing a future physical system is to decide which processes will be manual and which will be automated. For example at Peapod they must decide if the picking lists will be printed with the clerks recording the quantities picked by writing on the picking lists, or if the lists will be presented on the screen of a handheld computer with clerks recording quantities picked on the handheld's keyboard.

2. As a second step in developing an alternative physical design, the analyst must decide which processes will begin immediately upon occurrence of an event and which will only operate periodically (often with batches of transactions). For example, at Peapod, they must decide when they will record the movement and delivery of groceries. Will, for example, the deliveries be recorded in a batch at the end of the day or immediately recorded via handhelds as the groceries are delivered?

The final step in designing alternative physical systems is to complete specifications for the future physical system. Typically, specifications are written for each bubble in the future physical system. These specifications indicate how, where, and in what form inputs are processed; and how, where, and in what form outputs are produced. When specifying physical systems, we may choose from a host of alternatives typically dictated by alternative technologies and modes of processing.

Select the Best Alternative Physical System

The analysis team, working with the new system's users, must now recommend the implementation of one of the alternative physical systems. The ultimate selection involves two decisions. First, the analysis team must decide which alternative system to recommend to the users and management. Second, given the analysis team's recommendation, the firm's management, usually the IT steering committee, must decide whether to undertake further development. And, if further development is chosen, management must decide
which alternative system should be developed. This two-part decision process is often an iterative process. The analysis team may recommend one alternative, and the users may disagree, thus requiring that the team rework its proposed system. After agreeing on the proposed system, the user/analyst team's proposal is forwarded for approval by the IT steering committee. This committee must decide whether the development effort justifies expenditure of the firm's cash. To reduce costs, for example, the IT steering committee may ask for revisions to the system, thus requiring yet another reworking of the proposed system. To facilitate selecting a future physical system, the systems analysis team conducts a **cost/effectiveness study**, which provides quantitative and certain qualitative information concerning each of the alternatives. This information is used to decide which alternative best meets users' needs.

In making this determination, the team asks two questions. First, “Which alternative accomplishes the users’ goals for the least cost (or greatest benefit)?” This question is addressed by the **cost/benefit study** (or **cost/benefit analysis**). Second, “Which alternative best accomplishes the users’ goals for the system being developed?” This is the **effectiveness study** (or **effectiveness analysis**).

Respondents to a recent survey of 63 companies with enterprise systems, such as SAP R/3 and PeopleSoft, reported an average negative value of $1.5 million when quantifiable costs and benefits were compared.11 However, that does not mean that organizations should not implement enterprise systems. These systems often lead to better customer service, integration across organizational units, and improved decision making—intangible effectiveness benefits. These benefits show some of the difficulties present in performing effectiveness analysis. For example, we may know many of the direct costs, but we may not know the magnitude of indirect costs such as loss of productivity. Also, we may not be able to identify or quantify expected benefits. Finally, we may be asked to implement systems for which the costs exceed the benefits.

Complete and Package the Systems Analysis Documentation

To complete the systems analysis, the project team must collect the products of the analysis and organize these products into the documentation required for subsequent development steps. Let’s talk about how each piece is packaged. The first analysis deliverable is the logical specification. This is used in systems selection to choose the appropriate software to be acquired from external sources. Or, if the software is developed in house, it is used in structured systems design to design the software.

The second analysis deliverable is the physical requirements specification. These requirements are used in systems selection to acquire computer equipment for the new system. Table 6.3 summarizes typical physical requirements. In addition to the physical requirements related to hardware, the physical requirements should include functional layouts of inquiry screens and reports. At this point, sample reports and screens are called functional layouts because they show the information elements that are needed without getting into all the details of the screen or report design.

Another deliverable, implicit at the conclusion of each systems development step, is the budget and schedule document.

• The budget, estimated during the cost/benefit analysis, specifies the expected costs to complete the systems development.

• Schedules control systems development efforts by setting limits on the time to be spent on development activities and by coordinating those activities.

The final step in completing and packaging the systems analysis documentation is to obtain approvals. As discussed earlier, signoffs may be obtained from users, information services, management, and internal audit. In addition, the controller may sign off to indicate that the cost/benefit analysis is reasonable.

Conclusions

This unit has introduced you to some of the important management issues surrounding the development of new or revised Information Systems. It also describes how to conduct the first two steps in systems development, the systems survey and structured systems analysis. Let's expand on the implications of two issues that we raised.

As discussed in the next unit, organizations continue to increase their reliance on outside resources to conduct their systems development projects and to operate their Information Systems. As this trend continues, the mix of IT-related skills that an organization must have in-house changes. For example, as an organization contracts out for the development of computer programs and communications networks, it needs to retain fewer of those technical skills in-house. At the same time, IT-savvy management team members must make decisions about these outsourcing arrangements and manage outsource contracts and relationships with the vendors. Second, the implementation of very large systems, such as enterprise systems, makes project management more important and more difficult. These systems affect literally every unit and every person in an organization. If the organization is large and international, as many are, the project management problems are compounded. As a result, most major enterprise system vendors provide tools to help manage the implementation process.

Internal Presentation

When an analyst wishes to learn about the operation of a department, he or she might request that members of that department make an internal presentation. An internal presentation is a session at which members of the organization formally describe or display information to the analyst. In some situations, holding a presentation may be more efficient than conducting a number of interviews.

Observations

An analyst can also use **observations** to gather current information about how a system operates or to corroborate other information. Observation shows that systems often operate differently in practice than the business process owners (typically managers) believe that they do. Another related technique is a **walkthrough**, in which the analyst traces a business event as it is processed, observing and documenting what happens at each processing stage.

Database and Files Review

If the systems documentation gathered during the internal literature review is accurate, it gives us an understanding of the way a system is supposed to operate (the formal system). But, because this documentation often changes more slowly than the actual system, it is often out of date. Therefore, information from documentation must be supplemented by that gleaned from other techniques that tell how a system really operates currently (the informal system). An analyst can review an organization's database and paper files related to events processing; this is called a **database and files review**. Examples of items an analyst might review include a paper file of vendor invoices and inventory master data.

Questionnaires

forms containing a standardized list of questions—structure the fact-gathering process and extend the geographic boundaries for that process. Questionnaires can also gather information when personal contact is either not necessary or not possible. For example, an analyst could e-mail a questionnaire to a firm's sales force to gather information about an order entry system being developed. Questionnaires can be administered to a population sample and, if the questionnaire is designed properly, the results can be analyzed statistically to generalize the findings to the entire population.

REVIEW QUESTIONS

1. What is Systems Development Methodology? Explain its Phases.
2. What is the Controlling of the Systems Development Process? Describe its methodology
3. Discuss about various type of feasibility required for system development
4. Describe the implementation process of a system
5. What is system development life cycle.

FURTHER READINGS

- Information System Tecnology- Ross Malaga
- Information System Today-Leonard Jessup
- An Illustrated Information Technology-Alan Witchcomb
- Information Technology For Management Henry C.Lucas
- Information Technology in Business Management Dr. Mukesh Dhunna, J.B. Dixit

IMPORTANT NOTES

UNIT-7 SYSTEMS DESIGN AND IMPLEMENTATION

CONTENTS

Introduction

Depicts the systems development life cycle, including the phases, steps, and inputs and outputs for each step. we began our study of the systems development process and described the first phase of systems development, the systems analysis phase. In this unit we consider the remaining phases. The systems design phase includes two steps: systems selection (choosing software and hardware resources to implement new or revised systems) and structured systems design (detailed specification of new or revised software and the preparation of implementation plans). The systems implementation phase includes completing the design of the new or revised system and converting to that system. The systems operation phase includes two steps: the post-implementation review, during which we assess the adequacy of the new system to meet the users' requirements and the quality of the development process, and systems maintenance, which involves making minor system repairs and modifications. Recall from earlier discussions that certain systems development tasks are comparable to tasks undertaken in the construction of an industrial park. In systems selection, choosing software and hardware resources is similar to choosing contractors for a construction project. Structured systems design, planning implementation, and designing software is similar to drafting blueprints and other construction-related plans. Systems implementation (in which the computer programs are written, the design of databases, files, and documents is finalized, and the system is put into operation) is analogous to the process of actually constructing the industrial park. Post-implementation review, in which the organization checks to see that the system does what it was supposed to do, is similar to the building inspection that occurs soon after the industrial park is completed. Systems maintenance, in which system errors are corrected and enhancements are added to the system, is similar to undertaking plumbing or electrical repairs or minor building modifications, such as moving interior walls and relocating doors.

Systems Selection

systems selection lies between structured systems analysis (bubble 2.0) and structured systems design (bubble number 4.0). Systems selection uses the new system's functional requirements (the logical specification) and physical requirements that were developed in the analysis phase to decide what resources will be used to implement the new system. Only after the resources are chosen does detailed design begin.

Systems selection is a set of procedures performed to choose the computer software and hardware for an Information System. The systems selection goals are to:

• Determine what computer software will implement the logical specification developed in structured systems analysis. We must decide between in-house software development by Information Systems personnel, end-users, or contract programmers versus off-the-shelf rental or purchase. For instance, we should consider whether home grown systems can provide the level of integration and functionality that could be achieved through use of an enterprise system.

• Determine what computer hardware will satisfy the physical requirements established in structured systems analysis. We must evaluate and choose the architecture (e.g., client/server, LAN) and the type, manufacturer, and model of each piece of computer equipment.1 In making our choice, we should also be aware of the implications for security and control of Information Systems. Additionally, to understand cost implications, consideration should be given in the decision to environmental controls (i.e., temperature, electrical, etc.). • Choose acquisition financing methods that are in the best interest of the organization. We must decide whether it is better to purchase, rent, or lease the computer equipment. In addition, we must decide if our data center will be completely within our control or if we will use an applications service provider, or other outsourcing option.

• Determine appropriate acquisition ancillaries. We must establish contract terms, software site-licensing arrangements, computer maintenance terms, and software revision procedures and responsibilities.

1 An organization's existing hardware might be used to implement a new Information System. In this case, the hardware phase of the study would verify that the existing hardware is adequate, given the physical requirements.

Before we proceed, let's look at the sequence of activities presented in Figure 7.1 and in these goals. Historically, the logical specification and the physical requirements were developed in the systems analysis step after the business processes had been documented and accepted, or remodeled (e.g., business process reengineering). Then, a software package would be chosen (and modified, if necessary) or developed in house. This is the sequence depicted in Figure 7.1 and used in this text.

As we said in Unit 6, however, when we implement an enterprise system we change the sequence of activities. With enterprise system implementations we start by choosing the package and then retrofit business processes to match those required by the enterprise system. So, while we present the sequence of the SDLC as "typical," we ask you to be aware of the existence of practical variations in these activities.

Software and Hardware Acquisition Alternatives

Before proceeding to the intermediate steps in systems selection, let's spend time examining various software and hardware procurement options that an organization must consider. Computer software can be purchased, rented, leased, or developed in-house. Hardware can be acquired (rented, leased, or purchased) by an organization and managed by the organization's personnel.

Alternatively, the hardware can be owned and managed by external entities. Table compares these external and internal sources for computer software and hardware.

A review of Table should lead you to conclude that external sources usually provide more capacity and affect the organization's resources less, while internal sources can be matched more easily with the organization's needs. Organizations implementing e-business Web sites must balance the imperative to launch a site rapidly (i.e., purchase an off-the-shelf e-commerce suite) with their desire to tailor a site to their needs and present unique content and performance characteristics to distinguish their site from those operated by their competitors (i.e., develop their own proprietary site).

Software Acquisition Alternatives

Internal Development Software can be developed internally, purchased or rented from a vendor, or, in some cases, leased from a third party. Table 7.1 lists criteria useful in making the develop versus- buy decision. Within the organization, a systems development staff usually writes programs that are large and complex and involve a number of organizational units. Software development by users normally is appropriate when the program will be used by a small group or an individual, and must be tailored to that limited use. As more software becomes available, especially enterprise systems with many modules and add-on features, the option of in-house development has become increasingly rare.

External Acquisition Organizations not wishing to or unable to develop software in-house may purchase, rent, or lease a commercially available software package. Some organizations have rented software packages and used them to benchmark software being developed in-house. The rented software may also provide an interim solution while a system is developed in-house and might be retained on a long-term basis if it proves superior to the in-house solution.

Software can be acquired from computer manufacturers, software vendors, mail-order houses and retail stores (for personal computer software), as well as outsourcing firms, including service bureaus, systems integrators, and application service providers.

In general, **outsourcing** is the assignment of an internal function to an outside vendor. An organization can outsource its accounting, payroll, legal, data processing, strategic planning, or manufacturing functions, and so on. Since 1989, when the Eastman Kodak Company signed an agreement with IBM whereby IBM would own and operate Kodak's data centers, outsourcing has increasingly been an option for organizations willing to have an outsider provide some or all of their Information Systems services. The Gartner Group asserts that "outsourcing has become a noncontroversial, mainstream approach to managing IT... and senior executives (IT and non-IT) endorse and promote its judicious use within multiple processes across their enterprise."2 These projections show that, in addition to software, outsourcing is also a major alternative for the external acquisition of hardware and networks. 2 "The Varied Industry Perspectives of Outsourcing," Gartner Group Advisory Note No. LE-18-0527, September 4, 2002. A **service bureau** is a firm providing information processing services, including software and hardware, for a fee. The service bureau owns and manages the software and hardware, which is installed on the service bureau's property. Most of the services are on a fee-for-service basis, thus minimizing cost to the contracting organization. Many companies contract with service bureaus for payroll processing. **Systems integrators** are consulting/systems development firms that develop and install systems under contract. EDS, Accenture, CAP Gemini, and other professional services firms are major players in systems integration. Advantages of systems integrators and consultants to develop systems include:

• Consulting firms have broad experience and knowledge of specialty and leading edge technology, helpful if a project involves a substantial upgrade in technology beyond available inhouse expertise.

• Consulting firms have experience and may specialize in organization change, helpful to organizations not accustomed to change.

• Quick action must be taken to catch up with aggressive competition. Consultant expertise is flexible and rapid, and usually readily available for required services.

There is evidence, however, that the use of systems integrators doesn't always work out. For example, one study looked at 16,000 IT projects and found that none of the projects that had heavy participation by big systems integrators was completed on time and within budget.3 Technology Excerpt 7.1 proposes seven steps to preventing these disasters.

A rapidly developing segment of the outsourcing market is the application service provider (ASP). Technology Insight 7.1 discusses ASPs. ASPs are similar to service bureaus and other outsourcing options. The ASP, however, provides its services via an easy-to-use Web browser over public networks, rather than more expensive private lines. Several ASPs exist that specialize in providing enterprise system services to organizations. As the current generation of enterprise systems moves to Web-enabled clients that function through use of browser software, the usability of enterprise systems

in an ASP environment should become less complex and make this model of delivery even more cost effective. The Gartner Group predicted that only 20 percent of the ASPs in existence at the end of 2000 would survive through the end of 2003. Therefore, an organization should consider carefully the type of applications that it outsources. The outsourcing of critical applications should probably be kept in-house. They may be too important to hand over to another organization. Support applications such as human resources and accounting might be better outsourcing candidates.

Summary of Software Acquisition Alternatives An organization should consider the financial implications of the decision to develop (make) versus buy. Because software vendors can allocate software development costs across many products and across multiple copies of each product, the prices they charge to recover development costs are usually less than the organization would pay to develop the package in-house. Generally, software developed in-house for a mainframe computer can cost up to 10 times more than purchased software. And, annual maintenance of in-house software is typically 50 percent of the development cost, while annual maintenance for purchased software normally costs only 25 percent of the purchase price. To increase the potential market for a software package, vendors develop packages for a wide audience. This strategy leads to products that seldom possess characteristics exactly matching any particular organization's requirements. Organizations not satisfied with these generic packages can contract with a vendor to modify
one of the vendor's existing software packages or develop a custom tailored software package written specifically to meet the organization's unique requirements.

What is the bottom line from Table ? When a suitable standard package exists, buy it rather than try to reinvent it in-house. Notice the emphasis on suitable. Other considerations must include the organization's internal resources (personnel, capital) and available vendor support. Enterprise systems, for example, are off-the-shelf packages that are highly configurable, but still require compromises to benefit from the off-the-shelf nature and cost savings. Many external sources of software, such as ASPs, require little up-front implementation expense and provide the benefits of some of the best software solutions available. Even when providing enterprise systems services, ASPs tend to shorten implementation time for an organization drastically, albeit limiting the amount of tailoring that can be done to match a system with a business process. On the other hand, ASPs can provide business process reengineering specialists to help organizations implement best practices into their business processes and to match the processes with the enterprise system provided. In general with ASPs, implementation, operations, and maintenance requirements are minimal, freeing organization personnel time to focus on their mission. Contracted, in-house development is a software development option that combines some advantages of both in-house development and software purchase. An organization hires contract (nonemployee) analysts and programmers to develop a system. Because the services of these persons end at the completion of the project, the contracting option provides short-term labor and expertise that the organization requires. Some organizations use contractors to train their personnel to work with new technologies. When benefits are figured in, the contractors cost about the same as employees. These contractors can be on-site or they can be outsourced from anyplace in the world. For example, outsourcing of systems development services is a $6.2 billion industry in India. Services provided include maintenance of existing (i.e., legacy) systems, e-business development, and integration of applications.5 5 "Analysis of India: Today's Dominant Offshore Outsourcer," Gartner Group Research Note no. M-15-0304, January 16, 2002.

Hardware Acquisition Alternatives

Computer hardware can be purchased, rented, or leased from the manufacturer (vendor) or from a leasing company. Under these arrangements, hardware is acquired, installed in the organization's facilities, and operated by the organization's personnel. As noted in Table possession and management by the organization is less flexible (because of fixed cost and limited capacity, for example) than is use of external sources, but it does permit the organization to control and tailor the system. An organization preferring not to own or manage its own computer facilities can use one of the outsourcing options described above, such as a service bureau or an ASP, to fulfill its hardware needs.

The Intermediate Steps in Systems Selection

There are three major tasks in the systems selection process: prepare requests for proposals, evaluate vender proposals, and complete configuration plan. We will now discuss each of those tasks.

Prepare Requests for Proposal

A **request for proposal (RFP)** is a document sent to vendors that invites submission of plans for providing hardware, software, and services. The organization may send an RFP to vendors from whom it has previously received proposals or with whom it has previously done business. The analysts assigned to conduct systems selection also might research vendor evaluations published in the computer press or in other computer-based or paper-based services. This research, an example of external literature review, is described in Technology Insight Using the information contained in the logical specification and/or in the physical requirements, the analysts prepare the RFPs and send them to the chosen vendors.

The section on projected growth requirements is important relative to the RFP. The better an organization accurately projects the long-term requirements for a new system and obtains software and hardware that can satisfy that long-term demand, the longer it will be before the system needs to be revised and new software and hardware obtained. This principle may be less relevant to industries in which organizations need to apply rapidly evolving technology in order to remain competitive.

Evaluate Vendor Proposals

Using vendor responses to the RFP, the logical specification, and the physical requirements, analysts must decide which, if any, proposal best meets the organization's needs. The process of evaluating the vendor proposals includes three steps:

1. Validate vendor proposals.
2. Consider other data and criteria.
3. Suggest resources.

Many organizations assign a team to evaluate the proposals. The team could consist of personnel with IT technical expertise, business process owners, system users, external consultants, lawyers, and accountants. The evaluation team completes these three steps to suggest the software, hardware, and services that best meet the organization's requirements.

Validate Vendor Proposals The first evaluation step is to **validate** the vendor proposal to assess whether the system (software or hardware) does what the organization requires by studying a proposed system's specifications and performance. Specifications are straightforward descriptions of the hardware and software—such as a software package's maximum table sizes or a printer's speed— that can be examined to determine whether the system has the ability to perform as required. Performance features can be determined only through testing, measurement, or evaluation and often include items such as user friendliness, vendor support,6 quality of documentation, reliability, and ability of system to produce complete, accurate, and timely output.

One commonly used method for measuring system performance involves measuring the system's **throughput**, which is the quantity of work performed in a period of time. For instance, the number of invoices that a system processes in one hour is a measure of throughput. Other performance measures, such as ease of use, are more subjective and may be more difficult to determine.

After eliminating those proposals that do not meet minimum requirements, the evaluation team tests7 the remaining systems to determine the accuracy of the vendors' specifications and how well the equipment will work for the organization. Having determined what a system is, we test to determine what that system can do. 7 Often, vendors will propose a system that does not actually exist yet. In such cases, we cannot test an actual system; our only option is to simulate the proposed system, as discussed later in this section.

An evaluation team can test a system by:

• Varying input (workload) parameters, such as quantity, timing, and type of input.

• Varying system characteristics (parameters), such as quantity and size of data storage devices.

• Varying the factors being measured, such as CPU cycle time (a system parameter) or execution time (a performance measure).

• Testing an actual workload, such as a weekly payroll, or testing a workload model that is representative of the workload.

• Testing the actual system or a model of the system. The Internet has made it possible for vendors to demonstrate their software on their Web sites.

Consider Other Data and Criteria Rather than estimate vendor and system performance internally, the evaluation team can interview users of the vendors' products and visit those sites to witness the system in action. Quite often, vendor presentations are made at the site of an existing user. **External interviews**—interviews conducted with personnel outside the organization—can provide valuable insights into vendor performance. Where appropriate, questionnaires can also be used

to gather information from users. The following information might be collected from users:
• Were there delays in obtaining the software or hardware?
• Did the system have bugs?
• How responsive is the vendor to requests for service?
• Was the training the vendor provided adequate?

As mentioned in Technology Insight 7.2, there are several services that publish technical reviews, user surveys, and expert commentary on computer equipment, software, and a variety of related topics. The reviews and user surveys can be helpful when evaluating proposals.

A cost/benefit analysis is often used to determine the economic viability of the remaining vendor proposals. Quantifiable costs and benefits are summarized to determine whether vendor proposals can be justified economically. Ranking vendor proposals using the economic criteria is useful in the next step in systems selection, in which the evaluation team suggests which vendor proposal should be chosen. The identification and quantification of Information Systems costs and benefits, however, is a difficult process requiring as much art as science. Still, we must have some data with which to make a decision.

Suggest Resources At this point, the study team recommends one vendor proposal. Management then chooses the software and hardware resources. To recommend one vendor, the evaluation team compares the proposals that have not been eliminated. The evaluation team might list the relevant criteria and indicate the performance of each vendor on each criterion.

Complete Configuration Plan

To complete the configuration plan—the major output from the systems selection step in SDLC—the evaluation team must complete the software plan, complete the hardware plan, and obtain approvals. As with many of the steps in systems development, these processes are not necessarily sequential, but should be iterative.

The **software plan** documents how the logical specification will be implemented, using in-house development, vendor purchase or lease, ASP, or a combination of these. The **hardware plan** summarizes how the recommended vendor proposal will fulfill the physical requirements specified in structured systems analysis. Once the configuration plan (i.e., the combined software and hardware plans) is completed, it must be approved by the Information Systems steering committee, IT management, internal auditor, the controller, legal counsel, and other appropriate management personnel. Once approved, the configuration plan is used in the next step i n systems development: structured systems design.

Introduction to Structured Systems Design

Studies have shown that systems developed using structured systems design techniques are less costly over the life of the system because maintenance of the system is less expensive. Structured systems design also avoids design errors that further increase the cost of the system. Implementation planning, conducted during structured systems design and introduced in this section, increases the probability of a smooth transition to the new Information System that structured systems design is the fourth major step in the development of an Information System. **Structured systems design** is a set of procedures performed to convert the logical specification into a design that can be implemented on the organization's computer system. Structured systems design is often called detailed design or internal design. Concurrent with specification of the system's design, plans are developed for testing and implementing the new system and for training personnel. Portions of the user manual are also developed at this time.

The structured systems design goals are as follows:

• Convert the structured specification into a reliable, maintainable design. This is similar to the process of converting a building model into a blueprint.

• Develop a plan and budget that will ensure an orderly and controlled implementation of the new system. Procedures must be devised to get the hardware in place, the programming completed, the training conducted, and the new system operating.

• Develop an implementation test plan that ensures that the system is reliable, complete, and accurate. A plan must be developed to test the system to ensure that it does what the user wants it to do.

• Develop a user manual that facilitates efficient and effective use of the new system by operations and management personnel. Personnel must know how to use the new system effectively, and the information processing staff must know how to operate the system.

• Develop a program that ensures that users and support personnel are adequately trained.

The Intermediate Steps in Structured Systems Design

The sequence of activities and the amount of effort expended for each activity in structured systems design differs depending on some of the decisions made earlier in the systems development process. For example, if the organization has chosen to install an enterprise system, the design steps will include reengineering of the business processes and specification of how the enterprise system will be configured to match those processes. If the organization has chosen to develop the software in-house, the structured systems design step includes design of the software that will be written during the implementation step.

Specify Modules

If the software is to be developed in-house, it is at this point in the development process that we must specify the software design (i.e., detailed, internal design). The modular design of the software is one of the features unique to structured systems development. The main tool of the structured design process is the **structure chart**, a graphic tool for depicting the partitioning of a system into modules, the hierarchy and organization of these modules, and the communication interfaces between the modules.

The structure chart's overall appearance is similar to that of an organization chart. Each box on a structure chart is a **module**. These structure chart modules become computer program modules of 30 to 60 lines of computer program code (one-half to one page of code). During structured systems design, related activities are grouped together within a module. This grouping of activities leads to a more maintainable system because changes to one function of a system lead to changes in a minimum of modules.

Develop Implementation Plan and Budget

System designers possess valuable insights into how a system should be implemented. During the design phase, the project team documents these insights in an implementation plan. As the implementation plan evolves, the project team summarizes resources required to implement the new system into an implementation budget so that resources can be allocated and implementation tasks scheduled.

If the software is to be developed in-house, the structure chart, developed by the system designer, dictates which modules should be programmed and installed first, and this sequence becomes part of the plan. The systems designer uses the expected size and complexity of the computer programs to prepare a schedule and budget for the programmers required to write the program code.

Develop Implementation Test Plan

Each system module, and any interactions between modules, must be tested prior to implementation. Again, systems designers have valuable insights into how a system should be tested. As we saw in the discussion of structure charts, the inputs and outputs for each module (and module combination) are specified in the design phase so that the designers can specify test inputs and expected outputs and provide recommendations for the order in which the system's pieces should be tested.

Develop User Manual

Because the designer knows how the system and each program will operate, how each input should be prepared, and how each output is used, preparation of the user manual can begin in the design phase. At this point in the SDLC, the manual is used to begin briefing and training users. The development of the user manual proceeds concurrently and interactively with many other design activities. For example, user procedures usually depend on computer system procedures, but some system functions may depend on user procedures. Development team members must also know about user procedures so that they can design tests of those procedures.

Develop Training Program

User training should begin before the system is implemented and therefore must be planned during the design phase. Deciding when to conduct training is tricky. While training must be conducted before implementation, it cannot be too much before or trainees may forget what they learned. Training materials, user manuals, and the system used for training must also be consistent with the system actually implemented.

Complete Systems Design Document

The approved systems design document has three main components:

(1) the system design (structure charts and descriptions of logical processes);

(2) the implementation, testing, and training plans; and

(3) the user manual. The design project leader must assemble these components and obtain the required user approvals (to ensure the adequacy of the design and plans) and management approvals (to signify

concurrence with the design, training, and implementation process). In addition, IS management furnishes a supervisory/technical approval of the adequacy of the software specifications. Auditors ensure adequacy of the controls and the design process (including implementation planning).

Introduction to Systems Implementation

At this point in the SDLC, we have completed the systems analysis phase (the systems survey and structured systems analysis). We have also completed the systems design phase by selecting hardware and software (systems selection) and by preparing the systems design and
the implementation plan (structured systems design). It is time to install and begin to use our new or modified system.

Systems implementation is a set of procedures performed to complete the design (as necessary) contained in the approved systems design document and to test, install, and begin to use the new or revised Information System. Figure 7.1 (page 206) depicts systems implementation as the fifth major step in the development of an Information System.

The systems implementation goals are as follows:

• Complete as necessary the design contained in the approved systems design document. For example, the detailed contents of new or revised documents, computer screens, and database must be laid out and created.

• Write, test, and document the programs and procedures required by the approved systems design document.

• Ensure, by completing the preparation of user manuals and other documentation and by training personnel, that the organization's personnel can operate the new system.

• Determine, by thoroughly testing the system with users, that the system satisfies the users' requirements.

• Ensure a correct conversion by planning, controlling, and conducting an orderly installation of the new system.

In this section we describe implementation approaches that can be taken to install the new or modified system. the three most common implementation approaches.

The parallel approach, provides the most control of the three. In the **parallel approach**, both the old and new systems operate together for a time. During this period, time x to time y (which is usually one operating cycle, such as one month or one quarter), the outputs of the two systems are compared to determine whether the new system is operating comparably to the old. At time y, management makes a decision, based on the comparison of the two systems' outputs, whether to terminate the operation of the old system. The parallel approach provides more control because the old system is not abandoned until users are satisfied that the new system adequately replaces the old. Although this approach makes good intuitive sense, in practice it frequently alienates users who perceive parallel operations as doubling their workload.

The **direct approach**, is often called the "Big Bang" approach and is the riskiest of the three approaches. At time x the old system is stopped and the new system cuts in with no validation that the new system operates comparably to the old. While we will see a little later that it need not be so, enterprise systems are often implemented using this approach.

Sometimes, as you'll see in the Hershey story in Unit 11, direct implementations can lead to disaster. Figure 7.2(c), the modular approach, can combine parallel or direct approaches to tailor the implementation to the circumstances.

With the **modular approach**, the new system is either implemented one subsystem at a time or is introduced into one organizational unit at a time. For example, a new Order-to-Cash system could be implemented by first changing the sales order preparation and customer inquiry portions, followed by implementing the link to the billing system, followed by the link to the inventory system. depicts the gradual implementation of a new system into three organizational units. A new payroll system is installed for the employees of plant 1 at time x, followed by plant 2 at time y, and finally by plant 3 at time z. Implementation at any plant could be direct or parallel. Modular implementation permits pilot testing of a system or system component and elimination of any problems discovered before full implementation. Figure 7.3 depicts the modular schedule used at the Boston Scientific Corporation to implement SAP at all of its worldwide divisions and locations. As shown in this example, several installations were complete while two more were scheduled for the end of March. At Boston Scientific, several members of the project team were on location on each worldwide "go-live" date to provide assistance, ensure consistency of all implementations, and to learn and provide improvements for subsequent implementations.

The Intermediate Steps in Systems Implementation

As with structured systems design, the sequence of activities and the amount of effort expended on each depends on some of the decisions made earlier in the development process. For example, if the organization has decided to install an enterprise system, software and hardware may have been purchased and installed at this point in the development process. Also, if the software has been acquired (vs. developed in-house), as with an enterprise system, the only programming likely required would be to connect the enterprise software to any remaining legacy systems (i.e., old systems being retained).

Complete the Design

During systems implementation, we need to complete the detailed design of the new or revised systems. This may sound a little confusing. Didn't we perform structured systems design in the previous development step? Yes, we did. But that design was related to the design of software that was to be developed. Now we must design input and output reports, documents, computer screens, database, manual processes, and certain computer processes, such as those needed to link new software to legacy systems.

Acquire Hardware and Software

At any time after the computer resources are chosen and indicated in the approved configuration plan, the software and hardware may be acquired, the site prepared, and the computer system installed. Contract negotiation and site preparation are important parts of

the computer acquisition process. Technical, legal, and financial expertise must be combined to negotiate and execute the contracts.

Business process owners should review contracts to ensure that important user requirements, such as system availability and response times, are reflected. Detailed specifications protect both buyer and vendor. Technology Excerpt 7.3 provides some contract preparation guidelines.

The site to receive the computer equipment must be prepared carefully. Sufficient electrical power and power protection, air conditioning, and security, as well as the computer room's physical structure and access to that room, must be planned for and provided. If contracts are well written and the site well prepared, installation of the computer hardware, software, and related equipment should be relatively straightforward. Contingency plans to allow for delays in site preparation or equipment delivery should be considered.

Write, Configure, Test, Debug, and Document Computer Software

The next task in systems implementation is to produce or configure the software, test and debug the software, and complete the software documentation. For internally developed systems, the programming step is important because the programming task in systems development consumes more resources and time than any other development task.

If we have purchased a software package, much of the programming step is replaced with procedures to configure the system for this application. During the implementation of an enterprise system, this process can be extensive as we configure the system to select, for example, the steps to be completed for each business process, the design of the screens to be displayed at each step of the process, and the data to be captured, stored, and output during the processes. This is the point at which we ensure matching business processes that we have reengineered within the organization to elements of the enterprise system. For example, we can configure the SAP system to create and record a customer invoice automatically upon shipment of the goods, or we can require that the billing process be triggered later.

Some programming may remain, however. To tie the new enterprise system modules to legacy systems, program code must be written—in ABAP for SAP and C+ + for J. D. Edwards, for example.

Select, Train, and Educate Personnel

The organization must choose personnel to use the new system and train them to perform their system-related duties. The system's users must be educated about the new system's purpose, function, and capabilities. Such training becomes even more important if jobs have been redesigned during business process reengineering. Training may come from a combination of schools run by software vendors, hardware vendors, vendors specializing in training, and programs conducted by the organization itself. Computer-assisted learning, such as interactive tutorials, might also be used. Online HELP and EXPLANATION facilities, along with well-designed screens and reports, can reduce the amount of up-front training necessary and provide ongoing guidance to system users.

Computer-based training (CBT) provides learning via computer directly to the trainee's computer screen. Training may be delivered over the Internet by vendors whose business it is to design, produce, and deliver such training. Enterprise system vendors, such as SAP and J. D. Edwards, have created extensive CBTs to help users learn the features of their systems. CBT can be much less expensive than lectures, and it also permits individualized instruction, which can take place when and where needed. The interactive nature of CBT can get and keep a trainee's attention. However, some employees, particularly middle and senior management, prefer more personal, traditional delivery methods.

Complete User Manual

A user manual should describe operating procedures for both manual and automated systems functions. The manual should cover user responsibilities, system inputs, computer system interfaces, manual files and databases, controls (including error detection and correction), distribution and use of system outputs, and manual and automated processing instructions. Good user manuals can improve system efficiency and effectiveness. If users know how to use a system properly and they employ it willingly, the system will be used more frequently, more correctly, and more productively. The systems designer, the user, and the organization's technical writing and training staff should cooperate in preparing the user manual. Because the systems designer knows intimately what the system will do, he or she is well qualified to describe how to use the system. The user, who must study the manual to learn the system and

then keep the manual as a reference for continued operation of the system, must make sure that the manual is relevant for the tasks to be performed and that it is complete, accurate, and clear. The organization's training staff should be involved in preparing the manual because they must train users to operate the new system. The staff must learn the system themselves and develop separate training materials and/or use the user manual as the training vehicle.

Therefore they are very interested in the user manual and should have input to its development.

Test System

Beyond testing program modules, the entire system is tested to determine that it meets requirements established by business process owners and users, and that it can be used and operated to the satisfaction of both users and system operators. Testing is carried out by systems developers, by developers and the users together, and finally by users. The more closely the test can simulate a production environment (e.g., people, machines, data, inputs), the more representative the test will be and the more conclusive the results. Several types or levels of tests are usually completed before a system can be implemented. From the users' point of view, three of these tests are the most important. The **system test** verifies the new system against the original specifications. This test is conducted first by the development team and then by the users with the assistance of the team. The **acceptance test** is a user-directed test of the complete system in a test environment. The purpose is to determine, from the user's perspective, whether all components of the new system are satisfactory. The user tests the adequacy of the system, both manual and automated components; of the manuals and other documentation; and of the training the users received. Finally, the **operations test** or

environmental test runs a subset of the system in the actual production environment. This final test determines whether new equipment and other factors in the environment—such as data entry areas, document and report deliveries, telephones, and electricity—are satisfactory.

As noted earlier, enterprise systems are often implemented using a direct (Big Bang) approach. Successful implementations often involve extensive testing. For example, before implementing SAP at Lucent Technologies, Inc., more than 70 business users tested the system for six months. At the Gillette Company, 150 workers ran test transactions for four months.

Obtain Approvals

The project completion report—the systems implementation deliverable—is approved as follows:

• Users verify that the system, including the user manual, meets their requirements. Users also approve conversion and training plans to confirm that these plans are adequate.

• IT confirms that the system has been completed and that it works. IT also approves the training and conversion plans. Finally, IT performs a technical review of the system to determine that acceptable design and programming standards have been applied.

• Management reviews the systems performance objectives, cost, and projected benefits to ensure that implementation is consistent with the best interests of the organization.

• IT audit compares test results with the original system requirements and specifications to determine that the system has been tested and will operate satisfactorily. IT audit is also interested in the adequacy of controls within the system and the controls identified for the conversion process.

Conduct Conversion

After all previous design steps have been completed and signed off, the organization carefully converts to the new system. Conversion includes converting data, converting processes (i.e., the programs), and completing documentation. Controls must be in place to ensure accurate, complete, and authorized conversion of data and programs. As existing data are mapped into the new system, exception reporting situations must be devised to ensure that data are converted accurately. Users must suggest control totals that can be used to test completeness and accuracy of data conversion. For example, the total number of inventory items, the total on-hand quantity for all inventory items, or a hash total (described in Unit 9) of inventory
item numbers might be used as totals.

Both manual and computer-based processes must be converted. Conversion to new computer programs must be undertaken using program change controls (described in Unit 8) to ensure that only authorized, tested, and approved versions of programs are promoted to production status. The systems development project team now writes the project completion report, the final step in the implementation process. This report includes a summary of conversion activities and information with which to operate and maintain the new system. **Systems Operation**

An organization should periodically examine the system in its production environment to determine whether the system is continuing to satisfy users' needs. If it is possible to make the system work better, its value to users will increase. There are three different types of periodic examination:

1. The post-implementation review is conducted to follow up a system's recent implementation. This review is analogous to a follow-up examination that a doctor might perform after an operation.
2. Systems maintenance, performed in response to a specific request, is conducted if the system has a relatively minor deficiency. This examination is similar to one a doctor performs on sick people.
3. The periodic systems survey is undertaken whenever it is likely that the costs of the review will be less than the value of the improvements that the review will suggest. This re-evaluation is like a periodic physical examination.

The Post-Implementation Review

The **post-implementation review** is an examination of a working information system, conducted soon after that system's implementation. The post-implementation review determines whether the user's requirements have been satisfied and whether the development effort was efficient and conducted in accordance with the organization's systems development standards. The post implementation review should be brief and inexpensive.

Examinations conducted in response to a specific deficiency, systems maintenance, are discussed in the next section.

Post-implementation review goals are as follows:

• Determine whether users are satisfied with the new system.
• Identify the degree of correspondence between system performance requirements and the system's achieved performance.
• Evaluate the quality of the new system's documentation, training programs, and data conversions.
• Review the performance of the new system and, if necessary, recommend improvements.
• Ascertain that the organization's project management framework and SDLC were followed during development.
• Perfect the cost/effectiveness analysis process by reviewing cost projections and benefit estimations and determining the degree to which these were achieved.
• Perfect project planning procedures by examining total project costs and the project team's ability to adhere to project cost estimates and schedules.
• Make any other recommendations that might improve the operation of the system or the development of other information systems.

Consultants, IT auditors, or systems analysts (other than those who developed the system) may conduct the post-implementation review. The post-implementation review is performed as soon as the system is operating at full capacity, which could be a month or a year after implementation. The review should examine a fully functioning system so as not to draw erroneous conclusions about system performance. The review should be conducted soon enough after implementation to be able to take advantage of any improvements that can be made to the system or to the systems development methods used.

Systems Maintenance

Systems maintenance is the modification (e.g., repair, correction, enhancement) of existing applications. Systems maintenance expenditures can account for 50 to 70 percent of the total cost of a system over its total life cycle. For example, 80 percent of the total cost of software is in maintenance.12 Not all maintenance expense is necessarily bad; rather, the issue is the relative amount spent on systems maintenance. After all, applications must be adapted to a changing environment and improved over time.

Organizations often adopt the following procedures and controls for their systems maintenance process:

• Because systems maintenance is like miniature systems development, it should include analysis, cost/benefit study, design, implementation, and approvals for each development step. In systems maintenance, certain SDLC procedures deserve more attention than others. For example, changes must be tested prior to implementation to determine that a change corrects the problem and does not cause other problems. Participants and signoffs should be the same as those required for systems development. For example, users should review system changes.

• By charging users for maintenance costs, an organization can reduce the submission of frivolous maintenance requests.

• By adopting a formal procedure for submitting change requests, batching these requests together for each application, and then prioritizing the batches, management can gain control of systems maintenance and reduce the expense and disruptions caused by maintenance.

• During systems maintenance, information should be gathered that provides feedback to improve the operation of the system and to improve the systems development process. For instance, poor quality application documentation and inadequate user training can cause numerous systems maintenance requests. Correcting these deficiencies can preclude the need for similar maintenance requests in the future. Likewise, improvements in the systems development process can prevent deficiencies from occurring in other systems when they are being developed.

• Management should see that program change controls (see Unit 8) are used to ensure that all modifications to computer programs are authorized, tested, and properly implemented.

• High-quality documentation must be created and maintained. Without current, accurate documentation, maintenance programmers cannot understand existing programs, and therefore cannot effectively or efficiently modify them.

Conclusions

Systems selection is a process that is central to the success of systems development. Recall that the first objective of systems development is "to develop information systems that satisfy an organization's informational and operational needs." For this reason, one key to the success of systems development is to ensure that systems selection criteria are based on user requirements (i.e., the logical specifications and physical requirements) developed during the systems analysis phase of systems development.

Another key to systems development success is the full evaluation of available software and hardware resources. As the quantity of resources has grown, it has become more difficult to identify and evaluate all available resources. On the other hand, the Internet has made available to us large quantities of up-to-date, independent information to assist in the selection process. Indeed, as noted earlier in the unit, we can see product demos or actually conduct tests at many vendor Web sites. Finally, the success of systems development projects is found in the details. It may be such things as user manuals, training, and implementation schedules and plans that determine the success of the new or modified system.

There may be, however, another twist on the cause-and-effect relationship between successful completion of systems development steps and the achievement of the systems development objectives. At the time we have implemented a system and conducted the post implementation review, we might measure the development process as successful. That is, we have delivered a system that meets most of the user requirements, we have implemented the system on time and within budget, and there don’t seem to be any bugs. These are all short-term measures.

The ideas presented here are derived from Ed Yourdon, “Long- Term Thinking,” Computerworld (October 16, 2000): 50. It is not until we conduct systems maintenance that we discover that the system has some long-term faults. It may not be, for example, flexible, scalable, reliable, or maintainable. These faults are what drive up the life cycle cost of the system, that cause maintenance costs to be 50 to 70 percent of the long-term costs. The solution is to incorporate the long-term requirements (e.g., flexibility, maintainability) into the initial user requirements and to measure the success of the implementation over the long run, rather than at the time of implementation.

REVIEW QUESTIONS

1. What are the goals of system selection?
2. Discuss about the Intermediate Steps in Structured Systems Design.
3. Describe the purpose of the Post-Implementation Review.
4. Discuss about the purpose and process of system maintenance.
5. Describe the goal of system Implementation.

FURTHER READINGS

- Information System Tecnology- Ross Malaga
- Information System Today-Leonard Jessup
- An Illustrated Information Technology-Alan Witchcomb
- Information Technology For Management Henry C.Lucas
- Information Technology in Business Management Dr. Mukesh Dhunna, J.B. Dixit

UNIT-8 IT GOVERNANCE

CONTENTS

Why Do We Need Control?

This unit explores the strategies used to control the processes of a business organization. Recall from Unit 1 that business organizations are composed of three major components: the management process, the operations process, and the information process. This unit concentrates on controlling the entire business process (i.e., the combined management, operations, and information processes).

It is management's responsibility to exercise control over the business process. The major reasons for exercising this control are (1) to provide reasonable assurance that the goals of each process are being achieved, (2) to mitigate the risk that the enterprise will be exposed to some type of harm, danger, or loss (including loss caused by fraud, natural disasters, and terrorist attacks, or other intentional and unintentional acts), and (3) to provide reasonable assurance that certain legal obligations, such as accurate financial reporting, are being met. The sections that follow address all of these reasons.

Corporate Governance

Picture yourself as the manager of customer sales and service at one of the insurance companies located in the World Trade Center. It is the afternoon of September 11. You are OK and have made your way across the Hudson River to New Jersey. Let's say that you have been able to contact your family and friends and they are all OK. Now you want to reestablish customer services for your company; to provide customers with information about their coverage and to process claims. To do so you need an office, phones, computers, internal and external data networks, customer data, and customer service personnel.

Without the control processes that ordinarily exist, could you accomplish your objective of providing timely customer service?

Perhaps; perhaps not. While we can argue that process objectives might be achieved in the absence of control, the primary reason for control is to help ensure that process goals are achieved. For example, you might be able to buy the infrastructure necessary to resume operations. But, unless you had a business continuity plan in place, you might not be able to locate key customer service personnel and restore your customer data. Thus, you may have a low probability of resuming operations in a timely manner. Now assume that you are an employee (probably a former employee) at Enron. You were well paid and your retirement was secured with Enron stock. Now, after the bankruptcy declaration and resulting layoffs, you have no job and no financial assets. How did this happen? How could it have been prevented? Why didn't Sherron Watkins' memo result in changes to the accounting practices at Enron? Did Enron management really believe that these accounting practices would accomplish long- and short-run Enron objectives? Why did Andersen employees shred documents? Again, internal control can provide the mechanisms to develop and achieve
objectives.

The Committee of Sponsoring Organizations (COSO) of the Treadway Commission (National Commission on Fraudulent Financial Reporting) published a highly cited framework for internal control to help companies design effective control strategies. It says that "to effect control, there need to be predetermined objectives. Without objectives, control has no meaning (emphasis added)." The COSO report also states that control "involves influencing someone and/or something—such as an entity's personnel, a business unit or an entire enterprise—with the purpose of moving toward the objectives."1 In support of this point, a survey of 300 executives working for major companies based in the United States reported that executives who believed that their companies had strong internal control systems also believed that their companies were more likely to be successful in achieving corporate objectives, that their company's return on equity had increased over the past three years, and that their company had been more profitable than its competitors.

Rather than express the purpose of control in terms of the good to be achieved, we can also state its purpose in terms of the bad to be avoided. For instance, in our WTC illustration, is there a risk of not being able to resume operations in the long run? Yes! Therefore, a second reason for controlling systems is to lessen the risk that unwanted outcomes will occur. We define **risk** as the possibility that an event or action will cause an organization to fail to meet its objectives (or goals). Organizations must identify and assess the risk that untoward events or actions will occur and then reduce the possibility that those events or actions will occur by designing and implementing systems of control.

Internal control has recently become more important because of the emphasis placed by shareholders on corporate governance, demands placed on boards of directors and executives to implement and demonstrate control over business processes. The events at Enron, and later WorldCom and others, will make this even more important.

Enterprise systems help provide this control, because they can support global, comprehensive, and integrated information sharing. In a recent example, Boston Scientific uncovered fraudulent sales records in its Japan office soon after SAP, an enterprise system, was installed. The ability to track sales globally triggered a closer look at unusual sales return patterns in the Japanese operations. At
least one high-ranking corporate officer resigned as a result of this $70 million loss.

Executives, in turn, must implement and demonstrate governance of IT operations. Indeed, technology often represents a major portion of an organization's costs. On the other hand, without that technology an organization could not perform important operational processes, make decisions, or survive. In both cases—corporate and IT governance—frameworks for control, such as those introduced here and expanded upon throughout this text, will be key elements in this governance process. The events of September 11 forced all organizations to look more carefully at the strategies they had in place to recover from terrorist attacks and other such events. The Enron debacle will drive additional changes in the controls over the financial reporting process.

Let's now examine a few of the added challenges that management must address when the organization is engaged in e-business. Organizations engaged in e-business must protect the privacy of any information that they may gather from their customers. They must install controls to provide assurance that their privacy-related practices comply with state and federal laws. Also, customers may choose to not do business with merchants that do not protect customer data consistent with their stated policies.

Fraud and Its Relationship to Control

Was the scandal at Enron the result of fraud, or poor—perhaps unethical—management practices? In this section, we discuss management fraud, computer fraud, and computer abuse. Let's begin by defining **fraud** as a deliberate act or untruth intended to obtain unfair or unlawful gain. Management's legal responsibility to prevent fraud and other irregularities is implied by laws such as the Foreign Corrupt Practices Act,3 which states "a fundamental aspect of management's stewardship responsibility is to provide shareholders with reasonable assurance that the business is adequately controlled." Instances of fraud undermine management's ability to convince the various authorities that it is upholding its stewardship responsibility.

Why are Congress, the financial community, and others so impassioned about the subject of fraud? In some highly publicized business failures that caught people completely by surprise, financial statements showed businesses that were prospering. Tinkering with the financial statements, as at Enron, causes hardship or failure for many firms and individuals.

Let's examine some fraud-related problems that management must address when the organization is engaged in e-business. First, an organization that receives payment via credit card, where the credit card is not present during the transaction (e.g., sales via telephone or Web site), absorbs the loss if a transaction is fraudulent. To prevent this, the organization may install controls, such as antifraud software. Some banks will drop merchants who have unacceptably high fraud rates.

The proliferation of computers in business organizations has created expanded opportunities for criminal infiltration. Computers have been used to commit a wide variety of crimes, including fraud, larceny, and embezzlement. In general, these types of computer related crimes have been referred to as computer fraud, computer abuse, or computer crime.

describes some of the better-known techniques used to commit computer fraud or to damage computer resources. Be aware of two things: insiders commit the majority of computer crimes, and the methods listed in the summary are by no means exhaustive. For instance, two abuses not shown in Technology Insight 8.1 that typically are perpetrated by someone outside the organization are computer hacking and computer viruses. Technology Insight 8.2 (page 247) has a brief explanation of computer viruses. Both of these computer crimes, spreading viruses and hacking, are a major concern to organizations engaged in e-business because they affect the actual and perceived reliability and integrity of their electronic infrastructure.

Here are three important facts to remember. First, those who have authorized access to the targeted computer perpetrate the majority of malicious acts. Second, it has been estimated that losses due to accidental, nonmalicious acts far exceed those caused by willful, intentional misdeeds. Third, the manipulation of events (i.e., adding, changing, or deleting of events) is one frequently employed method of committing computer fraud. The most cost-effective method for minimizing simple, innocent errors and omissions as well as acts of intentional computer crimes and fraud is to apply normal controls within existing systems conscientiously.

Review Question

What are the relationships between fraud, in general, and internal control? Between computer fraud, in particular, and internal control?

Defining Internal Control

In the preceding sections, we discussed the importance of an organization achieving an adequate level of internal control. But what do we mean by internal control? The COSO report mentioned earlier in the unit emphasizes that internal control is a process.4 A **process** is a series of actions or operations leading to a particular and usually desirable result. Results could be effective internal control, or a specified output for a particular market or customer. The idea of process is important to our understanding of internal control and business processes in modern organizations. Armed with this perspective, let's proceed to a working definition of internal control to use throughout the text.

The COSO definition of internal control has become widely accepted and the basis for definitions of control adopted for other international control frameworks: Internal control is a process— affected by an entity's board of directors, management, and other personnel—designed to provide reasonable assurance regarding the achievement of objectives in the following categories:

• Effectiveness and efficiency of operations
• Reliability of financial reporting

• Compliance with applicable laws and regulations

Internal Control—Integrated Framework—Framework Volume (New York, NY: The Committee of Sponsoring Organizations of the Treadway Commission, 1992): 9, 12 and 14. Our working definition of control, presented in the next section, classifies control goals into two broad groups only—those for the operations process and those for the information process. Our two groupings roughly parallel the first two COSO categories. In our control framework and control matrices in this and later units, we include COSO's third category—compliance with applicable laws, regulations, and contractual agreements—as one of the control goals of the operations processes.

A Working Definition of Internal Control

Internal control is a system of integrated elements—people, structure, processes, and procedures—acting together to provide reasonable assurance that an organization achieves its business process goals. The design and operation of the internal control system is the responsibility of top management and therefore should:

• Reflect management's careful assessment of risks.

• Be based on management's evaluation of costs versus benefits.

• Be built on management's strong sense of business ethics and personal integrity.

Before discussing two key elements of the definition, which we call control goals and control plans, let's pause to examine the underpinnings of the system—namely, its ethical foundation. As you read this section, consider the events that unfolded at Enron.

Ethical Considerations and the Control Environment

COSO places integrity and ethical values at the heart of what it calls the control environment. In arguing the importance of integrity and ethics, COSO makes the case that the best designed control systems are subject to failure caused by human error, faulty judgment, circumvention through collusion, and management override of the system. COSO goes on to state that:

Ethical behavior and management integrity are a product of the "corporate culture." Corporate culture includes ethical and behavioral standards, how they are communicated and how they are reinforced in practice. Official policies specify what management wants to happen. Corporate culture determines what actually happens, and which rules are obeyed, bent or ignored.5

Management is responsible for internal control and can respond to this requirement legalistically or by creating a "control environment." That is, management can follow the "letter of the law" (its form), or it can respond substantively to the need for control. The **control environment** reflects the organization's (primarily the board of directors' and management's) general awareness of and commitment to the importance of control throughout the organization. In other words, by setting the example and by addressing the need for control at the top of the organization, management can make an organization control conscious.

For example, reward systems might consider ethical, legal, and social performance, as well as the bottom line. Strategies should be developed so as not to create conflicts between business performance and legal requirements. Management should consistently find it unacceptable for personnel to circumvent the organization's system of controls and, as importantly, should impose stiff sanctions for such unacceptable behavior. These actions are included in what some call the "tone at the top" of the organization. Some question whether the large campaign contributions made by Enron and its executives set the proper tone at the top of that organization.

A number of companies have articulated the ethical behaviour expected of employees in a very tangible way by developing corporate codes of conduct that are periodically acknowledged (i.e., signed) by employees. The codes often address such matters as illegal or improper payments, conflicts of interest, insider trading, computer ethics, and software piracy.

Business Process Control Goals and Control Plans

Our working definition of internal control describes it in the broad sense of both selecting the ends to be attained (control goals) and specifying the means to ensure that the goals are attained (control plans). Control also extends to the processes of reviewing a system periodically to ensure that the goals of the system are being achieved, and to taking remedial action (if necessary) to correct any deficiencies in the system (i.e., monitoring). Control is concerned with discovering courses of action that contribute to the general welfare of the business organization and with ensuring that the implementation of these action s produces the desired effects.

Control goals are business process objectives that an internal control system is designed to achieve. Table provides an overview of the generic control goals of the operations process and of the information process. To illustrate our discussion we use a cash receipts process.

Control Goals of the Operations Process

The first control goal, ensure effectiveness of operations, strives to ensure that a given operations process (e.g., our cash receipts process) is fulfilling the purpose for which it was intended. Notice that we must itemize the specific operations process goals. These goals are specific to each organization and no uniform set of operations goals exists. In each of the business process units, we provide a representative listing of operations process goals. As mentioned earlier in the unit, we also include compliance with applicable laws, regulations, and contractual agreements (i.e., COSO's third category of entity objectives) as one of the goals of each operations process to which such laws, regulations, or agreements might be appropriate. For instance, compliance with the Robinson/Patman Act is shown as a legitimate goal of the order entry/sales process in Unit 10.

The next goal, ensure efficient employment of resources, can be evaluated in only a relative sense. For example, let's assume that one goal is to deposit all cash on the day received. To determine efficiency we would need to know the cost of the people and computer equipment required to accomplish this goal. If the cost is more than the benefits obtained (e.g., security of the cash, interest earned), the system might be considered inefficient. Likewise, if our system costs more to operate than a system in a similar organization, we would judge the system to be inefficient.

Let's now discuss the last operations process control goal in Table 8.1, to ensure security of resources. As noted in the table, resources take many forms, both physical and nonphysical.

Information has become a key resource of most organizations. For example, the information about our customers (as stored in the accounts receivable master data) is very valuable for this company. An organization must protect all of its resources, both tangible and intangible.

Control Goals of the Information Process

A glance at Table 8.1 reveals that the first three control goals of the information process deal with entering event-related data into a system. Recall from Unit 1 that data input includes capturing data (for example, completing a source document such as a sales order, or, in the case of a cash receipts system, writing the check number and amount on the RA). Data input also includes, if necessary, converting the data to machine-readable form (for example, keying in the remittance advices to add events to the cash receipts events data). Therefore, events data are the subjects of the input control goals shown in Table 8.1. These three control goals trigger the following questions: "Did the event occur?" (input validity); "Is there a record of each event?" (input completeness); and "Is the record correct?" (input accuracy). Thinking about these control categories in this way may help you to identify controls that provide adequate coverage across all the categories.

To illustrate the importance of achieving the first goal, ensure input validity, assume that our accounts receivable clerk processes a batch of 50 cash receipts (including their payment stubs, or RAs). Further assume that two of the 50 RAs represent fictitious cash receipts (for example, a mailroom employee fabricates phony remittance advices for relatives who are customers). What is the effect of processing the 50 RAs including the 2 fictitious remittances? First, the cash receipts event data and the accounts receivable master data each have been corrupted by the addition of two bogus RAs. Second, if not detected and corrected, the pollution of these data will result in unreliable financial statements—overstated cash and understated accounts receivable—and other erroneous system outputs (e.g., cash receipts listings, customer monthly statements).

To discuss the second information process goal, ensure input completeness, let's return to the previous example and suppose that, while the 48 valid RAs are being key entered (we'll ignore the two fictitious receipts in this example), the accounts receivable clerk decides to get a cup of coffee. As the clerk walks past the batch of 48 RAs, 10 are blown to the floor and are not entered into the system. What is the effect of processing 38 RAs, rather than the original 48? First, the cash receipts transaction data will be incomplete; that is, it will fail to reflect the true number of remittance events. Second, the incompleteness of the data will cause the resulting financial statements and other reports to be unreliable (i.e., understated cash balance and overstated accounts receivable). In this example, the omission was unintentional. Likewise, fraudulent, intentional misstatements of organizational data can be accomplished by omitting some events.

When dealing with input completeness, we are concerned with the existence of documents or records representing an event or object, not the correctness or accuracy of the document or record. Accuracy issues are addressed by the third information process goal, ensure input accuracy. This goal relates to the various data fields that usually constitute a record of an event, such as a source document. To achieve this goal, we must minimize discrepancies between data items entered into a system and the economic events or objects they represent. Mathematical mistakes and the inaccurate transcription of data from one document or medium to another may cause accuracy errors. Again, let's return to our example. Suppose that one of the valid RAs is from Acme Company, customer 159, in the amount of $125. The accounts receivable clerk mistakenly enters the customer number as 195, resulting in Ajax, Inc.'s account (rather than Acme's) being credited with the $125.

Missing data fields on a source document or computer screen represent another type of accuracy error. For example, the absence of a customer number on a remittance advice would result in "unapplied" cash receipts (that is, receipts that can't be credited to a particular customer). We consider this type of system malfunction to be an accuracy error rather than a completeness error, because the mere presence of the source document suggests that the event itself has been captured and that the input data are, by our definition, therefore complete.

Now let's examine the last two information process control goals shown in Table 8.1. These goals deal with updating master data. As we learned in Unit 1, master data update is an information processing activity whose function is to incorporate new data into existing master data. We also learned that there are two types of updates that can be made to master data: information processing and data maintenance. In this textbook, we emphasize information processing; therefore, our analysis of the internal controls related to data updates is restricted to data updates from information processing.

In our cash receipts system, the goal of update completeness relates to crediting customer balances in the accounts receivable master data for all cash collections recorded in the cash receipts event data. The goal of ensure update accuracy relates to correctly crediting (e.g., correct customer, correct amount) customer balances in the accounts receivable master data.

Once valid data have been completely and accurately entered into a computer (i.e., added to event data such as our cash receipts event data), the data usually go through a series of processing steps. Several things can go wrong with the data once they have been entered into a computer for processing. Accordingly, the goals of update completeness and accuracy are aimed at minimizing processing errors. We should note, however, that if the events are processed using an online real-time processing system such as the one depicted in Figure 4.3 (page 114), the input and update will occur nearly simultaneously. This will minimize the possibility that the update will be incomplete or inaccurate.

Explain the difference between the following pairs of control goals: (1) ensure effectiveness of operations and ensure efficient employment of resources; (2) ensure efficient employment of resources and ensure security of resources; (3) ensure input validity and ensure input accuracy; (4) ensure input completeness and ensure input accuracy; (5) ensure input completeness and ensure update completeness; and (6) ensure input accuracy and ensure update accuracy.

Control Plans

Control plans are information processing policies and procedures that assist in accomplishing control goals. Control plans can be classified in a number of different ways that help us to understand them. A control hierarchy that relates control plans to the control environment, defined earlier. The fact that the control environment appears at the top of the hierarchy illustrates that the control environment comprises a multitude of factors that can either reinforce or mitigate the effectiveness of the pervasive and process control plans.

The second level control hierarchy consists of pervasive control plans. **Pervasive control plans** relate to a multitude of goals and processes. Like the control environment, they provide a climate or set of surrounding conditions in which the various business processes operate. They are broad in scope and apply equally to all business processes—hence, they pervade all systems. For example, preventing unauthorized access to the computer system would protect all of the specific business processes that run on the computer (such as sales and marketing, billing, "purchase-to-pay," business reporting, and so on). We discuss a major subset of these pervasive controls—IT processes (i.e., controls)—later in this unit.

Process control plans are those controls particular to a specific process or subsystem, such as inventory or human resources, or to a particular mode of processing events, such as online or batch. Process control plans are the subject of the control framework Another useful and common way to classify controls is in relation to the timing of their occurrence. **Preventive control plans** stop problems from occurring. **Detective control plans** discover that problems have occurred. **Corrective control plans** rectify problems that have occurred. Let's use the WTC tragedy to illustrate. By operating two computer processing sites—one primary and one

mirror site—companies located in the WTC could prevent the loss of their computer processing capabilities and the data and programs stored on the computers located in the WTC (i.e., duplicate copies would reside at the mirror site). Smoke and fire detectors could detect fires in the building that inevitably lead to the loss of processing capabilities. Other monitoring devices could detect the loss of phones, data communications, and processing capabilities. These devices, operating at an organization's facilities outside the WTC area, could have alerted company personnel to the loss of resources in the area of the WTC. Also, organizations can subscribe to services that will provide notification in the event of disaster. Finally, backup copies of programs and data could have been loaded onto computers at sites outside the WTC area to reinstate computer processing and related services. These are corrective controls because they replace data and services that were lost.

Introduction to Pervasive Controls

We begin our discussion of pervasive controls by introducing four broad IT control process domains and explain how IT control processes are directed at the control of IT resources and the attainment of the information qualities. Exhibit 8.1 defines IT resources that must be managed by the control processes. According to COBIT these IT resources must be managed to ensure that the organization has the information that it needs to achieve its objectives.7 COBIT also describes the qualities that this information must exhibit in order for it to be of value to the organization.

We must determine how we can protect an organization's computer from misuse, intentional or inadvertent, from within and from outside the organization. Pervasive controls are directed at answering the following questions. How can we protect the computer room, the headquarters building, and the rooms and buildings in which other connected facilities are located? In the event of a disaster, will we be able to continue our operations? What policies and procedures can be established (and documented) to provide for efficient, effective, and authorized use of the computer? What measures can we take to help ensure that the personnel who operate and use the computer are competent and honest? An organization's **Information Systems function (ISF)** is the department that develops and operates an organization's Information System. The function (department) is composed of people, procedures, and equipment. This function is the object of many of the IT controls and its management, at the same time, is responsible for the implementation and operation of these processes.

Before we move on to a discussion of the ten IT control processes, let's discuss the concept of a control process. A "control process" could easily be, and often is referred to as, a "management practice." This latter terminology emphasizes management's responsibility for control in the organization and the practices, or processes, which will bring about achievement of an organization's objectives. It is through a coordinated effort, across all IT resources and all organizational units, that the objectives of the organization are achieved.

Planning and Organization Domain

Within the planning and organization domain are processes to develop the strategy and tactics for an organization's information technology. The overriding goal of these processes is to identify ways that IT can best contribute to the achievement of the organization's objectives. Then, management must communicate that strategic vision to interested parties (within and outside the organization) and put in place the IT organization and technology infrastructure that enables that vision. These processes must identify and address external threats and internal and external requirements,

and take advantage of opportunities for strategic implementation of emerging information technology.

IT Process 1: Establish Strategic Vision for Information Technology

To strike an optimal balance of IT opportunities and business requirements, management of the information systems function should adopt a process for developing a strategic plan for all of the organization's IT resources, and for converting that plan into short term goals. The information systems strategic planning effort must ensure that the organization's strategic plan is supported and that IT is used to the best advantage of the organization. An organization wants to be sure that the ISF is prepared to anticipate the competition's actions and to take advantage of emerging IT. An organization must establish links between organizational and information systems strategic planning to ensure that strategies plotted in the organizational plan receive the IT support they need. Elements of the strategic plan can help the organization achieve important enterprise systems, e-business, and technology objectives. For example, plans for any new lines of business, such as Internet ordering and payment, or changes in business processes, resulting from changes to an enterprise system, will require new data and new relationships among the data. These data elements and relationships must be incorporated into the organization's information architecture model. The plan must also include processes to review IT capabilities to ensure that there is adequate technology to perform the IS function and to take advantage of emerging technology.

Finally, the plan must contain procedures that ensure compliance with laws and regulations, especially those related to e-business (e.g., privacy, transborder data flows).

IT Process 2: Develop Tactics to Plan, Communicate, And Manage Realization of the Strategic Mission

To ensure adequate funding for IT, controlled disbursement of financial resources, and effective and efficient utilization of IT resources, IT resources must be managed through use of information services capital and operating budgets, by justifying IT expenditures, and by monitoring costs (in light of risks). To ensure the overall effectiveness of the ISF, IS management must establish a direction and related policies addressing such aspects as positive control environment throughout the organization, code of conduct/ethics, quality, and security. Then, these policies must be communicated (internally and externally) to obtain commitment and compliance. IS management's direction and policies must be consistent with the control environment established by the organization's senior management.

To ensure that projects are completed on time and within budget and that projects are undertaken in order of importance, management must establish a project management framework to ensure that project selection is in line with plans and that a project management methodology is applied to each project undertaken.

Management should establish a quality assurance (QA) plan and implement related activities, including reviews, audits, and inspections, to ensure the attainment of IT customer requirements. A systems development life cycle methodology (SDLC) is an essential component of the QA plan.

To ensure that IT services are delivered in an efficient and effective manner, there must be adequate internal and external IT staff, administrative policies and procedures for all functions (with specific attention to organizational placement, roles and responsibilities, and segregation of duties), and an IT steering committee to determine prioritization of resource use. We divide these controls into two groups: organizational control plans and personnel control plans.

Organizational Control Plans We will concentrate on two organizational control plans: segregation of duties and organizational control plans for the information systems function.

Segregation of duties control plan. The concept underlying segregation of duties is simple enough: Through the design of an appropriate organizational structure, no single employee should be in a position both to perpetrate and conceal frauds, errors, or other kinds of system failures.

Segregation of duties consists of separating the four basic functions of event processing. The functions are:

- Function 1: authorizing events.
- Function 2: executing events.
- Function 3: recording events.
- Function 4: safeguarding resources resulting from consummating events.

A brief scenario should illustrate this concept. John Singletary works in the general office of Small Company. He initiates a sales order and sends the picking ticket to the warehouse, resulting in inventory being shipped to his brother. When Sue Billings sends Singletary the customer invoice for the shipment, he records the sale as he would any sale. Sometime later, he writes his brother's account off as a bad debt. What is the result? Inventory was stolen and

Singletary manipulated the information system to hide the theft. Had other employees been responsible for authorizing and recording the shipment or for the bad debt write-off, Singletary would have had a tougher time manipulating the system.

Table illustrates segregation of duties in a typical system. Examine the top half of the table, which defines the four basic functions. The bottom half of the table extends the coverage of segregation of duties by illustrating the processing of a credit sales event.

Now, let's examine Table 8.2 as a means of better understanding the control notion underlying segregation of duties. Ideal segregation of duties requires that different units (departments) of an organization carry out each of the four phases of event processing. In this way, there would need to be collusion between one or more persons (departments) in order to exploit the system and conceal the abuse. Whenever collusion is necessary to commit a fraud, there is a greater likelihood that the perpetrators will be deterred by the risks associated with pursuing a colluding partner and that they will be caught.

Controls to prevent unauthorized execution of events ensure that only valid events are recorded. Therefore, function 1—authorizing events—takes on particular significance in our segregation of duties model. Control plans for authorizing or approving events empower individuals or machines to initiate events and to approve actions taken subsequently in executing and recording events. Authorization control plans often take the form of policy statements and are implemented by including necessary procedures and process controls within the information system that will process the events. For example, through proper design of the sales order form, an organization can see that credit is granted by including a block on the document that requires the credit manager's signature. Or, a computer-based system can be designed to approve events within some predetermined credit limits. **Digital signatures** on electronic documents also authenticate or authorize requests from external parties, as seen in Technology Excerpt 8.2 (page 260). These procedures receive management authorization when the system is approved during initial development, or when the system is changed.

Organizational control plans for the information systems function. The information systems function normally acts in a service capacity for other operating units in the organization. In this capacity, it should be limited to carrying out function recording events and posting event summaries. Approving and executing events along with safeguarding resources should be carried out by departments other than the ISF. This arrangement allows for effective implementation of segregation of duties. There are situations, however, where the functional divisions we mentioned can be violated. For instance, some ISFs do authorize and execute events; for example, the computer might be programmed to approve customer orders.

Within the ISF, we segregate duties to control unauthorized use of and/or changes to the computer and its stored data and programs. Segregation of duties within the ISF can be accomplished in a number of ways. One method of separating systems development and operations is to prevent programmers from operating the computer; thus reducing the possibilities of unauthorized data input or unauthorized modification of organizational data and programs. Passwords, assigned by an information security specialist, are critical to separating key functions between the ISF and operational units within the ISF.

Personnel Control Plans IT personnel resources must be managed to maximize their contributions to IT processes. Specific attention must be paid to recruitment, promotion, personnel qualifications, training, backup, performance evaluation, job change, and termination. As we discussed earlier in the unit, an organization that does not have honest, competent employees will find it virtually impossible to implement other control plans.

The personnel control plans described in Table help to protect an organization against certain types of risks. As you study each plan, think of the problems that the plan can prevent or the control goal that could be achieved by implementing the plan. Also, consider how much more important these plans are when we consider the impact that they have on systems personnel. Three plans in Table require a little discussion. The control notion underlying rotation of duties and forced vacation is that if an employee is perpetrating some kind of irregularity, it will be detected by his/her substitute. Furthermore, if these plans are in place, they should act as a deterrent to the irregularity ever occurring in the first place (i.e., a preventive control). Beyond the control considerations involved, these two plans also help to mitigate the disruption that might be caused when an employee leaves the organization. When another person is familiar with the job duties of each position, no single employee is irreplaceable.

Finally, rigorous application of personnel termination policies is particularly important in the ISF. Disgruntled employees working in the ISF have the opportunity to cause much damage in a short time. For example, computer operations personnel could erase large databases in a matter of minutes. For this reason, key employees who have access to important program and databases may be asked to leave the facility immediately, and in some cases, company security personnel may escort them from the premises.

Acquisition and Implementation

Within the acquisition and implementation domain are processes to identify, develop or acquire, implement IT solutions, and integrate them into the business processes. Once installed, procedures must also be in place to maintain and manage changes to existing systems. For example, if we do not correctly determine the requirements for a new information system and see that those requirements are satisfied by the new system, the new system could cause us to update the wrong data or perform calculations incorrectly. Or, we may not complete the development on time and within budget. Finally, should we fail to develop proper controls for the new system, we could experience inventory shortages, inaccurate record keeping, or financial loss.

IT Process 3: Identify Automated Solutions

To ensure the selection of the best approach to satisfying users' IT requirements, an organization's Systems Development Life Cycle (SDLC) must include procedures to define information requirements; formulate alternative courses of action; perform technological, economic, and operational feasibility studies; and assess risks. These solutions should be consistent with the strategic information technology plan and the technology infrastructure and information architecture contained therein.

IT Process 4: Develop and Acquire IT Solutions

Once IT solutions have been identified and approval to proceed has been received, development—and/or appropriate acquisition—of the application software, infrastructure, and procedures may begin. To ensure that applications will satisfy users' IT requirements, an organization's SDLC should include procedures to create design specifications for each new, or significantly modified, application, and to verify those specifications against the user requirements. Design specifications include those for inputs, outputs, processes, programs, and databases.

The SDLC should also include procedures to ensure that platforms (hardware and systems software) support the new or modified application. Further, there should be an assessment of the impact of new hardware and software on the performance of the overall system. Finally, procedures should be in place to ensure that hardware and systems software are installed, maintained, and changed so as to continue to support existing or revised business processes.

To ensure the ongoing, effective use of IT, the organization's SDLC should provide for the preparation and maintenance of service level requirements and application documentation. Service level requirements include such items as availability, reliability, performance, capacity for growth, levels of user support, disaster recovery, security, minimal system functionality, and service charges. These requirements become benchmarks for the ongoing operation of the system. As IT organizations become larger and more complex, especially those that must implement and operate enterprise systems, these service level requirements become important methods for communicating the expectations of the business units for IT services. Further, if the organization is engaged in e-business these service levels are benchmarks for service on a Web site or to and from business partners engaged in electronic commerce.

IT Process 5: Integrate IT Solutions into Operational Processes

To ensure that a new or significantly revised system is suitable, the organization's SDLC should provide for a planned, tested, controlled, and approved conversion to the new system. After installation, the SDLC should call for a review to determine that the new system has met users' needs in a cost-effective manner. When organizations implement enterprise systems, the successful integration of new information systems modules into existing, highly integrated, business processes becomes more difficult, and more important. The challenges are the result of the interdependence of the business processes and the complexity of these processes and their connections. Any failure in a new system can have catastrophic results.

IT Process 6: Manage Changes to Existing IT Systems

To ensure processing integrity between versions of systems and to ensure consistency of results from period to period, changes to the IT infrastructure (hardware, systems software, and applications) must be managed via change request, impact assessment, documentation, authorization, release and distribution policies, and procedures.

Program change controls provide assurance that all modifications to programs are authorized, and ensure that the changes are completed, tested, and properly implemented. Changes in documentation should mirror the changes made to the related programs. Figure 8.3 (page 264) depicts the stages through which programs should progress to ensure that only authorized and tested programs are placed in production, which means that the programs are in use by the organization in the conduct of business. Notice that separate organizational entities are responsible for each stage in the change process. These controls take on an even higher level of significance with enterprise systems. Should unauthorized or untested changes be made to such systems, the results can be disastrous. For example, let's say that a change is made to the inventory module of an enterprise system without testing to see the impact that change will have on the sales module used to enter customer orders. Since these two modules work together, and orders from customers for inventory cannot be processed without the inventory module, changes to either module must be carefully planned and executed.

Delivery and Support

Within the delivery and support domain are processes to deliver required IT services, ensure security and continuity of services, set up support services, including training, and ensure integrity of application data. Failure of these processes can result in computing resources being lost or destroyed, becoming unavailable for use, or leading to unauthorized use of computing resources.

IT Process 7: Deliver Required IT Services

This process includes activities related to the delivery of the IT services that were planned by the IT processes in the planning and organization domain, and developed and implemented by the IT processes in the acquisition and implementation domain. Table 8.4 describes some of the key service-delivery activities.

IT Process 8: Ensure Security and Continuous Service

The IS function must see that IT services continue to be provided at the levels expected by the users. To do so, they must provide a secure operating environment for IT and plan for increases in required capacity and potential losses of usable resources. To ensure that sufficient IT resources remain available, management should establish a process to monitor the capacity and performance of all IT resources. For example, the actual activity on an organization's Web site must be measured and additional capacity added as needed. To ensure that IT assets are not lost, altered, or used without authorization, management should establish a process to account for all IT components, including applications, technology, and facilities, and to prevent use of unauthorized assets. To ensure that IT resources remains available, processes should be in place to identify, track, and resolve in a timely manner problems and incidents that occur. Three important aspects of the IT processes designed to address these issues are discussed below: ensuring continuous service, restricting access to computing resources, and ensuring physical security.

Ensure Continuous Service To ensure that sufficient IT resources continue to be available for use in the event of a service disruption, management should establish a process, coordinated with the overall business continuity strategy, that includes disaster recovery/contingency planning for all IT resources and related business resources, both internal and external. These control plans are directed at potential calamitous losses of resources or disruptions of operations—for both the organization and its business partners. Catastrophic events, such as those experienced on September 11, 2001, have resulted in a heightened awareness of the importance of these controls. The types of backup and recovery covered in this section have been referred to in a variety of ways, including but not limited to: **disaster recovery planning, contingency planning, business interruption planning,** and **business continuity planning.** Regardless of the label, these controls must include a heavy dose of pre-loss planning that will reasonably ensure post-loss recovery. Before we go further, let us note that contingency planning extends much beyond the mere backup and recovery of stored computer data, programs, and documentation. The planning involves procedures for backing up the physical computer facilities, computer, and other equipment (such as communications equipment—a vital resource in the event of a catastrophe), supplies, and personnel. Furthermore, planning reaches beyond the IS function to provide backup for these same resources residing in operational business units of the organization. Finally, the plan may extend beyond the organization for key resources provided by third parties. You might also note that the current thinking is that we plan contingencies for important processes rather than individual resources. So, we develop a contingency plan for our Internet presence, rather than for our Web servers, networks, and other related resources that enable that presence.

Numerous disaster backup and recovery strategies may be included in an organization's contingency plan. Some industries require instant recovery and must incur the cost of maintaining two or more sites. One such option is to run two processing sites, a primary and a **mirror site** that maintains copies of the primary site's programs and data. During normal processing activities, master data is updated at both the primary and mirror sites. Located miles away from the primary site, the mirror site can take over in seconds if the primary site goes down. Mirror sites are very popular with airline and e-business organizations because they need to keep their systems and Internet commerce sites online at all times. **Server clustering** can also be used to disperse processing load among servers so that if one server fails, another can take over.8 These clustered servers are essentially mirror sites for each other.

Here is one example of the importance of these contingency processes to e-business. In June 1999 the Web site for eBay, Inc., the online auctioneer, was unavailable for 22 hours. This downtime caused eBay to forego $3 to $5 million in fees and some erosion of customer loyalty. This failure spurred eBay to accelerate its plans for a better backup system. George Anders, "eBay To Refund Millions in Listings Fees as Outage Halts Bis for About 22 Hours," The Wall Street Journal (June 4, 1999): B8.

For most companies, maintaining duplicate equipment is simply cost-prohibitive. Therefore, a good control strategy is to make arrangements with hardware vendors, service centers, or others for the standby use of compatible computer equipment. These arrangements are generally of two types—hot sites or cold sites. A **hot site** is a fully equipped data center, often housed in bunker like facilities, that can accommodate many businesses—sometimes up to 100 companies—and that is made available to client companies for a monthly subscriber's fee. Less costly, but obviously less responsive, is a **cold site**. It is a facility usually comprising air conditioned space with a raised floor, telephone connections, and

computer ports, into which a subscriber can move equipment. The disaster recovery contractor or the manufacturer provides the necessary equipment.

Ensuring continuous service in a centralized environment has become fairly straightforward. We know that we need to back up important databases, programs, and documentation, move those backups to recovery sites, and begin processing at that site. However, ISF environments are seldom that centralized; there are usually client-server applications and other distributed applications and connections. For example, a company may be doing business on the Internet and would need to include that application in their continuity plan. Technology Insight 8.3 describes several lessons about ensuring continuous service that were learned as a result of the events of September 11, 2001.

In the spring of 2000, several organizations, including Yahoo!, eBay, CNN.com, and Amazon.com, experienced a serious threat to their ability to ensure continuous service to their customers. The culprit was a relatively new phenomenon, the distributed denial of service attack. Technology Insight describes these attacks and the processes that might be put in place to detect and correct them to ensure that organizations achieve the level of service that they plan. The Yankee Group estimated that the overall cost of these attacks was $1.2 billion. For example, the Yahoo! site was unavailable for three hours, which cost Yahoo! $500,000. Amazon's site was down for an hour, resulting in a likely loss of $240,000.

Restrict Access to Computing Resources Can you believe that 90 percent of the respondents to a survey conducted by the Computer Security Institute (CSI) with the participation of the San Francisco Federal Bureau of Investigation's Computer Intrusion Squad reported security breaches in a recent 12-month period?11 To ensure that organizational information is not subjected to unauthorized use, disclosure, modification, damage, or loss, management should implement logical and physical access controls to assure that access to computing resources—systems, data, and programs—is restricted to authorized users for authorized uses by implementing two types of plans:

1. Control plans that restrict physical access to computer facilities.
2. Control plans that restrict logical access to stored programs, data, and documentation.

Control plans for restricting physical access to computer facilities. Naturally, only authorized personnel should be allowed access to the computer facility. As shown in the top portion of Figure 8.4, control plans for restricting physical access to computer facilities encompass three layers of controls.

Control plans for restricting access to stored programs, data, and documentation. Control plans for restricting access to stored programs, data, and documentation entail a number of techniques aimed at controlling online and offline systems. In an online environment, access control software called the **security module** will ensure that only authorized users gain access to a system and report violation attempts. These steps are depicted in the lower portion of Figure 8.4.

The primary plans for restricting access in an offline environment involve the use of segregation of duties, restriction of access to computer facilities, program change controls, and library controls. The first three plans have been defined and discussed in previous sections. **Library controls** restrict access to data, programs, and documentation. Library controls are provided by a librarian function, a combination of people, procedures, and computer software. Librarian software can keep track of versions of event and master data and ensure that the correct versions of such data are used. The software can also permit appropriate access to development, testing, staging, and production versions of programs.

Ensure Physical Security To protect IT facilities against manmade and natural hazards, the organization must install and regularly review suitable environmental and physical controls. These plans reduce losses caused by a variety of physical, mechanical, and environmental events. Table summarizes some of the more common controls directed at these environmental hazards.

The advanced state of today's hardware technology results in a high degree of equipment reliability. Even if a malfunction does occur, it is usually detected and corrected automatically. In addition to relying on the controls contained within the computer hardware, organizations should perform regular **preventive maintenance** (periodic cleaning, testing, and adjusting of computer equipment) to ensure its continued efficient and correct operation.

IT Process 9: Provide Support Services

To ensure that users make effective use of IT, management should identify the training needs of all personnel, internal and external, who make use of the organization's information services, and should see that timely training sessions are conducted. To use IT resources effectively, users often require advice and may require assistance to overcome problems. This assistance is generally delivered via a "help desk" function.

Monitoring

Within the monitoring domain is a process to assess IT services for quality and to ensure compliance with control requirements. Monitoring may be performed as a self-assessment activity within an organizational unit such as the ISF, by an entity's internal/IT audit group, or by an external organization such as a public accounting or IT consulting firm.

IT Process 10: Monitor Operations

To ensure the achievement of IT process objectives, management should establish a system for defining performance indicators (service levels), gathering performance data, and generating performance reports. Management should review these reports to measure progress toward identified goals. Independent audits or evaluations should be conducted on a regular basis to increase confidence that IT objectives are being achieved, that controls are in place, and to benefit from advice regarding best practices for IT.

Conclusions

Three factors will likely cause managers to confront the issues addressed in this unit much more directly than have their predecessors. First, the events of September 11, 2001, have changed the way we think about the protecting an organization's resources, especially its IT resources, and making them available for use. Second, as computer-based systems become more sophisticated, managers must continually question how such technological changes affect the system of internal controls. For example, some companies have already implemented paperless (totally electronic) Information Systems. Others employ electronic data interchange (EDI) technology, which we introduced in Unit 4. The challenges to managers are to keep pace with the development of such systems, and to ensure that changes in any system are complemented by enhancements in the company's internal controls.

Third, the events associated with the downfall of companies such as Enron Corp. has heightened the concerns of an organization's stakeholders—stockholders, customers, employees, taxpayers, etc.— and has caused them to raise a number of corporate (organizational) governance issues. They are asking, for example, how well their board of directors governs its own performance and that of the organization's management. And, how do the board of directors and management implement and demonstrate that they have control over their business processes? The answers to these questions can be found only in a thorough and effective system of internal control.

REVIEW QUESTIONS

1. Write a detailed note one "Need of IT Governance for better control."
2. Define fraud and its relationship to control.
3. What are control plans? Describe its levels
4. Describe the benefits of corporate governance.
5. Discuss about the Acquisition and Implementation of IT solutions.

FURTHER READINGS

- Information System Tecnology- Ross Malaga
- Information System Today-Leonard Jessup
- An Illustrated Information Technology-Alan Witchcomb
- Information Technology For Management Henry C.Lucas
- Information Technology in Business Management Dr. Mukesh Dhunna, J.B. Dixit

IMPORTANT NOTES

UNIT-9 CONTROLLING INFORMATION SYSTEMS

CONTENTS

Introduction

Having covered the control environment and IT control processes in Unit 8, we are now ready to move to the third level of control plans appearing in the hierarchy shown in Figure 8.2 on page 256— process control plans (the first two were the control environment and pervasive control plans). We begin by defining the components of a control framework and introduce tools used to implement it. Then we apply the control framework to a few generic business processes. These generic processes include process controls that may be found in any information system. Later in the text, in Units 10 through 14, we examine process controls that might be found in particular business processes (e.g., order-to-cash, purchase-to-pay, and so forth).

The Control Framework

In this section, we introduce a control framework specific to the control requirements of the operations process and the information process. We again use the Causeway Company cash receipts system, this time to illustrate the control framework.

The control framework provides a structure for analyzing the internal controls of business organizations. However, structure alone is of little practical value. To make the framework functional, you need to feel comfortable using the tools for implementing the framework. In Unit 2, you saw one of the key tools—the systems flowchart. Now we use the other important tool—the control matrix.

The Control Matrix

The **control matrix** is a tool used to analyze a systems flowchart (and related narrative) to determine the control plans appropriate to that process and to relate those plans to the processes control goals. It establishes criteria to be used in evaluating a particular process. We'll start by taking a look at the four essential elements of the matrix—control goals, recommended control plans, cell entries, and explanations of the cell entries. Then, we'll elaborate on the steps used to prepare the matrix.

Steps in Preparing the Control Matrix

Control goals represent the first element of the matrix. The goals are listed across the top row of the matrix; they should be familiar to you from discussions in Unit 8. Indeed, in Figure 9.1, we have merely tailored the generic goals shown in Table 8.1 (see page 250) to Causeway's cash receipts system. The tailoring involves:

- Identifying operations process goals for a cash receipts process; we include only two examples here—namely,
- Goal A—to accelerate cash flow by promptly depositing cash receipts.
- Goal B—to ensure minimum cash balances are maintained in our depository bank.

Remember that one of the goals of any business process may be compliance with applicable laws, regulations, and contractual agreements. Depending on the particular process being analyzed, we tailor the matrix to identify the specific law, regulation, or agreement with which we desire to achieve compliance. In Causeway's case, we assume that its loan agreements with its bank require that it maintain certain minimum cash balances— known as compensating balances—on deposit. (Other possible goals of a cash receipts process would be shown as goals C, D, and so forth, and would be included at the bottom of the matrix.)

- Listing the resources of interest in this process—namely, Causeway's physical asset, cash, and an information resource, the accounts receivable master data.
- Naming the information process inputs—namely, remittance advices representing cash receipts data.
- Identifying the master data being updated in this system— namely, the accounts receivable master data.

In determining what operations process goals are appropriate for the operations process under review, you may find it helpful to first ask yourself, "What undesirable events might occur?" For example, in deciding on Causeway's operations process goal of accelerating cash flow by promptly depositing cash receipts, we might have first speculated that there was a possibility that the mailroom could delay the processing of incoming payments, the cashier could hold endorsed checks for a time before taking them to the bank, and so forth. Noting these weak points can also be useful in deciding on recommended control plans, discussed next.

Recommended control plans, appropriate to the process being analyzed, represent the second element of the matrix. To illustrate, we list two representative plans for a cash receipts process such as Causeway's in the left column of Figure 9.1. Each of these plans (and others) will be explained in Unit 11. Two other plans listed in Figure 9.1 are identified merely as plans 3 and 4. In the body of the matrix, located at various intersections of goals and plans, are cells. Cells can have entries in them (P-1, P-2, M-1, M-2), or they can be left blank. Entries in cells represent

the third element of the matrix. If a recommended control plan can help to achieve a control goal (i.e., there is a relationship between that plan Gelinas 9-8
and a particular goal), an entry—either a P or an M—should appear in that cell. A corresponding entry (e.g., P-1, M-2) is also made on the systems flowchart for purposes of cross-referencing. We refer to this technique as annotating a systems flowchart. The process of relating the plans listed in the matrix to the point where the plans can be located on the systems flowchart is illustrated in Figure 9.2, the annotated flowchart for Causeway. Take a few moments to trace the codes, P-1, P-2, M-1, and M-2,

From the descriptions of plans P-1 and M-1 do you agree with where we have put them ? If not, check with your instructor.

There are two types of entries that you can register in a cell. You can enter a "P," which indicates that a particular control plan is present in the flowchart. For example, the entries "P- 1" and "P-2" indicate that those plans are present in Causeway's system. A glance at the flowchart in Figure 9.2 shows the location of these plans. Alternatively, you can enter an "M," which signifies that a particular, recommended control plan is missing (for example, entries "M-1" and "M-2" indicate that those plans are not present in Causeway's system). Again, identifies the location of where these desirable, but missing, plans should be installed to control Causeway's cash receipts process more effectively. Because the control plans listed in the first column of the matrix are all recommended plans, entering a "P" in a cell symbolizes a strength in the system. It depicts a control plan as contributing to the accomplishment of one or more control goals. For example, in Figure 9.1, the plan "Immediately endorse incoming checks" helps to ensure that the cash resource (customer checks) will not be misappropriated. We depict this relationship by entering a "P-1" in
the cell where this plan intersects with the goal of ensuring security of resources. And as importantly, at the bottom of the matrix, we provide the fourth, and final, matrix element—the explanation of how this plan helps to achieve this particular goal. In this case, a restrictive endorsement on the check (i.e., "deposit only to the account of Causeway Company") prevents it from being diverted to any other purpose. Of the four matrix elements, many people have the most difficulty in providing these explanations. Yet this element is the most important part of the matrix because the whole purpose of the matrix is to relate plans to goals. Unless you can explain the association between plans and goals, there's a good possibility you may have guessed at the cell entry. Sometimes you'll guess right, but it's just as likely you'll guess wrong. Be prepared to defend your cell entries.

Entering "M" in a cell symbolizes a weakness in the system. It tells us that a system does not incorporate a particular control plan that may be necessary to ensure the accomplishment of a related control goal. For example, in Figure 9.1, notice that the recommended plan, "Immediately separate checks and remittance advices," is missing from Causeway's system. The explanation of cell entries goes on to explain what goals would be achieved if this plan were present.

When your assessment leads you to the identification (and correction) of control weaknesses, you are fulfilling the fourth step of the control framework: recommending remedial changes to the system (if necessary) to correct deficiencies in the system. In addition to telling you about the control strengths and weaknesses of a particular system, a completed matrix also
facilitates evaluation from the perspectives of control effectiveness (are all the control goals achieved?), control efficiency (do individual control plans address multiple goals?), and control redundancy (are too many controls directed at the same goal?).
Exhibit 9.1 summarizes the steps we have just undertaken in preparing the illustrative control matrix . Combined with the preceding discussion and illustration, the steps should be self-explanatory. You should take a fair amount of time now to study each of the steps and to make sure that you have a reasonable understanding of them.

Control Plans for Data Entry without Master Data

As mentioned before, perhaps the most error-prone—and inefficient—steps in an operations process or an information process are the steps during which data is entered into a system. While a lot has been done over the years to improve the accuracy and efficiency of the data entry process, problems still remain, especially when humans type data into a system. So, we begin our discussion of process controls by describing those controls that improve the data entry process. We divide our discussion of data entry controls into three parts: controls when master data is not available during data entry, controls when master data is available during data entry, and controls when the input data may be collected into batches. As you study these controls, keep in mind improvements that have been made to address errors and inefficiencies of the data entry process. These improvements include:

• Automation of data entry. Documents may be scanned for data entry. Documents and labels may contain bar codes that are scanned. This automation reduces or eliminates manual keying.

• Business events, such as purchases, may be initiated in one (buying) organization and transmitted to another (selling) organization via the Internet or EDI. In this case, the receiving
(selling) organization need not enter the data at all.

• Multiple steps in a business process may be tightly integrated, such as in an enterprise system. In these cases the number of data entry steps is greatly reduced. For example, there may be no need to enter a shipment (sale) into the billing system because the shipping system shares the same integrated database with the billing system where the data have already been entered.

System Description and Flowchart

The systems flowchart for a hypothetical system that we will use to describe our first set of controls. In our first pass through the system, please ignore the control annotations, P-1, P-2, and so forth. They have been included so that we will not have to repeat the flowchart later when we prepare the control matrix. The processing starts in the first column of Figure with the clerk typing in the input data. Usually, the data entry program would present the clerk with an input screen and then prompt the user to enter certain data into fields on that screen (e.g., customer code, items numbers, and so on).

Note that the first processing square in the data entry devices column “edits” the data before they are actually accepted by the system. The editing is done through various programmed edit checks; these are discussed later in this section. Having edited the input, the computer displays a message to the user indicating that the input either is acceptable or contains errors. If errors exist, the user may be able to correct them immediately. Once users have made any necessary corrections, they type in a code or click the mouse button to instruct the system to accept the input. That action triggers the computer to simultaneously:

• Record the input in machine-readable form—the event data disk.

• Inform the user that the input data have been accepted.

To verify that the event data were keyed correctly, the documents could be forwarded to a second clerk who would type the data again. This procedure, called key verification, was introduced in Unit 2 and will be further explained below. Typically, key verification is applied only to important fields on low volume inputs. Our flowchart stops at this point without depicting the update of any master data. Certainly our system could continue with such a process. We have not shown it here so that we can concentrate on the input controls.

Applying the Control Framework

In this section, we apply the control framework to the generic system described above. Figure presents a completed control matrix for the systems flowchart shown in Figure . Through the symbols P-1, P-2, . . . P-7, we have annotated the flowchart to show where specific control plans are implemented. We also have one control plan that we assume is missing (code M-1) because the narrative did not mention it specifically.

As you recall from the previous section, step 2 in preparing a control matrix is to tailor the control goals across the top of the matrix to the particular business process under review. Because our model system does not show a specific system such as cash receipts, inventory, or the like, we cannot really perform the tailoring step. Therefore, in Figure 9.4 under the operations process section, we have shown only one operations process goal for illustrative purposes. We identify that goal as goal A: To ensure timely processing of (blank) event data (whatever those data happen to be). In the business process units (Units 10 through 14) you will see how to tailor the goals to the systems discussed in those units. The recommended control plans listed in the first column in Figure are representative of those commonly associated with controlling the data entry process. The purpose of this presentation is to give you a sense of the multitude of control plans available for controlling such systems. The plans are not unique to a specific system such as sales, billing, cash receipts, and so forth. Rather, they apply to any data entry process. Therefore, when the technology of a system is appropriate, these controls are incorporated into the list of recommended control plans.

Let’s take a general look at how several of the control plans work.2 Then, in Exhibit , we explain each of the cell entries in the control matrix. As you study the control plans, be sure to see where they are located on the systems flowchart.

P-1: Document design. **Document design** is a control plan in which a source document is designed in such as way to make it easier to prepare initially and to input data from later. We designate this as a present plan because we assume that the organization has designed this document to facilitate the data preparation and data entry processes.

P-2: Written approvals. A **written approval** takes the form of a signature or initials on a document to indicate that a person has authorized the event.

P-3: Preformatted screens. **Preformatted screens** control the entry of data by defining the acceptable format of each data field. For example, the screen might require users to key in exactly nine alphabetic characters in one field and exactly five numerals in another field. To facilitate the data entry process, the cursor may automatically move to the next field on the screen. And the program may require that certain fields be completed, thus preventing the user from omitting any mandatory data sets. Finally, the system may automatically populate certain fields with data, such as the current date and default shipping methods, sales tax rates, and other terms of a business event. Automatic population reduces the number of keystrokes required, making data entry quicker and more efficient. With fewer keystrokes and by utilizing the default data, fewer keying mistakes are expected. To ensure that the system has not provided inappropriate defaults, the clerk must compare the data provided by the system with that on the input.

P-4: Online prompting. **Online prompting** asks the user for input or asks questions that the user must answer. For example, after entering all the input data for a particular customer sales order, you might be presented three options: (A)accept the order, (E)dit the order, or (R)eject the order. By requiring you to stop and “accept” the order, online prompting is, in a sense, advising you to check your data entries before moving on. Many systems provide context sensitive help whereby the user is automatically provided with, or can ask for, descriptions of data to be entered into each input field. Another way to provide choices for a field or to limit allowable choices is to restrict entry to the contents of a list that pops up. For
example, a list of state abbreviations can be provided from which the user chooses the appropriate two-letter abbreviation.

P-5: Programmed edit checks. **Programmed edit checks** are edits automatically performed by data entry programs upon entry of the input data. Erroneous data may be highlighted on the terminal screen to allow the operator to take corrective action immediately. Programmed edits can highlight actual or potential input errors, and allows them to be corrected quickly and efficiently. The most common types of programmed edit checks are the following:

1. **Reasonableness checks.** Reasonableness checks, also known as **limit checks,** test whether the contents (e.g., values) of the data entered fall within predetermined limits. The limits may
describe a standard range (e.g., customer numbers must be between 0001 and 5000, months must be 01 to 12), or maximum values (e.g., no

normal hours worked greater than 40 and no overtime hours greater than 20).

2. **Document/record hash totals.** Document/record hash totals are a summary of any numeric data field within the input document or record, such as item numbers or quantities on a customer order. The totaling of these numbers typically serves no purpose other than as a control. Calculated before and then again after entry of the document or record, this total can be used to determine that the applicable fields were all entered and were entered correctly.

3. **Mathematical accuracy checks.** This edit compares calculations performed manually to those performed by the computer to determine if a document has been entered correctly. For this check, the user might enter the individual items (e.g., quantity purchased, unit cost, tax, shipping cost) on a document, such as an invoice, and the total for that document. Then, the computer adds up the individual items and compares that total to the one input by the user. If they don't agree, something has likely been entered erroneously. Alternatively, the user can review the computer calculations and compare them to totals prepared before input.

4. **Check digit verification.** In many processes, an extra digit—a check digit—is included in the identification number of entities such as customers and vendors. More than likely you have a check digit as part of the ID on your ATM card. The check digit is calculated originally by applying a complicated and secret formula to an identification number; the check digit then is appended to the identification number. For instance, the digit 6might be appended to the customer code 123 so that the entire ID becomes 1236. In this highly oversimplified example, the digit 6 was derived by adding together the digits 1, 2, and 3.

Whenever the identification number is entered later by a data entry person, the computer program applies the mathematical formula to verify the check digit. In our illustration, if the ID were input as 1246, the entry would be rejected because the digits 1, 2, and 4 do not add up to 6. You are already saying to yourself, "But what about a transposition like 1326?" This entry would be accepted because of the simple method of calculating the check digit. In practice, check digits are assigned by using much more sophisticated formulas than simple cross-addition; those formulas are designed to detect a variety of input errors, including transpositions.

P-6: Interactive feedback checks. An **interactive feedback check** is a control in which the data entry program informs the user that the input has been accepted and recorded. The program may flash a message on the screen telling a user that the input has been accepted for processing.

M-1: Key verification. With **key verification** documents are typed by one individual and retyped by a second individual. The data entry software compares the second entry to the first entry. If there are differences, it is assumed that one person misread or mistyped the data. Someone, perhaps a supervisor or the second clerk, would determine which typing was correct, the first or the second, and make corrections as appropriate.

P-7: Procedures for rejected inputs. **Procedures for rejected inputs** are designed to ensure that erroneous data—not accepted for processing—are corrected and resubmitted for processing. To make sure that the corrected input does not still contain errors, the corrected input data should undergo all routines through which the input was processed originally. A "suspense file" of rejected inputs is often retained (manually or by the computer) to ensure timely clearing of rejected items. To reduce the clutter in the simple flowcharts in this text, we often depict such routines with an annotation "Error routine not shown."

Explanation of control matrix cell entries. Armed with an understanding of the mechanics of certain control plans, let's now turn our attention to Exhibit —Explanation of Cell Entries for Control Matrix in Figure See whether you agree with (and understand) the relationship between each plan and the goal(s) that it addresses. Remember that your ability to explain the relationships between plans and goals is more important than your memorization of the cell entries themselves.

Control Plans for Data Entry with Master Data

Our next set of input controls are those that may be applied when we have access to master data during the input process. The availability of such data can greatly enhance the control, and efficiencies, that be gained in the data entry process. For example, let's say that we are entering orders from our customers. If we have available to us data entry programs such as those depicted in Figure we can check to see if the customer number is in the range of valid numbers (i.e., a limit check) or has been entered without error (e.g., check digit verification). But, these edits determine only that the customer number might be correct or incorrect. If we have available the actual customer master data, we can use the customer number to call up the stored customer master data and determine if the customer number has been entered correctly, if the customer exists, the customer's correct address, and so forth. While access to master data may facilitate and control the data entry process, access to master data needs to be controlled. For example, when we allow customers or other users to communicate with us over the Web, we need to be extra cautious in protecting access to stored data. Technology Excerpt 9.1 provides some control guidelines to protect against unauthorized Internet-enabled access to stored data.

The next section describes some additional controls that become available when the master data is available during data entry.

System Description and Flowchart

Figure depicts another hypothetical system. As with Figure, we make some assumptions. First, we have event data entering the system from a remote location because communications with a data entry system may be from sites away from the computer center. For instance, an existing customer might enter an order through a Web site. Second, we show that the events are typed into the system without using a source document by reference to master data. Normally, if a user enters valid data such as a valid customer code, the system automatically retrieves certain standing master data such as the customer name and address. Having edited the input, the computer displays a message to the user indicating that the input either is acceptable or contains errors. If errors exist, the user may be able to correct them immediately. Once users have made any necessary corrections, they type in a code or click the mouse button to instruct the system to accept the input. As it did in Figure, that action triggers the computer to record simultaneously the input and inform the user that the input data has been accepted.

As with Figure, our flowchart stops at this point without depicting the update of any master data. Certainly our system could continue with such a process. We have not shown it here so that we can concentrate on the input controls.

Applying the Control Framework

In this section, we apply the control framework to the generic system described above. Figure 9.6 presents a completed control matrix for the systems flowchart shown in Figure 9.5.

This matrix shows format and assumptions similar to those made in Figure, The recommended control plans listed in the first column in Figure are representative of those commonly associated with controlling the data entry process when master data is available. Most of the control plans described with Figures may also be applicable. But, for simplicity, we will not repeat them here.

In this section, we first see in general terms how several of the control plans work.3 Then,

P-1: Enter data close to the originating source. This is a strategy for capture and entry of event-related data close to the place (and probably time) that an event occurs. Online transaction entry (OLTE), online real-time processing (OLRT), and online transaction processing (OLTP) are all examples of this processing strategy. When this strategy is employed, databases are more current and subsequent events can occur in a more timely manner. Because data are not transported to a data entry location, there is less of a chance that inputs will be lost (input completeness). The input can be more accurate because the data entry person may be in a position to recognize and immediately correct input errors (input accuracy). Finally, some efficiencies can be gained by reducing the number of entities handling the event data.

P-2: Digital signatures. Whenever data are entered from remote locations via telecommunications channels like the Internet, there is the risk that the communication may have been sent by an unauthorized system user or may have been intercepted/modified in transit. To guard against such risks, many organizations employ **digital signatures** to authenticate the user's identity and to verify the integrity of the message being transmitted. To learn more about how digital signatures work.

P-3: Populate inputs with master data. Numeric, alphabetic, and other designators are usually assigned to entities such as customers, vendors, and employees. When we **populate inputs with master data**, the user merely enters an entity's identification code and the system retrieves certain data about that entity from existing master data. For example, the user might be prompted to enter the customer ID (code). Then, the system automatically provides information from the customer master data, such as the customer's name and address, preferred shipping method, and sales terms. Fewer keystrokes are required, making data entry quicker, more accurate, and more efficient. To ensure that system users have not made a mistake keying the code itself, they compare data provided by the system with that used for input. Finally, the entry cannot proceed without valid (authorized) master data that includes such items as terms and credit limits that were previously recorded via a data maintenance process.

P-4: Compare input data with master data. A data entry program can be designed to compare the input data to data that have been previously recorded. When we **compare input data with master data** we can determine the accuracy and validity of the input data. Here are just two types of comparisons that can be made: 1 **Input/master data dependency checks.** These edits test whether the contents of two or more data elements or fields on an event description bear the correct logical relationship. For example, input sales events can be tested to determine whether the person entering the data is listed as an employee of that customer. If these two items don't match, there is some evidence that the customer number or the salesperson identification was input erroneously.

2 **Input/master data validity and accuracy checks.** These edits test whether master data supports the validity and accuracy of the input. For example, this edit might prevent the input of a shipment when there is no record of a corresponding customer order. If there is no match, we may have input some data incorrectly, or the shipment might simply be invalid. We might also compare elements within the input and master data. For example, we can compare the quantities to be shipped to the quantities ordered. Quantities that do not match may have been picked from the shelf or entered into the computer incorrectly.

Explanation of control matrix cell entries. Armed with an understanding of the mechanics of certain control plans, let's now turn our attention to Exhibit 9.3—Explanation of Cell Entries for Control Matrix in Figure 9.6. Notice how data entry by the customer affects these controls. See whether you understand the relationship between each plan and the goal(s) that it addresses. Remember that your ability to explain the relationships between plans and goals is most important.

Controls Plans for Data Entry with Batches

This section, as did the preceding two, presents a hypothetical system. This next flowchart, however, uses the example of a shipping and billing process to illustrate certain points. The distinguishing control-related feature in this system is that it processes event data in batches.

System Description and Flowchart

The systems flowchart for our hypothetical batch processing system. Again, please ignore the control annotations, P-1, P-2, and so forth, until we discuss them in the next subsection. Processing begins in the first column of the flowchart with picking tickets that have been received in the shipping department from the warehouse. Let's assume that accompanying these picking tickets are goods to be shipped to customers. Upon receipt of the picking tickets, a shipping department employee assembles them into groups or batches. Let's assume that the employee batches the documents in groups of 25 and takes batch totals. The batch of documents is then scanned onto a disk. As the batch is recorded, the data entry program calculates one or more totals for the batch and displays those batch totals to the shipping clerk. The clerk determines if the displayed totals agree with the ones previously calculated. If they don't, error-correcting routines are performed. This process is repeated throughout the day as picking tickets are received in the shipping department.

Periodically, the file containing the shipment data is sent to the computer for processing by the shipment programs(s). This program records the sales event data and updates the accounts receivable master data to reflect a new sale. Invoices are printed and sent to the customer. Packing slips are printed and sent to the shipping department where they are matched with the picking ticket before the goods are sent to the customer. "Further processing" includes packing and shipping the goods.

One of the system outputs is usually an **exception and summary report**. This report reflects the events—either in detail, summary total, or both—that were accepted by the system, and those that were rejected by the system. Even though the keyed input was edited and validated, some data still could be rejected at the update stage of processing. In our system the totals on this report are compared to the input batch totals.

Applying the Control Framework

In this section, we apply the control framework to the generic batch processing system described above. Figure 9.8 (page 302) presents a completed control matrix for the systems flowchart shown in Figure 9.7. Figure 9.7 has been annotated to show the location of recommended control plans that exist in the system (codes P-1, P2, . . . P-5). We also have some control plans that we assume are missing (codes M-1, M-2) because the narrative system description did not mention them specifically. In Figures , we could not complete certain parts of the top of the control matrix. However, for this example, we have assumed that we know the nature of the input (i.e., picking tickets), we know the resources that are to be protected (i.e., the inventory and the accounts receivable master data), and we know the data that are to be updated.

This section discusses each of the recommended control plans listed in the first column of the matrix, describing how the plans work.4 Exhibit 9.4 explains the cell entries appearing in the control matrix. Be sure to trace each plan to the flowchart location where it is implemented (or could be implemented in the case of a missing plan).

Before we start, let's explain what we mean by batch controls.5 **Batch control plans** regulate information processing by calculating control totals at various points in a processing run and subsequently comparing these totals. When the various batch totals fail to agree, evidence exists that an event description(s) may have been lost (completeness problem), added (validity problem), or changed (accuracy problem). Once established, batch totals can be reconciled manually or the computer can reconcile them. In general, for batch control plans to be effective, they should ensure that: 5 These batch controls apply to groups of documents. The document/record hash totals introduced earlier in the unit apply to individual documents.

• All documents are batched; in other words, the batch totals should be established close to the time that the source documents are created or are received from external entities.

• All batches are submitted for processing; batch transmittals and batch logs are useful in protecting against the loss of entire batches.

• All batches are accepted by the computer; the user should be instrumental in performing this checking.

• All differences disclosed by reconciliations are investigated and corrected on a timely basis.

Batch control procedures must begin by grouping event data and then calculating a control total(s) for the group. For example, Figure 9.7 shows the shipping department employee preparing batch totals for the picking tickets documents to be scanned. Several different types of batch control totals can be calculated, as discussed in the following paragraphs. You will note in the following discussion that certain types of batch totals are better than others in addressing the information process control goals of input validity, input completeness, and input accuracy.

Document/record counts are simple counts of the number of documents entered (e.g., 25 documents in a batch). This procedurerepresents the minimum level required to control input completeness. It is not sufficient if more than one event description can appear on a document. Also, because one document could be intentionally replaced with another, this control is not very effective for ensuring input validity and says nothing about input accuracy.

Item or line counts are counts of the number of items or lines of data entered, such as a count of the number of invoices being paid by all of the customer remittances. By reducing the possibility that line items or entire documents could be added to the batch or not be input, this control improves input validity, completeness, and accuracy. Remember, a missing event record is a completeness error and a data set missing from an event record is an accuracy error.

Dollar totals are a summation of the dollar value of items in the batch, such as the total dollar value of all remittance advices in a batch. By reducing the possibility that entire documents could be added to or lost from the batch or that dollar amounts were incorrectly input, this control improves input validity, completeness, and accuracy.

Hash totals are a summation of any numeric data existing for all documents in the batch, such as a total of customer numbers or invoice numbers in the case of remittance advices. Unlike dollar totals, hash totals normally serve no purpose other than control. Hash totals can be a powerful batch control because they can be used to determine if inputs have been altered, added, or deleted. These batch hash totals operate for a batch in a manner similar to the operation of document/record hash totals for individual inputs.

P-1: Turnaround documents. **Turnaround documents** are printed by the computer and are used to capture and input a subsequent event. Picking tickets, inventory count sheets, remittance advice stubs attached to customer invoices, and payroll time cards are all examples of turnaround documents. For example, we have seen picking tickets that are printed by computer, are used to pick the goods, and are sent to shipping. The bar code on the picking ticket is scanned to trigger recording of the shipment. When the bar code is scanned the items and quantities that should have been picked are displayed. If the items and quantities are correct, the shipping clerk need only click one key to record the shipment.

P-2: Manual agreement of batch totals. The manual agreement of batch totals control plan operates in the following manner:

• First, one or more of the batch totals are established manually. As individual event descriptions are entered (or scanned), the data entry program accumulates independent batch totals.

• The computer produces reports (or displays) at the end of either the input process or update process, or both. The report (or display) includes the relevant control totals that must be manually reconciled to the totals established prior to the particular process.

• The person who reconciles the batch total (see the shipping department employee in Figure 9.7) must determine why the totals do not agree and make corrections as necessary to ensure the integrity of the input data.

M-1: Computer agreement of batch totals. This control plan does not exist in Figure 9.7 and therefore is shown as a missing plan. Note in Figure 9.7 where we have placed the M-1 annotation. The computer agreement of batch totals plan is pictured in Figure 9.9 and works in the following manner:

• First, one or more of the batch totals are established manually .

• Then, the manually prepared total is entered into the computer and is recorded on the computer as batch control totals data. • As individual event descriptions are entered, a computer program accumulates independent batch totals and compares these totals to the ones prepared manually and entered at the start of the processing.

• The computer then prepares a report, which usually contains details of each batch, together with an indication of whether the totals agreed or disagreed. Batches that do not balance are normally rejected, and discrepancies are manually investigated.

M-2: Sequence checks. Whenever documents are numbered sequentially—either assigned a number when the document is prepared or prepared using **prenumbered documents**—a sequence check can be applied to those documents. One of two kinds of sequence checks may be used—either a batch sequence check or a cumulative sequence check.

In a **batch sequence check**, the event data within a batch are checked as follows:

1. The range of serial numbers constituting the batch is entered. 2. Each individual, serially prenumbered event is entered. 3. The computer program sorts the event data into numerical order, checks the documents against the sequence number range, and reports missing, duplicate, and out-of-range event data.

Batch sequence checks work best when we can control the input process and the serial numbers of the input data. For example, this control would not work for entering customer orders that had a variety of numbers assigned by many customers. A slight variation on the batch sequence check is the cumulative sequence check. The **cumulative sequence check** provides input control in those situations in which the serial numbers are assigned within the organization (e.g., sales order numbers issued by the sales order department) but later are not entered in perfect serial number sequence (i.e., picking tickets might contain broken sets of numbers). In this case, the matching of individual event data (picking ticket) numbers is made to a file that contains all document numbers (all sales order numbers). Periodically, reports of missing numbers are produced for manual follow-up.

Reconciling a checkbook is an example of a situation in which numbers (the check numbers) are issued in sequence. But when we receive a bank statement, the batch may not contain a complete sequence of checks. Our check register assists us in performing a cumulative sequence check to make sure that all checks are eventually accounted for.

P-3: Agreement of run-to-run totals. This is a variation of the agreement of batch totals controls. With this control, totals prepared before a computer process are compared, manually or by the computer, to totals prepared after the computer process. The controls after a process are often found on an error and summary report. When totals agree, we have evidence that the input and the update took place correctly. This control is especially useful when there are several intermediate steps between the beginning and the end of the process and we want to be assured of the integrity of each process.

P-4: Tickler files. A **tickler file** is a file that is reviewed on a regular basis for the purpose of taking action to clear items from that file. In Figure 9.7, we see a file of picking tickets representing items that should be shipped. Should these documents remain in this file for an extended period of time, we would fail to make the shipments or to make them in a timely manner. Tickler files may also be computer records representing events that need to be completed, such as open sales orders, open purchase orders, and so forth.

P-5: One-for-one checking. **One-for-one checking** is the detailed comparison of individual elements of two or more data sources to determine that they agree as appropriate. This control is often used to compare a source document to an output produced later in a process. Differences may indicate errors in input or update. If the output cannot be found for comparison, there is evidence of failure to input or process the event. While this procedure provides us details as to what is incorrect within a batch, agreement of run-to-run totals will tell us if there is any error within a batch. One-for-one checking is expensive and should be reserved for low-volume, high-value events.

Having examined what each of the recommended control plans means and how each operates, we can now look at how the plans meet the control goals. Exhibit 9.4 explains the relationship between each control plan and each control goal that it helps to achieve. As you study Exhibit 9.4, we again urge you to concentrate your energies on understanding these relationships.

Conclusions

In this unit, we began our study of process control plans, the third level in the control hierarchy (shown in Figure 8.2 on page 256). Our study of process control plans will continue in Units 10–14, where we will apply the control framework and explore controls that are unique to each business process. Before we leave, let’s address one more aspect of process controls. Many of these controls attempt to detect data that may be in error. For example, a reasonableness test may reject a price change that is beyond a normal limit. But, it may be that the price change has been authorized and correctly entered. As another example, perhaps a customer order is rejected because it does not pass the credit check. But, it might be that it is in the best interest of the company to permit the sale anyway. In these cases, we need to be able to override the control and permit the event to process. If our control system is to remain effective, these overrides must be used sparingly and require a password or key and signature be necessary to effect the override. Finally, a record of all overrides should be periodically reviewed to determine that the override authority is not being abused.

REVIEW QUESTION

1. What are two common programmed edit checks? Describe each check.
2. Explain the Controls Plans for Data Entry with Batches
3. Describe the process of Applying the Control Framework.
4. Explain about the most common types of programmed edit checks.
5. What are the Steps in Preparing the Control Matrix? Describe .

FURTHER READINGS

- Information System Tecnology- Ross Malaga
- Information System Today-Leonard Jessup
- An Illustrated Information Technology-Alan Witchcomb
- Information Technology For Management Henry C.Lucas
- Information Technology in Business Management Dr. Mukesh Dhunna, J.B. Dixit

IMPORTANT NOTES

UNIT-10 CORE BUSINESS PROCESSES

CONTENTS

Introduction

Before we look at the details of the M/S process and how it functions, let’s set the stage for our study by picturing again how this process relates to other processes in a company. Figure depicts the usiness events that combine to form the Order-to-Cash process.

You can see from Figure that the M/S process triggers the revenue collection portion of the Order-to-Cash process and shares data with the purchasing and manufacturing processes but does not interact directly with the general ledger in the business reporting process. When M/S prepares a sales order, it works with the inventory process so that the products can be sent to the customer. Later, when the goods are shipped, M/S informs the revenue collection process of the shipment so a bill can be sent. These interfaces are examined in detail later in this unit. The operational aspects of the M/S process are critical to the success—in fact, the very survival—of businesses today and in the future. Indeed, many organizations focus the bulk of their strategic Information Systems investment on supporting M/S process effectiveness. That is why later sections of the unit discuss the vital topics of decision making, satisfying customer needs, and employing technology to gain competitive advantage.

Process Definition and Functions

The **marketing and sales (M/S) process** is an interacting structure of people, equipment, methods, and controls designed to achieve certain goals. The primary function of the M/S process is to support: 1. Repetitive work routines of the sales order department, the credit department, the warehouse, and the shipping department. To focus our discussion, we have assumed that these departments are the primary ones related to the M/S process. For a given organization, however, the departments associated with the M/S process may differ.

2. Decision needs of those who manage various sales and marketing functions.

3. Information flows and recorded data in support of the operations and management processes. Let's examine each of these functions. First, the M/S process supports the repetitive work routines of the sales order, credit, and shipping departments by capturing and recording sales-related data. As but one example, a sales order form or screen often supports the repetitive work routines of the sales order department by capturing vital customer and order data, by facilitating the process of granting credit to customers, and by helping to ensure the timely shipment of goods to customers. To further illustrate this point, we can consider that a copy of the sales order (whether paper or electronic in physical existence) may serve as a communications medium to inform workers in the warehouse that certain goods need to be picked and transported to the shipping department.

Second, the M/S process supports the decision needs of various sales and marketing managers. Third, in addition to these managers, any number of people within a given organization may benefit from information flows generated by the M/S process. This information is critical to succeeding in a highly competitive economy.

Organizational Setting

In this section, we take both a horizontal and vertical view of how the M/S process fits into the organizational setting of a company. The horizontal perspective will enhance your appreciation of how the M/S process relates to the repetitive work routines of the sales order, credit, warehouse, and shipping departments. The vertical perspective will sharpen your understanding of how the M/S process relates to managerial decision making within the marketing function.

A Horizontal Perspective

Figure and Table present a horizontal view of the relationship between the M/S process and its organizational environment. The figure shows the various information flows generated or captured through the M/S process. The information flows are superimposed onto the organizational structures that house the departments. The figure also illustrates the multiple entities with which the M/S process interacts (customers, carriers, other business processes, and so forth).

The information flows also connect those departments with the entities residing in the relevant environment of the M/S process. If the order itself were initiated over the Internet or other EDI-based system, many of the flows would be automated and require less human intervention.

For example, the first information flow apprises representatives in the sales order department of a customer request for goods. This information flow, the customer order, might take the physical form of a telephone call, a mailed document, or an electronic transmission. In turn, flow 5 informs workers in the shipping department of a pending sale; this communication facilitates the operational planning and related activities associated with the shipping function. This information flow, the sales

order, might take the form of a copy of a paper copy of a sales order, or it might be electronically transmitted
and observed on a computer screen in the shipping department.

As noted earlier in the text, many of the information flows through an organization become automated when enterprise systems are in place. Having reviewed the information flows in Table 10.1 and Figure 10.2, you should take a few minutes now to read Technology Insight 10.1 (page 330), which discusses how the horizontal information flows in an enterprise system become automated and, therefore, more efficient in terms of supporting the M/S process.

A Vertical Perspective

To understand the relationship between the M/S process and managerial decision making, you need to become familiar with the key players involved in the marketing function. Figure 10.3 (page 331) presents these players in the form of an organization chart. As the figure illustrates, sales-related data are captured in the sales order department and then flow upward (in a summarized format) to managers housed within the marketing organizational structure. Much of this information would be based traditionally on sales-related events and normally would be captured through the use of a sales order form or through entry of data directly into a computer database. As organizations become ever increasingly focused on customers, however, the information needed for decision making is less focused on executing and recording the sale and more on customer characteristics, needs, and preferences. The next section provides an overview of the relationship between management decision making and the M/S process, and how information technology facilitates these demands of decision makers.

Managing the M/S Process: Satisfying Customer Needs

In recent years, the print media has been glutted with articles stressing that the most critical success factor for businesses entering the new millennium is their ability to know their customers better and, armed with that knowledge, to serve their customers better than their competition. With companies facing more and more global competition, a renewed emphasis on satisfying customer needs has emerged. To compete effectively, firms must improve the quality of their service to customers. A satisfied customer tends to remain a customer, and it’s less costly to retain existing customers than to attract new ones. Technology Excerpt 10.1 illustrates how technology-enabled cross-selling can enhance the relationship between a firm and its customers.

What does this situation mean for the M/S process? Most importantly, it has expanded the type and amount of data collected by the M/S process regarding customer populations. To respond to the increasing information demand, many organizations have developed a separate marketing Information System to assist decision making in the marketing function. Often, these are tightly coupled with the Information Systems supporting the M/S process. For example, a company using an enterprise system might have a customer relationship management system sharing the same underlying database (a topic we will explore in greater detail shortly). The focus of these new systems is generally on replacing mass marketing or segmented marketing strategies with approaches that use computing resources to zero in on increasingly smaller portions of the customer population, with the ultimate aim being to concentrate on the smallest component of that population—the individual consumer. Technology Insight 10.2 illustrates one way in which data generated over the Internet could be used to augment internal sales data.

Decision Making and Kinds of Decisions

Now let's look at one brief example of decisions that marketing managers confront. Put yourself in the position of an advertising manager. A few representative questions for which you might need answers are:

• Where is sales volume concentrated?
• Who are our specific major customers, both present and potential?
• What types of advertising have the greatest influence on our major customers?

Could the Information System help you to obtain the answers?

Certainly, if it captured and stored historical data related to sales events and additional data related to customers. For example, to answer the first question, you might find a sales report by region helpful, and a sales report by customer class could provide some answers to the second question.

Where might you find answers to questions like the third one? Census reports, market research questionnaires, and trade journals often are included in the broader marketing Information System. Research houses garner vast amounts of information from public records—drivers' licenses, automobile registrations, tax rolls, mortgage registrations, and the like—and sell that information to

other companies. In certain industries, the mechanisms to collect data regarding customers, their buying habits, and other demographics have become quite sophisticated. Recent advances in database management systems and the underlying technologies are leading to a focus on the use of data warehousing and data mining techniques (as discussed in Unit 4) to support marketing analysis. Let's take a closer look at some of the key technologies supporting these efforts.

Using Data Mining to Support Marketing

Data warehousing applications in organizations are usually viewed as focusing on either operational or analytical applications. Operational applications focus on providing decision makers the information they need to monitor and control their organization. Analytical applications, which include data mining, allow the use of sophisticated statistical and other analytical software to help develop insights about customers, processes, and markets.3 Several analytical applications are discussed in Technology Application 10.1.

Data warehouses can be a massive effort for a company. For instance, Wal-Mart's worldwide data warehouse is the largest in the world with over 16 terabytes of data in a single data warehouse.4 For many companies, such integration of corporate-wide data is a taxing process that requires years of development. This complexity is raised another magnitude as companies increasingly try to use data warehousing tools in contemporary enterprise systems to merge data captured through processing with other types of data desired in a data warehouse.

Using this massive array of data from which customer buying habits, characteristics, and addresses can be analyzed and linked, marketing departments can undertake extensive studies. Researchers armed with neural networks (as discussed in Unit 5), comprehensive statistical analysis packages, and graphical presentation software can rapidly begin to develop insights about relationships within the marketing information. Of course, as demonstrated in Technology Excerpt 10.2 (page 336), users of the data warehouse need to consider carefully what the outputs of such analyses really mean.

Mastering Global Markets with E-Business

Recall that in Unit 4 we studied various e-business systems in great detail. Here, we will explore how these e-business systems can be used to penetrate global markets and allow a company to easily process international orders without a physical presence.

In Unit 4 we discussed one of the great challenges to EDI being the inconsistent document protocols used by different countries to complete electronic transactions. (Refer to the discussion in Unit 4 and the example in Figure Varying standards can be a barrier to penetrating new global markets. In recent years, software has emerged to facilitate the translation between these differing standards.

While such products enable the efficient use of e-business in the global marketplace, the costs can still be formidable for small and medium-sized companies. This barrier is finally being overcome through Internet access that can be used to facilitate e-business in an inexpensive format.

A variety of software solutions are now available that take a company's business information transmitted over the Internet and convert it into EDI format. Likewise, when EDI information is transmitted to the company, the software translates the EDI format into an Internet transmission format that provides compatible business information for the organization's systems. Another alternative is to use XML to encode business data in a generally accepted Internet transaction standard. XML, as presented in unit 4, is beginning to replace EDI standards in several industries, especially among Web-enabled large companies. In EDI systems, the user receives orders and sends invoices via a Web-based interface. The electronic messages are processed by an intermediary that serves the role of both translator between Internet and EDI forms and provider of value-added network (VAN) services with EDI-enabled companies (as were discussed in Unit 4). Recent estimates have placed the costs of processing a paper-based order at $50 as compared to $2.50 to process the order using EDI and $1.25 using an Internet-based solution.5 Thus, companies using

commerce-business may choose only to make purchases from vendors equipped to handle electronic orders.

Customer Relationship Management (CRM) Systems Customer relationship management systems (CRM) are systems designed to collect all of the data related to customers, such as marketing, field service, and contact management data. Over the past few years, CRM has become the primary focus of information systems managers and CIOs responsible for prioritizing new systems acquisitions. CRM has also become the focus of enterprise system vendors who realize the need to tap into this growing

market and to integrate CRM data with the other data already residing within the
enterprise system's database. The concept behind CRM is that better customer service means happier customers and greater sales—particularly repeat sales. Part of the concept is field-service support and contact management. Contact management facilitates the recording and storing of information related to each contact a salesperson has with a client and the context of the conversation or meeting. Additionally, each time the client makes contact regarding queries or service help, this information is also recorded as field service records. The result is that a salesperson can review all pertinent historical information before calling on a customer and be better prepared to provide that customer with targeted products and services. These systems also support the recording of information about the customer contact, such as spouse's name, children, hobbies, etc., that help a salesperson make quality contact with a customer.

At the same time, the software supports the organizing and retrieving of information on historical sales activities and promotions planning. This facilitates the matching of sales promotions with customers' buying trends. For example, the Ticketmaster vignette demonstrated how customer data can be used when competing over the Internet. This is a particularly crucial area for integration with any existing enterprise system as much of the information necessary to support sales analyses comes from data captured during the recording of sales event data in the enterprise system.

A third area prevalent in CRMs is support for customer service—particularly for phone operators handling customer support call-in centers. For many organizations, phone operators who have not had previous contact with the customer handle the bulk of customer service activities. The CRM quickly provides the phone operator with information on the customer's history and usually links the operator with a database of solutions for various problems that a customer may have. These solutions may simply be warranty or contracts information, or at a more complex level, solutions to operations or maintenance problems on machinery or equipment. All of this information can be efficiently stored for quick retrieval by the system's user.

Logical Description of the M/S Process

Using data flow diagrams, this section provides a logical view of a typical M/S process. Although the narrative highlights certain key points in the diagrams, your study of Unit 2 equipped you to glean much knowledge simply from a careful study of the diagrams themselves. The section ends with a description of data created or used by the M/S process. As we have indicated in earlier units, whenever we show data being stored in separate data stores, you should recognize that such data stores represent a process's view of data that in reality may reside in an entity-wide database.

Logical Data Flow Diagrams

Our first view of the process is a general one. Figure 10.4 portrays the M/S process in the form of a context diagram. Recall that a context diagram defines our area of interest. Although it presents an abstract view of the process, it serves the purpose of delineating the domain of our study. In Figure 10.4, one input enters the process and seven outputs emerge. Also, notice the entities in the relevant environment with which the M/S process interacts. Some of these entities reside outside the organization (Customer and Carrier), whereas some are internal to the organization but external to the M/S process (payroll process and revenue collection process.) These internal entities are covered in detail in subsequent units. 7 The slash on the lower right corner of the Customer entity square indicates that there is another occurrence of this entity on the diagram.

To focus our discussion, we have assumed that the M/S process performs three major functions. A given M/S process, however, may perform more or fewer functions than we have chosen to illustrate here. Each of the three functions (process bubbles) shown in Figure 10.5 is decomposed (that is, "exploded") into lower-level diagrams in Appendix A.

The line enclosing the right side of the Sales order master data store indicates that there is another occurrence of that data store on the diagram. The physical means used to disseminate the order may vary from using a paper sales order form to using computer screen images as illustrated in Figure . Regardless of the physical form used, we generally expect the dissemination to include the following data flows:

• A **picking ticket** authorizes the warehouse to "pick" the goods from the shelf and send them to shipping. The picking ticket identifies the goods to be picked and usually indicates the warehouse location.

• A **packing slip** is attached to the outside of a package and identifies the customer and the contents of the package.

• A **customer acknowledgment** is sent to the customer to notify him or her of the order's acceptance and the expected shipment date.

• A **sales order notification** is sent to the billing department to notify it of a pending shipment.

• The **bill of lading** represents a contract between the shipper and the carrier in which the carrier agrees to transport the goods to the shipper's customer.

The carrier's signature on the bill of lading, and/or the customer's signature on some other form of receipt, substantiates the shipment.

Logical Data Descriptions

• Marketing data
• Sales order master data
• Customer master data
• Completed picking ticket file
• Inventory master data
• Shipping notice file
• Accounts receivable master data

With the exception of the inventory and accounts receivable master data, the other five data stores are "owned" by the M/S process, meaning that the M/S process has the responsibility for performing data maintenance and master data updates on these data stores. This section discusses the purpose and contents of each of these five data stores.

Earlier, we noted that the marketing data is the repository of a variety of sales-oriented data, some of which result from recording sales event data (i.e., processed sales orders) and some of which originate from activities that do not culminate in completed sales, such as customer requests for inventory not stocked and/or available. The marketing data also house information from the marketing information system. Typically, these data could include economic forecasts, census reports, responses to market research questionnaires, customer buying habits, customer demographics, and the like.

Customer master data include data that identify the particular characteristics of each customer, such as name, address, telephone number, and so forth. These data also contain various credit data. Although customer data may be altered directly, proper control techniques require that all such master data changes (i.e., data maintenance) be documented and approved, and that a report of all data changes be printed periodically.

As shown in the data flow diagrams, records in the **sales order master data** store are created on completion of a sales order. Each of the sales order master data records contains various data elements, typically those that appear on the sales order in Figure. Like the sales order master data, the completed picking ticket data and the shipping notice data will parallel the contents of their related business documents. The bulk of the data elements on these two documents would be identical to those on the sales order. Recall that unlike the sales order itself, the completed picking ticket and the shipping notice would reflect the physical quantities actually picked and shipped. In addition, the shipping notice would include data concerning the shipment such as shipping date, carrier, bill of lading number, and the like. In practice all of this data could simply be added to the record of the sales order that is maintained in the database.

Physical Description of the M/S Process

We have assumed a particular physical model to illustrate the M/S process. As you examine the process's physical features, notice a close resemblance between them and the logical design of the M/S process, as presented in Figures 10.4 and 10.5 and in Figures 10.10 through 10.12 in Appendix A. You should also relate the physical features to the technology discussion earlier in this unit.

The M/S Process

Figure presents a systems flowchart of the model. Take some time now to examine the flowchart. On this first pass, please ignore the control annotations, P-1, P-2, etc. Controls

will be covered in later sections. Each field salesperson is provided with a laptop and a portable printer. The laptop is equipped with a modem that allows the salesperson to communicate with the centralized computer via 24- hour, toll-free, high-speed leased telephone lines. With this type of direct access and the capabilities provided by order-taking software, a salesperson can perform a number of services for a customer, including the following:

Because the leased lines provide a relatively secure communication channel, the salespeople's transmissions are not encrypted nor are digital signatures used. Note that salespeople may not have access to all the menu options. For example, they may not have access to certain data maintenance functions or reporting options.

• Checking availability of inventory
• Determining status of open orders
• Initiating sales
• Confirming orders immediately

To illustrate typical process features, let's assume that the salesperson invokes the option to process a sales order. The order might have been taken orally at the customer's office or by telephone at the salesperson's office. The first screen to appear generally contains information about the header section of the sales order form. Typically, the system automatically assigns sequential order numbers.

Then the system prompts the salesperson to enter the customer code. If the salesperson enters a customer code for which the system has no record, the system rejects the order, and recording of the event terminates. If the customer is new, the salesperson asks the customer to complete a credit application. The salesperson then forwards the application to the credit department. Next, a credit officer initiates a credit investigation, resulting in either credit approval (usually with a dollar ceiling) or credit denial. The third part of Figure 10.7 illustrates these procedures. Assuming the salesperson enters a valid customer code, the system automatically retrieves certain standing data, such as customer name(s), address(es), and credit terms, from the customer data. Next, the salesperson enters the other data in the sales order header, guided by the cursor's moving to each new position in the preformatted screen.

After the user completes and accepts the header section, the PC displays the middle section of the sales order (i.e., sales order lines). The salesperson enters data for each item ordered, starting with the part number. The system automatically displays the description and price.

Finally, the salesperson enters the quantity ordered and the date the customer needs the goods. If the total amount of the current order, any open orders, and the outstanding receivable balance exceeds the customer's credit limit, the operator is warned of this fact, the order is suspended, and credit rejection procedures are initiated. If the total amount falls within the customer's credit range, processing continues. Should the balance shown on the inventory data be less than the quantity ordered, back order procedures commence.

Once the salesperson finishes entering the order data, the computer updates the sales order master data, the inventory master data, the shipment event data, and the sales commission data and produces an exception and summary report. A two-part customer acknowledgment prints on the salesperson's portable printer; the original is left with (or mailed to) the customer to confirm the order, and the duplicate is retained by the salesperson. Simultaneously, a three-part sales order and sales order (SO) bar code labels (BCLs)— containing the sales order header information—are printed and distributed.. The warehouse layout is optimized to facilitate order picking. Each item in the warehouse has a ticket attached to it that contains the product bar code as well as its printed identification code and product description. We call this a BCT—

bar code ticket—in the flowchart. As the items are picked, the stub of each BCT is removed as that item is packaged in a shipping carton—several items are contained in each carton. One of the sales order bar code labels (BCL) is pasted to the outside of the carton, and the individual BCTs are temporarily stapled to the carton as well. When the entire order has been picked, warehouse personnel insert the picked quantities on the picking ticket, initial the ticket, and then move the goods and the completed picking ticket to the shipping department. Shipping personnel compare the goods to the completed picking ticket and their copy of the packing slip. Then, they scan each carton's BCL and the individual product BCTs that comprise that carton. The scanning process automatically prints a two-part bill of lading and a shipping notification on a printer located in the shipping department and simultaneously updates the shipping notice data and sales order master data to reflect the shipment. The goods themselves plus the original of the bill of lading and the completed packing slip are given to the carrier for delivery, and the shipping notification is sent to the billing section of the accounts receivable department. The bill of lading duplicate, completed picking ticket, and product BCTs are filed in the shipping department. Consider how the M/S process documented in Figure 10.7 might change in an enterprise system environment. Other aspects of the process can also benefit from automation. For example, as mentioned in Unit 5, expert systems are being used increasingly in practical business applications, including M/S processes. To illustrate, the American Express Company has developed an expert system called Authorizer's Assistant that helps the credit authorization staff to approve customer charges. The Authorizer's Assistant searches through 13 databases and makes recommendations to the person making the authorization decision. Authorizer's Assistant raises the user's productivity by 20 percent and reduces losses from overextension of credit. In addition to cost savings, this expert system application allows American Express to differentiate itself from its competition by offering individualized credit limits.

Management Reporting

In an online system that incorporates an inquiry processing capability, the need for regular preparation of printed management reports is reduced or eliminated. Instead, each manager can use a PC to access a marketing database or CRM system and retrieve relevant management information. For example, a sales manager could access the marketing database at any time and assess the performance of particular salespeople. Sales reports in many desired formats can be obtained on demand using a computer. For example, some of the report options could include sales analyses by part number, product group, customer, or salesperson as well as open order status, sorted and accumulated in a variety of ways. Figure illustrates a sample sales analysis report generated in SAP. This report shows the five top selling items for a period.

Application of the Control Framework

The methodology for studying process controls appeared in Unit 9. In this section, we apply that control framework to the M/S process. Figure 10.9 presents a completed control matrix for the systems flowchart presented in Figure. The flowchart is annotated to show the location of the various process control plans.

Control Goals

The control goals listed across the top of the matrix are no different from the generic goals presented in Unit 9, except that they have been tailored to the specifics of the M/S process. Two categories of control goals are presented in the matrix. The operations process control goals are:

• **Effectiveness of operations.** A through E in Figure identify five representative operations process goals for the M/S process. Operations process goals support the purpose of the process. In the case of the M/S process, notice that for the most part the operations process goals address the issue of satisfying customers, a topic discussed earlier in the unit. In addition, the control matrices in this text incorporate as one of the process goals the goal of complying with laws, regulations, and contractual agreements when applicable. For that reason, we include goal E for the M/S process—Comply with the fair pricing requirements of the Robinson-Patman Act of 1936. (Briefly stated, that act makes it illegal in industrial and wholesale markets for a seller to charge different prices to two competing buyers under identical circumstances unless the seller can justify the pricing differential based on differences in its cost to manufacture, sell, and deliver the goods.)

• **Efficiency in employment of resources.** These goals support the savings of time and money.

• **Resource security.** Note that in this column we have named two specific resources that are of concern to the M/S process. Control plans should be in place to prevent theft or unauthorized sale of merchandise inventory. Equally important are plans designed to preclude unauthorized access to or copying, changing, selling, or destruction of the customer master data.

The information process control goals comprise the other category. These goals are divided into two sections—one section for sales order inputs and a second section for shipping notice inputs. To focus our discussion, we have not included other inputs (i.e., customer inquiries, credit applications, credit-limit changes, and management inquiries). The information process control goals are:

• **Input validity (IV).** A valid sales order is one from an existing customer—one contained in the customer master data—whose current order falls within authorized credit limits. Recall that to be added to the customer master data, a customer had to pass an initial credit investigation. By adding the customer to the customer master data, management has provided authorization to do business with that customer. Valid shipping notice events are those that are supported by both an approved sales order and an actual shipment of goods.

• **Input completeness (IC) and input accuracy (IA) of sales orders or shipping notices.** These goals ensure that all orders are entered and entered correctly.

• **Update completeness (UC) and update accuracy (UA) of the sales order and inventory master data.**12 We have seen earlier in the unit that the sales order master data is updated twice— once when a new sales order is created, and later to reflect the shipment of that order. The single inventory master data update occurs at the same time the new sales order is created. Again, to focus our discussion, we have limited our coverage of system updates to just the sales order and inventory master data.

Recommended Control Plans contains a discussion of each recommended control plan listed in the control matrix, including an explanation of how each plan meets the related control goals. As you study the control plans, be sure to see where they are located on the systems flowchart. Also, see whether you agree with (and understand) the relationship between each plan and the goal(s) that it addresses. Remember that your ability to explain the relationships between plans and goals is more important than your memorization of the cell entries themselves. Recall that process control plans include both those that are characteristic of a particular business process and those that relate to the technology used to implement the application. Section B reviews the technology-related control plans—introduced in Unit 9—that apply to the particular M/S configuration in Figure . For simplicity, we have assumed that each of the plans in section B exists in our system (i.e., is a "P" plan), regardless of whether it was specifically mentioned in the narrative or not. One of the control plans described in Unit 9—namely, digital signatures—is not used in this particular system because the salespeople communicate with the centralized data processing department over leased telephone lines.

You should recognize that the plans in section B (unlike those in section A) are not unique to an M/S process. Rather, they apply to any system implemented using this technology. However, when the technology of a system is appropriate, these controls are incorporated into the list of recommended control plans. We discussed each of the plans listed in section B in Unit 9, including an explanation of how each plan helps to attain specific control goals. We will not repeat that discussion here except to point out, as necessary, how and where the plan is implemented in the M/S process pictured in Figure . If you cannot explain in your own words the relationship between the plans and goals, you should review the explanations in Unit 9.

Conclusions

The M/S process is critical to revenue generation for the organization and as such is often a priority process for new technology integration. We have demonstrated one such system in this unit. You should be aware that organizations have differing levels of technology integration in their business processes. As these levels of technology change, the business processes are altered accordingly. As the business process evolves, so also must the specific internal control procedures necessary to maintain the security and integrity of the process. Keep this in mind as you explore the alternative levels of technology integration presented in Units 11 and 12. Think about how the control systems change and how the controls in the M/S process would similarly change given similar technology-drivers for the business process. This unit presented a Marketing and Sales process that relies on a knowledgeable salesperson for initiating orders. What's in store for the future? Well, consider an Internet storefront. Buyers can send **agents** over the Internet to browse

through electronic catalogs or Internet portals to compare prices and product specifications; and can make purchases at any hour. Consider that there are as many as 100 million people worldwide
now using the Internet. In the United States alone, 10 million users have made at least one purchase over the Web. The much larger market supporting business-to-business orders is many times larger with an expected annual value of $7.29 trillion by 2004.13 Many firms such as General Electric and Dell Computer generate large portions of their revenue from their e-businesses.

REVIEW QUESTIONS

1. Describe the core business Process and their Functions?
2. Write a short notes on “Mastering Global Markets with E-Business”.
3. What are Application of the Control Framework?
4. Describe the usefulness of Logical Data Flow Diagrams.
5. What are the goals of control matrix? Explain in detail.

FURTHER READINGS

- Information System Tecnology- Ross Malaga
- Information System Today-Leonard Jessup
- An Illustrated Information Technology-Alan Witchcomb
- Information Technology For Management Henry C.Lucas
- Information Technology in Business Management Dr. Mukesh Dhunna, J.B. Dixit

IMPORTANT NOTES

Notes

UNIT-11 THE "ORDER-TO-CASH" PROCESS

CONTENTS

Introduction

The M/S process performs the critical tasks of (1) processing customer orders and (2) shipping goods to customers. The RC process completes the Order-to-Cash business process by accomplishing three separate yet related activities: (1) billing customers, (2) managing customer accounts, and (3) securing payment for goods sold or services rendered.

The **revenue collection (RC) process** is an interacting structure of people, equipment, methods, and controls designed to: 1. Support the repetitive work routines of the credit department, the cashier, and the accounts receivable department1

1 To focus our discussion, we have assumed that these departments are the primary ones related to the RC process. For a given organization, however, the departments associated with the RC process may differ.

2. Support the problem-solving processes of financial managers

3. Assist in the preparation of internal and external reports

4. Create information flows and recorded data in support of the operations and management processes

First, the RC process supports the repetitive work routines by capturing, recording, and communicating data resulting from the tasks of billing customers, managing customer accounts, and

collecting amounts due from customers. Next, the RC process supports the problem-solving processes involved in managing the revenue stream of the company. As but one example, the credit manager, reporting to the treasurer, might use an accounts receivable aging report such as the one in Figure to make decisions about extending further credit to customers, pressing customers for payment, or writing off worthless accounts. Third, the RC process assists in the preparation of internal and external reports, such as those demanded by investors and bankers. Finally, the information process creates information flows and stored data to support the operations processes and decision-making requirements associated with the process.

The RC process occupies a position of critical importance to an organization. For example, an organization needs a rapid billing process, followed by close monitoring of receivables, and a quick cash collections process to convert sales into cash in a timely manner. Keeping receivables at a minimum should be a major objective of an RC process. While we tend to associate the RC process with mundane recordkeeping activities, the process also can be used to improve customer relations and competitive advantage. First, let's take a look at the organizational aspects of the RC process.

Organizational Setting

A horizontal view of the relationship between the RC process and its organizational environment. Like its counterpart in Unit 10, it shows typical information flows handled by the RC process. The flows provide an important communications medium among departments and between departments and entities in their relevant environment. The object here is simply to have you identify the major information flows of the RC process. Technology Insight discusses how horizontal information flows in an enterprise system become automated and therefore more efficient in terms of supporting the RC process.

Next, we introduce the key "players" shown within the "Finance" entity of Figure (i.e., those boxes appearing in the right-most triangle of that figure). As illustrated by the figure, the major organizational subdivision within the finance area is between the treasury and controllership functions. Most organizations divorce the operational responsibility for the security and management of funds (treasury) from the recording of events (controllership). In other words, the treasurer directs how the company's money is invested or borrowed (i.e., an external focus), and the controller tracks where sales and other income comes from and how it is spent (i.e., an internal focus). The pervasive control plans (see Unit 8) of segregation of duties and physical security of resources motivate this division between the treasury and the controllership functions. Within the treasury function, the activities having the greatest effect on the RC process relate to the credit manager and the cashier. First, note that the credit manager is housed within the finance area rather than within marketing. This separation of the credit and sales functions is typical. If the credit function were part of marketing, credit might be extended to high-risk customers simply to achieve an optimistic sales target.

It is important also to separate the credit function (event authorization) from the recordkeeping functions of the controller's area. Within the controller's area, the major activities involved with the RC process are those of the accounts receivable department. This functional area is primarily involved in recordkeeping activities.

Managing the RC Process: Leveraging Cash Resources

It seems a simple concept—to increase net income without increasing the amount of sales you must reduce costs. The RC process provides several opportunities to cut costs through emerging technologies and improved management processes. We discuss three frequently used methods in this section: (1) customer self-service systems, (2) digital image processing systems, and (3) cash receipts management.

CRM: Customer Self-Service Systems

In Unit 10 we saw customer relationship management (CRM) systems and how they can be used to improve customer management and service during the M/S process. We extend that discussion here by looking at another common feature of CRM systems—customer self-service systems. A **customer self-service system** is an Information Systems extension that allows a customer to complete an inquiry or perform a task within an organization's business process without the aid of the organization's employees.

Banks were probably the first industry to implement such systems on a broad base with the introduction of automated teller machines (ATMs). ATMs allow a customer to withdraw cash, make deposits, transfer funds between accounts, and so forth, without the help of a teller. Another place where similar added convenience has become widespread is the so-called "pay-at-the-pump" system for purchasing gasoline. In many cases, a human worker is not even required onsite, as a set of gasoline pumps are provided on location and purchases are made with either credit or debit cards. Telephone systems through which the customer selects options and enters account information with number keys are a common self-service application.

Internet systems that provide access to customers are now the norm in many industries. While these systems tend to take customers about as much time to use as telephone-based systems, studies show that consumers prefer Internet-based systems to the much-maligned phone-based systems. Internet-based systems also bring much more capability to systems. For instance, delivery companies (i.e., FedEx, UPS, etc.) now allow users to connect through the Internet and identify where their package is currently located, and if delivered, who signed for it.

A major benefit of these systems arises from the interconnection of customer self-service systems with enterprise systems. In some companies, customers can now check on their orders as they progress through the manufacturing process or even check on inventory availability before placing orders. Some of the more advanced systems also let customers check production planning for future manufacturing to determine if goods will be available at the time they will be needed.

Why are companies so interested in customer-self service systems and willing even to allow access to information in their internal systems? Quite simply, the payback on such systems is huge because of the reduced number of people needed to staff customer call centers. Reduction of staffing needs for call centers counterbalances the high human turnover in such centers, a result of boredom associated with the job.

Digital Image Processing Systems

Many of the capabilities of digital image processing systems were explored in Unit 4. Here, we take a brief look at the use of digital image processing systems in the RC process. Because of the amount of paper documents that traditionally flowed through the RC process, the ability to quickly scan, store, add information to, and retrieve documents on an as-needed basis can significantly reduce both labor costs for filing and the physical storage space and structures necessary for storing paper-based files.

Here is how digital image processing systems typically work. Given the abundance of digital image documents that rapidly stack up in a large payment processing center, these documents need to be organized and filed away (much like their paper counterparts). Electronic folders are created to store and organize related documents. The folders are retrievable via their electronic tabs. As a result, the image storage and retrieval processes logically parallel the same processes used in traditional paper systems, without the headache of storing the mounds of paper and having to deliver requested documents by hand across the building or even across the world. Likewise, if a customer contacts a customer service representative, the representative can quickly retrieve the digital image of each customer statement and provide the customer a timely response—avoiding wasted time with retrieving paper documents and possible call-backs to the customer. Specific examples from practice are discussed in Technology Application. We will take another look at the use of digital image processing during the controls discussion later in this unit.

Managing Cash Receipts

The advent of electronic banking has made companies acutely aware of the critical importance of sound cash management for improving earnings performance. The name of the cash management game is to free up funds so that they either can be invested to earn interest or used to reduce debt, thus saving interest charges. Of course, before cash can be invested or used for debt reduction by the treasurer, it first must be received and deposited. The overall management objective, therefore, is to shorten as much as possible the time from the beginning of the selling process to the ultimate collection of funds.

In the billing function, the goal is to get invoices to customers as quickly as possible, with the hope of reducing the time it takes to obtain payments. Having the RC process produce invoices automatically helps ensure that invoices are sent to customers shortly after the goods have been shipped.

At the other end of the process, the treasurer is concerned with potential delays in collecting/depositing customer cash receipts and having those receipts clear the banking system. The term **float,** when applied to cash receipts, is the time between the customer's making payment and the availability of the funds for company use. Float is a real cost to a firm. Enhanced processing of checks, charge cards, and debit cards can reduce or eliminate float associated with cash receipts.

Logical Process Description

The principal activities of the Revenue Collection process are to bill customers, collect and deposit cash received from those customers, record the invoices and cash collections, and inform the general ledger system to make entries for sales and cash receipts. In addition to the billing and cash receipts functions, the RC process manages customer accounts. Activities normally included in this process are sales returns and allowances, account write-offs, and sending periodic statements to customers. This section shows and explains the key event data and master data used by the process.

Logical Data Flow Diagrams

As you learned in Unit 2 and saw applied in Unit 10, our first view of the process is a general one, shown in the form of a context diagram. For the RC process, that view appears in Figure 11.3. Note the external entities with which this process interacts and the data flows running to and from those entities.

Now let's explode Figure into the level 0 diagram reflectedin Figure. In this expanded view of the process, we see that the single bubble in Figure has become three process bubbles. We also see the event and master data for this process. At this point, review Figure and compare it to Figure to confirm that the two figures are "in balance" with each other. Each of the three process bubbles shown in the level 0 diagram are decomposed into their lower-level diagrams in Appendix A.

In the section "Logical Data Descriptions" that follows later in the unit, we define or explain the accounts receivable master data, sales event data, and invoice data. Before proceeding, let's take a brief look at the information content of an invoice. Figure is an example of a sales order inquiry of invoice items. The **invoice** is a business document used by a vendor to notify the customer of an obligation to pay the seller for the merchandise ordered and shipped. Notice that the information at the top of the screen represents that part that would be printed to an invoice to identify the unique order placed and associated with a specific customer. The body of the screen captures the item or items ordered by the customer and the related pricing information. When the invoice is printed, it may often include the payment details.

Logical Data Descriptions

Seven data stores appear in Figure, the level 0 diagram, five of which are related to event occurrences. Of the two master data stores, the customer master was defined in Unit 10.

Accounts receivable master data contain all unpaid invoices issued by an organization and awaiting payment. As the invoice is created, a record of the receivable is entered in the master data. Subsequently, the records are updated—i.e., the receivable balance is reduced—at the time that the customer makes the payment. The records also could be updated to reflect sales returns and allowances, bad debt write-offs, or other adjustments.

The accounts receivable master data provide information useful in minimizing outstanding customer balances and in prompting customers to pay in a timely manner.

Now let's look at the event data maintained in the RC process. First, the process records an entry for the sales data after it has validated the shipment and as it produces an invoice. In the previous section, we showed you a specimen invoice. The logical data definition for **sales event data** would essentially comprise one or more records of invoices. However, each data record would not contain all of the details reflected on the invoice itself. For example, item numbers, descriptions, quantities ordered, quantities shipped, and quantities back ordered typically are not recorded in the sales event data. Rather, these details would be found in the invoice data.

Accounts receivable adjustments data are created as sales returns, bad debt write-offs, estimated doubtful accounts, or similar adjustments are processed as part of managing customer accounts. As in any event data, records in this data store are typically keyed by date.

Cash receipts data, created when customer payments are recorded, contain details of each payment as reflected on the remittance advice accompanying a payment. A **remittance advice (RA)** is a business document used by the payer to notify the payee of the items being paid. The RA can take various forms. For instance, it may be a copy of the invoice, a detachable RA delivered as part of a statement periodically sent to the customer (often a "stub" attached to the statement, a turnaround document), or a stub attached to the payer's check. In any case, RC uses the RA to initiate the recording of a cash receipt. Finally, as its name suggests, the remittance advice file contains copies of the remittance advices themselves.

Types of Billing Systems

In general, there are two kinds of billing systems. A **postbilling system** prepares invoices after goods have been shipped and the sales order notification has been matched to shipping's billing notification. The data flow diagrams in this section and in Unit 10 assume a postbilling system.

A **prebilling system** prepares invoices immediately on acceptance of a customer order—that is, after inventory and credit checks have been accomplished. Prebilling systems often occur in situations where there is little or no delay between receipt of the customer's order and its shipment. For instance, prebilling systems are not uncommon in catalog sales operations such as that of L.L. Bean. In such systems, there is no separate sales order document; copies of the invoice serve as the picking ticket, packing slip, and other functions required by the M/S process.2 In other words, the customer is billed (and the inventory, accounts receivable, and general ledger master data are updated) at the time the customer order is entered. However, the customer copy of the invoice is not released until shipment has been made. For this type of system to operate efficiently, the inventory control system must be very reliable. If an order is accepted and an item then turns out to be unavailable, all financial records have to be adjusted. 2 By eliminating one source document (the sales order) and a separate data transcription step (from shipping documents to the customer invoice), prebilling helps to ensure certain control goals. For that reason, we include prebilling procedures as a control plan for the billing process in a later unit section.

Physical Process Description of the Billing Function

Figure 11.6 presents a process for billing events. From Unit 10, you have an understanding of the order entry and shipping functions leading up to billing. Review the flowchart for general ideas.

The Billing Process

At the time the sales order documents were prepared in the order entry department, copy 1 was sent to the billing department (the annotation to the left of the sales order data indicates that these “sales order notifications” are held pending receipt of the shipping notices). At the end of each day, billing receives (from the shipping department) batches of bills of lading (copy 1), accompanied by shipping notices (sales order copy 2).

In the billing department, a clerk compares the details of these documents. Data that fail to pass the document-matching control are removed from the batch; these data are handled by a separate exception routine. Corrected data will be submitted to the computer during a subsequent processing cycle.

If there is agreement among the data items, the billing clerk prepares batch totals, logs each batch, and sends the batches to data control. Data control logs the batches and forwards them to data preparation. Data preparation clerks records the shipping notices to the sales event database. A second clerk reenters the inputs. After reconciliation of any differences between the manually calculated batch totals and the batch totals calculated by the program, the sales data are forwarded to computer operations. This concludes the recording process.

The first step of the update process is to sort and merge sales data in order to prepare the data for sequential processing against the accounts receivable master data. A maintenance run brings the master data up to date and prints one or more reports. Any errors discovered during the process run are recorded with the error suspense data along with a record of each sales order (i.e., shipping notice) number processed during the run. Output invoices are sent back to data control to be logged out and then are sent to the billing department. Once the invoices have been received by the billing department, a clerk logs the batch back in and matches the invoices with the sales orders and bills of lading. If the documents match, the original invoice is sent to the customer, and the copy is filed with the sales order and bill of lading. Once you have had the opportunity to study the billing process

documented in Figure, stop and consider how this might change in an enterprise system environment. After you have thought through the impact and the resulting changes to Figure, read Technology Insight, which provides an overview of how a fully implemented enterprise system impacts the billing process discussed in this unit.

Selected Process Outputs

A variety of outputs (records, documents, statements, and reports) are generated in this process. The key document/record produced by the process depicted in Figure is the sales invoice. (Invoice

records are depicted in Figure The computer numbers these documents/records sequentially.

Another important document, the customer monthly statement, is prepared at the end of each month from data appearing in each customer's accounts receivable master data record. Sending periodic customer statements is part of the function of managing customer accounts. Other analyses and reports can be prepared as needed. For example, if an accounts receivable aging report were desired, the relevant account data would be extracted from the accounts receivable master data.

Application of the Control Framework for the Billing Function

This section applies the control framework to the billing function. Figure presents a completed control matrix for the systems flowchart depicted in Figure is annotated to show the location of the control plans keyed to the control matrix.

Control Goals

The control goals listed across the top of the matrix are derived from the framework presented in Unit 9. Effectiveness of operations shows only two representative operations process goals. Obviously, in actual billing processes, other operations process goals are possible. As mentioned in Unit 9 and reinforced in Unit 10, the resource security column should identify only the assets that are directly at risk. For that reason, cash is not listed because it is only indirectly affected by the validity of the billings. The resource of interest here is the accounts receivable master data. Controls should prevent unauthorized access, copying, changing, selling, or destruction of the accounts receivable master data.

To focus our discussion, we limit our coverage of process inputs to just the shipping notice. Note, however, that other process inputs could be included in the matrix. From the point of view of the billing process, valid bills are those that are properly authorized and reflect actual credit sales. For example, a bill should be supported by a proper shipping notification and should be billed at authorized prices, terms, freight, and discounts.

Recommended Control Plans

Each of the recommended control plans listed in the first column of the control matrix is discussed in Exhibit. This exhibit is divided into two sections:

• A. Billing process control plans that are unique to the billing process.

• B. Controls for the processing technology in place or that apply to any business process. Your study of Unit 9 supplies understanding of how these plans relate to specific control goals. In other words, you should be able to explain the cell entries in Figure for these four control plans. If you cannot do so readily.

As usual, you will find that some of the recommended control plans are present in the process and others are missing. As you study the control plans, be sure to notice where they are located on the systems flowchart.

Physical Process Description of the Cash Receipts Function

As discussed earlier, the procedures employed in collecting cash vary widely. For example, some companies ask customers to mail checks along with remittance advices to the company, others ask customers to send payments to a designated bank lockbox, while in e-business environments some form of electronic funds transfer is generally used. Figure depicts a process in which customer payments arrive by mail. The source documents include checks and remittance advices. Each day, the process begins with mailroom clerks opening the mail. Immediately, the clerks endorse all checks. They assemble enclosed statements (remittance advices that come in the form of billing statement detachments from the customer invoice—i.e., turnaround documents) in batches and prepare batch totals for control purposes. The receipts data—batch total and remittance details from the customer billing statements—are then entered into the computer system via a scanning process and use of optical character recognition technology in the mailroom. The computer edits the data as they are entered and computes batch totals. Once the data are verified, details are written to the cash receipts event data. The batched statements are sent to the accounts receivable department for filing, and the checks are transferred to the cashier. For most processes of the type illustrated in Figure, input requirements are minimal. As indicated, the editing process verifies the correctness of the entered data, including customer number and so forth. By accessing open invoice data that reside within the accounts receivable master data, the process also verifies that any cash discounts taken by the customer are legitimate (i.e., they have been authorized). To check the dollar amount of each invoice remitted, the system calculates the balance due by adding the cash payment to the cash discount taken (if any); it then compares the computed balance-due total to the balance-due total scanned in by the mailroom clerk.

Once the data have passed all the control checks, the accounts receivable master data are updated. Also, the computer generates various cash reports and prepares the deposit slip. The deposit slip is transferred to the cashier. The cashier compares the checks and the deposit slip; if they agree, all documents are sent to the bank. Once you have had the opportunity to study the cash receipts process documented in Figure 11.8, consider how this process might change in an enterprise system environment. After you have thought through the impact and the resulting changes to Figure, read Technology Insight, which provides an overview of how a fully implemented enterprise system affects the cash receipts process discussed in this unit.

Control Goals

By now, you are familiar with the control goals listed in the column headings of the matrix. We will discuss only two of those goals. First, as you learned in Unit 7, the COSO study and report on internal control recommends three categories of control goals, the third being compliance with applicable laws, regulations, and contractual agreements. Also, recall that we elect not to show the "compliance" goal as a separate category but to include it under the system goals for the operations system. As we did with Causeway's cash receipts process in Unit 9, we assume that the company whose process appears in Figure has loan agreements with its bank that require it to maintain certain minimum cash balances on deposit. For that reason, operations process goal C—"To comply with minimum balance agreements with our bank"—appears in Figure. Our second comment concerns the input validity (IV) control goal. We define valid remittance advices as those that represent funds actually received and for which cash discounts have been authorized and approved.

Recommended Control Plans

Each of the recommended control plans listed in the matrix isdiscussed in Exhibit. We have intentionally limited the number of plans to avoid redundancy. As you study the recommended control plans, be sure to check where they are located on the systems flowchart. Note that Exhibit is divided into two sections: (A) Cash receipts process control plans that are unique to the cash receipts function, and (B) other control plans.

Conclusions

With the conclusion of this unit, we complete the discussion of the order-to-sales process, as depicted in Figure. In later units, we discuss the interaction of M/S and RC with the other key business processes in an organization. This unit presented a number of ways that technology can affect the operations of RC. For example, technology was discussed as a means of solving certain problems regarding cash flow. What's in the future? We are rapidly moving toward a checkless society. Even cash is becoming less of an accepted medium for payment. Your challenge will be to keep abreast of the ways businesses are affected by the transition from checks and cash to electronic transfers of money.

REVIEW QUESTIONS

1. Explain the Application of the Control Framework for the Billing Function.
2. Describe the Physical Process Description of the Billing Function.
3. Discuss about the Customer Self-Service Systems, how it is different from CRM.
4. Explain the process of Managing Cash Receipts with the help of control plan.
5. Explain the revenue collection (RC) process and its benefits.

FURTHER READINGS

- Information System Tecnology- Ross Malaga
- Information System Today-Leonard Jessup
- An Illustrated Information Technology-Alan Witchcomb
- Information Technology For Management Henry C.Lucas
- Information Technology in Business Management Dr. Mukesh Dhunna, J.B. Dixit

IMPORTANT NOTES

UNIT–12 THE “PURCHASE-TO-PAY” (PTOP) PROCESS

CONTENTS

Introduction

We begin by reviewing how the PtoP process combines with other processes within a company. depicts the PtoP process. Note that the PtoP process interacts with inventory (in the Order to- Cash process) as the ordering, receipt of goods, and updating of inventory data takes place. The PtoP process also interacts with the general ledger (Unit 14). We examine those relationships later in the unit. Let’s take a closer look at the PtoP process.

Process Definition and Functions

The **Purchase-to-Pay process** is an interacting structure of people, equipment, methods, and controls that is designed to accomplish the following primary functions:

1. Handle the repetitive work routines of the purchasing department, the receiving department, the accounts payable department, the payroll department, and the cashier2 2 To focus our discussion, we have assumed that these four departments are the primary operating units related to the PtoP process. For a given organization, however, the departments associated with the process may differ.
2. Support the decision needs of those who manage the departments listed in item.
3. Assist in the preparation of internal and external reports

First, the PtoP process handles repetitive work routines by capturing and recording data related to the day-to-day operations of affected departments. The recorded data then may be used to generate source documents (such as purchase orders and receiving reports) and to produce internal and external reports.

The PtoP process prepares a number of reports that personnel at various levels of management use. For example, the manager of the purchasing department might use an open purchase order report to ascertain which orders have yet to be filled. The cash disbursements manager might use a cash requirements forecast to help her decide which invoice(s) to pay next.

Finally, the PtoP process assists in the preparation of external reports such as financial statements. The process supplies the general ledger with data concerning various events related to the procurement activities of an organization.

Before leaving this section, we need to clarify two terms that we will be using throughout the unit: goods and services. Goods are raw materials, merchandise, supplies, fixed assets (e.g., buildings, machinery), or intangible assets (e.g., patents, copyrights, franchises). Services are tasks performed by outside vendors, including contractors, catering firms, towel services, consultants, auditors, and the like. Employee activities feeding the payroll process are a specialized form of services.

Organizational Setting

You are already familiar with some of the roles shown in the figure. We will concentrate on the managers or the supervisors of the accounts payable, payroll receiving, and purchasing departments.

A Vertical Perspective

The accounts payable department is responsible for processing invoices received from vendors, preparing payment vouchers for disbursement of cash for goods or services received, and recording purchase and disbursement events. Responsibility for all cash disbursements lies with accounts payable, except payroll, which is handled separately by the payroll department.

The receiving department is responsible for receiving incoming goods, signing the bill of lading presented by the carrier or the supplier in connection with the shipment, reporting the receipt of goods,3 and making prompt transfer of goods to the appropriate warehouse or department.

3 In this section and the section describing the logical PtoP process, we assume that the receiving supervisor also is responsible for indicating that services have been received. In practice, the receipt of services might well be reported by various operating departments instead.

The chief purchasing executive assumes various titles in different companies, such as manager of purchasing, director of purchasing, or purchasing agent. We use the term purchasing manager. The purchasing manager usually performs major buying activities as well as the required administrative duties of running a department. In many organizations, professional buyers do the actual buying.

A Horizontal Perspective

presents a horizontal view of the relationship between the PtoP process and its organizational environment. They show various information flows generated or captured by the process. which discusses how horizontal information flows in an enterprise system become automated and therefore more efficient in terms of supporting the PtoP process.

Goal Conflicts and Ambiguities in the Organization

As discussed in Unit 5, the goals of individual managers may conflict with overall organizational objectives. For instance, some of the managers and supervisors shown in the organization chart might very well be "marching to different drummers." As one specific example, the purchasing manager may well want to buy in large quantities to take advantage of quantity discounts and to reduce ordering costs. Receiving, inspecting, and storing large quantities of inventory, however, likely presents problems for the receiving department supervisor and the warehouse manager.

In addition to goal conflicts between managers, ambiguity often exists in defining goals and defining success in meeting goals. For instance, one of the purchasing goals might be to select a vendor who will provide the best quality at the lowest price by the promised delivery date. But what does this goal mean precisely? Does it mean that a particular vendor must satisfy all three conditions of best quality, lowest price, and timely delivery? Realistically, one vendor probably will not satisfy all three conditions.

Recall from Unit 5 that prioritizing goals is often necessary to choose the best solution given the various conflicts and constraints placed on the process. This necessity implies that trade-offs must be made in prioritizing among goals that conflict. For example, if a company operates in an industry that is extremely sensitive to satisfying customer needs, it may be willing to incur excessive cost to ensure that it is procuring the best quality goods and obtaining them when needed.

Logical Process Description

This section expands on the PtoP process. Once again, logical data flow diagrams present the basic composition of a typical process. We consider the relationship between certain goals of the process and the process' logical design. The section includes brief discussions of the interfaces between the PtoP and Inventory processes. We also examine the process' major data stores.

4 As we have in several earlier units, we remind you once again that the data stores in the logical DFDs and systems flowchart might well be the PtoP process's view of an entity-wide database.

Discussion and Illustration

To focus our discussion, we have assumed that the PtoP process performs four major subprocesses, represented by the four bubbles in the DFD. Note that purchase requisitions are initiated by entities outside the context of the PtoP process. The purchasing process begins with each department identifying its need for goods and services. These needs are depicted by one of two data flows entering bubble 1.0: inventory's purchase requisition or purchase requisition—supplies and services.

At first glance, the processes involved in preparing a purchase requisition may appear to be quite simple and straightforward. However, a closer analysis reveals that the techniques and methods involved in determining what inventory to order, when to order it, and how much to order are considerably more intricate and complex than we might first imagine. The processes associated with reordering inventory involve several important concepts and techniques, such as cyclical reordering, reorder point analysis, economic order quantity (EOQ) analysis, and ABC analysis. We discuss each of these methods in Technology Insight. Each of the four process bubbles shown in the level 0 diagram are exploded in

Appendix A, along with a discussion of the handling of exception routines.

Vendor selection can have a significant impact on the success ofan organization's in ventory control and manufacturing functions. For example, goods must arrive from vendors when needed and must meet required specifications. After selecting a vendor, the buyer prepares a **purchase order**, a request for the purchase of goods or services from a vendor. Typically, a purchase order contains data regarding the needed quantities, expected unit prices, required delivery date, terms, and other conditions. The purchase order notification could take a number of forms— including paper or electronic. It is not uncommon for the copy available for the receiving department to be a **blind copy**, meaning that certain data are blanked out (i.e., blinded) or simply not included in an electronic replica. For instance, the quantities ordered might be blanked out so that the receiving personnel will not be influenced by this information when counting goods. Price data may also be blinded because receiving personnel have no need to know that information.

At some point, the vendor uses a notification known as a **vendor acknowledgment** to inform the purchaser that the purchase order has been received and is being processed. In the case of inventory, the **vendor packing slip**, which accompanies the purchased inventory from the vendor and identifies the shipment, triggers the receiving process. Once annotated with the quantity received, the PO receiving notification becomes a **receiving report**, which is the form used to document and record merchandise receipts. As in the case of the receipt of goods, services received also should be documented properly. Some organizations use an **acceptance report** to acknowledge formally the satisfactory completion of a service contract. The acceptance report data supports the payment due to the vendor in the same way as the receiving report. For simplicity in drawing the DFDs, we intend that the single data flow labeled receiving report represents either a receiving report (goods) or acceptance report (services).

The accounts payable process is triggered by receipt of the **vendor invoice**, a business document that notifies the purchaser of an obligation to pay the vendor for goods or services that were ordered by and shipped to the purchaser.

Logical Data Descriptions

The general PtoP process entails several different data stores. The **accounts payable master data** contain all unpaid vendor invoices. The design of the accounts payable master data should consider how data are processed when the cash manager is deciding what payments to make. For example, the manager may want to merge vendor invoices so that the total amount due each vendor can be accumulated. Alternatively, the manager might want to select specific invoices for payment.

The **vendor master data** contain a record of each vendor from whom the organization is authorized to make purchases. Purchasing personnel when selecting an appropriate vendor usually accesses the data. During processing, vendor data are retrieved to prepare purchase orders and to issue payments. In addition to storing identification data, vendor data are used by management to evaluate vendor performance and to make various ordering decisions. The **purchase order master data** are a compilation of open purchase orders and include the status of each item on order. To keep track of a purchase, the purchasing department generally creates an entry in the purchase order master data. The data are a compilation of open purchase orders, including information about the status of each item on order. The order is closed only on receipt and acceptance of all goods detailed on the order. Other data stores appearing in the data flow diagrams are the:

• **Inventory master data**, which contain a record of each inventory item that is stocked in the warehouse or is regularly ordered from a vendor. These records are used to manage the inventory and to support the inventory balance in the general ledger.

• **Receiving report data**, which contain a record of each receipt. These data combine purchase order data with the quantity received and date goods were received.

• **Cash disbursements event data**, which show, in chronological sequence, the details of each cash payment made.

Technology Trends and Developments

Recall from Unit 4 the rapid movement toward electronic document interchange (EDI) to improve the business processes between two organizations exchanging goods. The PtoP process is the primary candidate for EDI in major organizations (although they certainly may use this technology in the Order-to-Cash process as well). As noted in Technology Application 12.1, several major companies have implemented EDI systems into the P toP process, resulting in significant cost savings. An increasing trend among some of these major companies is to require all vendors to use EDI in their business processes with the company. You may also recall in Unit 4 that we discussed the emergence of electronic marketplaces that create a more competitive purchasing market. The introduction of these marketplaces into the business processes of major business organizations is usually the Purchase-to- Pay process. Accordingly, we explore several examples of such marketplaces arising in certain industries as described in Technology Application 12.2. Recall from Unit 4, however, that there are many risks also involved in the move towards electronic marketplaces that may limit success in the short-term.

Physical Process Description

As the name implies, **paperless systems** eliminate documents and forms as the medium for conducting business. In a truly paperless system, printed reports are replaced with screen displays of requested information. With the increasing use of EDI, electronic funds transfer (EFT), digital image processing, electronic mail, workflow software, enterprise systems, and similar technologies, is the paperless office at hand? A growing number of organizations operate the bulk of their business processes using paperless systems. The major roadblocks are more likely to be organizational and behavioural /psychological than technological in nature. Over time, these cultural barriers to the paperless office continue to disintegrate as a new generation of managers—who have grown up with the computer as a fact of their daily lives—emerges.

Online billing is one area wherein widespread acceptance is beginning to be noted.

The physical model of the PtoP process presented in this section employs electronic payments and data communications technology. Although the process is not completely paperless, hard copy documents are held to a minimum.

Discussion and Illustration

At several points in the flowchart, you see notations that exception routines are not flowcharted. They are also omitted from the discussion in the following paragraphs.

Requisition and Order Merchandise As shown in the first column, the purchasing process begins when a cost center employee establishes a need and completes a requisition form on the computer system. When a requisitioner calls up the system, the system automatically supplies a four-digit requisition number. The requisitioner designates the items desired, as well as information about the cost center making the request.

The completed requisition is routed via the system to a cost center supervisor for approval. Depending on the amount and nature of the requisition, several approvals may be required. Approval is granted in the system by forwarding the requisition to the next person on the list; approval codes are attached to the record along the way and are displayed in the appropriate boxes on the requisition form. The approved requisition is automatically recorded to the audit data and routed to the purchasing department.

In the purchasing department, a buyer checks the requisition for proper approval by matching the codes against "authorized approver" data. Then, vendor candidates are chosen by consulting the inventory and vendor master data. Final vendor selection and price determination may require contact with the potential vendor. When the vendor choice is settled, the buyer updates the requisition by adding any necessary details. Next, the system displays the purchase order (see the second page of the flowchart), and the buyer or the purchasing manager checks the purchase order data on the screen against the requisition data on the screen. The manager then approves the purchase order, a system confirmation is made available to the requisitioner, a record is created in the purchase order master data, and the inventory records are updated to reflect the quantity on order. The purchasing process releases the PO to the EDI translator, where it is converted to the appropriate EDI format. The translation software also encrypts the EDI message and appends a digital signature to it.

Receive Merchandise On the third page of the flowchart, we see that receiving department personnel receive and count the merchandise sent by the vendor. They compare the items and item quantities received to those on the open purchase order master data.6 If the shipment is correct, they enter the receiving data into the computer. This information creates a record in the receiving report data, updates the status field in the purchase order data, and records the receipt in the inventory master data. The shipping documents are filed in chronological sequence for audit trail purposes. Alternatively, an image of the shipping documents might be stored on the computer.

The database software prevents receiving personnel from accessing price data in the purchase order master data. In this way, the process implements the blind copy concept explained earlier.

Establish Accounts Payable The organization's system picks up the vendor's invoice from the Value-Added Network (VAN) and routes it to the EDI translator. The EDI translator converts the invoice to the appropriate format and records it in the incoming invoice data. Triggered by the receipt of a batch of EDI invoices, the accounts payable application accesses the purchase order and receiving report data and compares the items, quantities, prices, and terms on the invoice to comparable data from the PO and receiving report data. If the data correspond, a payable is created, and the general ledger is updated. The purchase order, receiving report, and invoice data must be marked so that it cannot be used to establish another payable. **Make Payments** The physical model depicted on the fourth flowchart page utilizes EDI to make the payment. Banks that are members of the National Automated Clearing House (ACH) Association combine EDI and electronic funds transfer (EFT) standards to transmit electronic payments between companies and their trading partners.

As shown in Figure 12.7, the accounts payable master data are searched each day for approved vendor invoices due that day. The cash disbursements application prepares the payment order and remittance advice, updates the accounts payable master data and the general ledger for the payment, and sends the data on to the EDI translator. The translator converts the data to the appropriate format, encrypts the message, adds a digital signature, and sends the EDI payment order and remittance advice on to the communications network.

If the bank is acting as a VAN for the payment order, the communications network sends the data to the bank. Otherwise, the system sends the payment order to a VAN for pickup by the bank. The bank debits the account and then sends the payment order to an automated clearinghouse for processing. Next, the automated clearinghouse sends the data to the vendor's bank, where it is automatically credited to the vendor's bank account. Finally, the vendor's bank transmits the RA and payment data to the vendor. If the electronic remittance advice does not accompany the payment order through the banking system, it would be forwarded directly (via VAN) to the supplier.

7 You should be aware that using electronic funds transfer (EFT) to wire funds between banks and employing EDI to transmit remittance data from the payer's to the vendor's computer system do not necessarily go hand in hand. For instance, a company could utilize EFT to make payments but still rely on paper remittance advices to notify the vendor of the details of what is being paid.

Consider how this process might change in an enterprise systems environment. After you have thought through the impact and the resulting changes to Figure 12.7, read Technology Insight 12.3, which provides an overview of how a fully implemented enterprise system affects the PtoP process discussed in this unit.

Application of the Control Framework to General Expenditures In this section, we apply the control framework from Unit 9 to the PtoP process. Figure 12.8 (pages 442–443)presents a completed control matrix for the annotated systems flowchart shown in Figure 12.7. After briefly discussing the control goals shown as column headings in the matrix, we then consider in Exhibit 12.1 (pages 444– 445) each of the recommended control plans listed in the first column. As you study the control plans, be sure to see where they are located on the systems flowchart.

Control Goals

The following control-goal categories are presented in the matrix. Those for the operations process are:

• Effectiveness of operations relative to four example operations process goals. The first goal, mentioned earlier, might be to select a vendor who will provide the best quality at the lowest price by the promised delivery date. When goods arriving at the receiving department are inspected, counted, and compared to the vendor packing slip, the receiving clerk is helping to achieve a second operations process goal: to ensure that the right goods in the correct amount are received in acceptable condition. To help achieve a third operations process goal, to optimize cash discounts, the responsibility for ensuring savings through cash discounts includes (1) seeing that proper cash discount terms are incorporated in the order, (2) securing invoices promptly from vendors, (3) processing invoices promptly and getting them to the disbursing office within the discount period, and (4) when unavoidable delays are encountered because of some fault of the seller, making sure that the discount privilege is not waived and that the vendor is notified to this effect.

Most cash managers attempt to optimize cash balances to help achieve a fourth operations process goal: to ensure that the amount of cash maintained in demand deposit accounts is sufficient (but not excessive) to satisfy expected cash disbursements. To accomplish this goal, many banks offer to their commercial customers a cash management service by which the bank transfers from the customer's money market or other investment account into its checking account the exact amount needed to cover the checks that clear each day.

• Effectiveness of operations in respect to complying with the organization's code of conduct concerning conflicts of interest, accepting illegal or improper payments, and like matters. Recall from Unit 8 that one of the three categories of control objectives is compliance with applicable laws, regulations, and contractual agreements. For each process to which it applies, we have elected to include COSO's "compliance" objective under our operations goals.

• Efficiency of the purchasing, receiving, payables, and cash disbursement processes.

• Resource security; note that the resources include assets, cash, inventory, and the information resources represented by the purchase order and accounts payable master data. Controls for the information system are:

• Input validity (IV) of input events8

• Input completeness (IC) and input accuracy (IA)

• Update completeness (UC) and update accuracy (UA) Input validity for each input event type can be summarized as follows:

• Purchase requisitions. Those that have been properly approved and that utilize existing (real) and approved vendors.

• Vendor packing slips. Those that are supported by authorized purchase orders and that represent existing (real) receipts of goods and services.

• Vendor invoices. Those that bill the company for goods that were actually ordered and actually received (i.e., the invoices are supported by proper purchase orders and receiving reports).

• Payment vouchers. Those that are documented by validated, unpaid vendor invoices. Note that in this case, part of ensuring validity is to prevent paying for an item twice. In the matrix, please note that the inputs and master data vary for each of the processes. These variations can be summarized as follows:

Process Nature of inputs Updated master data

purchasing purchase requisition purchase order

receiving vendor packing slip purchase order

payables vendor invoice accounts payable

cash disbursements payment voucher accounts payable

Recommended Control Plans

Before analyzing control plans for the PtoP process, let's begin by summarizing some plans that are not listed in the control matrix nor discussed in Exhibit 12.1. First, in the interest of simplicity, we exclude those plans that are related to the information processing method (see Unit 9), such as preformatted purchase requisition screens, online prompting, digital signatures, and programmed edit checks.

As we mentioned in earlier applications of the control framework, the controls enumerated here should be included, wherever appropriate, in your list of "recommended control plans" (step 3 in "Steps in Preparing a Control Matrix," Exhibit 9.1 on page 287). Second, certain control plans simply aren't appropriate to the procedures used in the process that we are reviewing. However, you might very well encounter them in practice. The following are a few examples:

• Where paper documents are the basis for making disbursements, paid invoices (and supporting purchase orders and receiving reports) are often marked "void" or "paid" to prevent their being paid a second time. In paperless systems, the computerized payable records would be "flagged" with a code to indicate they had been paid and to prevent duplicate payment.

• Where payments are by check, appropriate physical controls should exist over supplies of blank checks and signature plates that are used for check signing.

• It is not uncommon to have more than one authorized signature required on large-dollar checks.

• Most companies have standing instructions with their banks not to honor checks that have been outstanding longer than a certain number of months (e.g., three or six months).

• To prevent alteration of (or misreading of) check amounts, many businesses use check-protection machines to imprint the check amount in a distinctive color (generally a blue and red combination).

Finally, another control plan not presented in the control matrix is to have the firm's internal audit staff conduct periodic vendor audits. In a vendor audit, the purchasing organization's internal auditors periodically visit a vendor's office and examine its records. At a minimum, the site visit and inspection of the vendor's facilities validates the existence of the vendor. The vendors chosen for udit

could be those doing large volumes of business with the company, those with peculiar names or names very similar to one another, those whose invoices are in tight sequential order, or other characteristics that might flag the vendor's relations to a firm as peculiar or unusual. The on-site audit program generally covers vendor disbursements for entertainment, promotion, commissions, travel, donations, payroll, and the like. Now turn to Exhibit 12.1 and study the explanations of the cell entries appearing in the control matrix. As you know from similar studies in prior units, understanding how the recommended control plans relate to specific control goals is the most important aspect of applying the control framework.

Conclusions

This unit has covered the PtoP process that accounts for most of a company's expenditures. Like the Order-to-Cash process, the purchasing component of the PtoP process fills a central coordinating role as it supports the supplies and inventory components of an organization's operations.

The physical process implementation presented in this unit evidences many attributes of the paperless office of the future. Are these visions of a paperless society that farfetched? Hardly. The technology exists today, and many companies have availed themselves of some, if not all, of that technology.

REVIEW QUESTIONS

1. Explain the Process and Functions PtoP .
2. What are the steps involve in Physical Process Description?
3. What organisational setting are required for PtoP.
4. Give some examples of control plans of PtoP.
5. Discuss the benefits of control plans of PtoP

FURTHER READINGS

- Information System Tecnology- Ross Malaga
- Information System Today-Leonard Jessup
- An Illustrated Information Technology-Alan Witchcomb
- Information Technology For Management   Henry C.Lucas
- Information Technology in Business Management   Dr.   Mukesh Dhunna, J.B. Dixit

UNIT-13 THE BUSINESS REPORTING (BR) PROCESS

CONTENTS

Process Definition and Functions

Similar to the business processes covered in Units 10 through 13, the **business reporting process (BR)** is an interacting structure of people, equipment, methods, and controls designed to accomplish both operations and information process functions. Unlike other business processes, the BR process has fewer operational functions; it focuses mainly on information functions. While the other processes perform important functions related to their "work" of providing goods and services to customers, the processing and communicating of information is the work of the BR process.

Periodic financial reports are one of the many kinds of reports that result from the BR process. Their importance lies not only in their critical value for internal decisions, but also in the fulfillment of regulatory and other fiscal requirements. The major source of data for financial reporting is the general ledger (GL). Because financial reporting is so vital to every firm, the general ledger updating and reporting process will appear in detail in the following sections. This detailed example illustrates the issues and complexities of the more inclusive BR process, which itself relies on the general ledger as well as many other database updates first covered in Units 10 through 13.

What are the important Information Systems functions of the business reporting process? • Accumulating data, classifying data, and recording data • Providing for the generation of both ad hoc and predetermined business reports that support operational and strategic decision making

• Preparing general-purpose, external financial statements from data accumulated by other business processes that flow into the general ledger

• Generating Web-based forms of key business reporting information for dissemination via the Internet.

Before beginning your exploration of the BR process, it may be useful to revisit Figure 1.6 (page 18) and think about the competing values of information. Ponder these values as you explore the various types of internal and external information that organizations have and choose to make available to decision makers.

Business Reporting: The Special Case of the General Ledger While many BR functions support a wide range of managers and decision makers in an organization, some financially oriented business-reporting activities remain in the purview of the finance function. Information Systems typically support **ad hoc** (i.e., on demand) business reporting for the benefit of all decision makers who access data through easy-to-use business intelligence software.

Periodic (i.e., regularly scheduled) business reports, such as the financial reports produced by the financial function from the data stored in the general ledger, are also supported by the Information Systems function. In this section we focus on the role of the general ledger in the BR process and the interactions between the general ledger and its relevant environment.

Before we begin, we should define a term that is used in this section and throughout the unit. A **feeder process** is any business process that accumulates business event data that are then communicated to and processed within the enterprise system database (and to the general ledger within that database). Accordingly, the feeder processes include all those discussed in the earlier business process units, as shown in Figure 14.1. Business event data flow into the enterprise database, from which both periodic and ad hoc reports are produced. The general ledger comprises the accumulation of financially related business event data, providing summary-level data to the financial functions. Consider how the information flows in Figure 14.1 are affected by integrated enterprise systems. The flows from feeder processes to the integrated database permit the consolidation of data, without creating separate physical copies of this data. For example, the general ledger data flows directly from the business processes along with nonfinancial business event data and does not have to be stored separately in its own file or database. The output side from the enterprise systems is much the same, providing information that can be extracted by the respective departments or managers using either pre-established reporting forms or queries of the enterprise system data. Because financial and nonfinancial data are truly integrated, analysts can focus on the provision of more complex and interesting information that can be used to increase the effectiveness and efficiency of the organization's operations and strategies. We will explore some of the possibilities within this extended business reporting capability later in this unit.

As we look to emerging capabilities, we should also consider how the external reporting model is changing. Increasingly, organizations are deciding to make financial information available on the Internet. Currently, there is little standardization to this information between companies. Figure 14.2 (page 498)provides a diagram that synthesizes these various financial information flows in what is labeled the "financial information chain." Note that the "operational data stores" are the central enterprise system database or other business reporting system data storage. From this data store(s),
information is extracted for internal reporting (i.e., the reports on the left hand side of the diagram). Note that for external reporting, however, the information must be first filtered through the chart of accounts and the general ledger. Additional formatting may be required for special-purpose reports, such as those submitted to the Securities and Exchange Commission (SEC) or publication of the statements on the Web. Later in this unit, we will discuss current efforts to improve the standardization and quality of this information to improve the efficiency and effectiveness of business reporting.

Budgets and Financial Reporting

The finance function provides the oversight needed for preparation of required financial reports. Other business reports and analysis, both financial and nonfinancial, are easily accessed by technology supporting business intelligence capabilities. In addition, companies often employ budget analysts to assist managers in the identification and preparation of special reports containing financial plans.

Examples of these include departmental budgets and performance reports.

The **budgeting department** advises and assists managers in preparing their budget. The budgeting department should not actually prepare the budget estimates; it should offer technical advice to the operating line managers as they develop the budgets for their centers. Good participative management practice argues that the responsibility for budget preparation should fall to the operating center managers who later will be held accountable for budget variations.

Some budget assessment reports are called **performance reports** because they compare actual performance with budgeted expectations. In a hierarchically organized company, as information is reported upward, the level of detail is filtered, meaning that figures are aggregated (summarized) as they are reported to successive management levels. Figure 14.3 shows a specimen performance reporting flow for the production arm of an organization.

As we will discuss later in this unit, major enterprise system vendors support much of this additional business reporting demand for performance reporting. The integration of this functionality allows these reports to be generated easily from information captured by business processes and maintained at the business event level in the enterprise-wide database.

Horizontal and Vertical Information Flows

The distinction between horizontal and vertical information flows was introduced at a conceptual level. Perhaps now is a good time to review the concepts shown in Figure 1.5 and enhance that figure based on our study of information systems. Figure 14.4 (page 500)is designed to do exactly that. Along the bottom of Figure 14.4, we can trace the horizontal business event data flows as they progress from left to right through the various operations processes, culminating in the general ledger or BR databases, and resulting in external business reporting. We also see the vertical reporting dimension (in the form of internal performance reports prepared from information supplied by the general ledger, the BR database, and through budgeting) flowing upward in each of the principal functional columns. Again, note that in an enterprise system environment, the distinction between the general ledger and BR databases vanishes, and all business event data can be used as the basis of managerial reports in support of vertical information flows.

Logical System Description

Once again in this unit, we use DFDs to explain the logical features of the business reporting process. This section focuses specifically on the general ledger update and financial reporting pieces of the process, which are fairly standardized in business today due to extensive government regulation. Business reporting is frequently an ad hoc process, making it difficult to portray in a generic diagram. However, a good understanding of the general ledger update activity will give you the foundation to recognize the potential and widespread usefulness of business reporting.

Discussion and Illustration

We start with the highest-level view of the general ledger reporting process; namely, the context diagram,.

Note the business event data flows from the business processes discussed in Units 10 through 13. If you are uncertain about the nature and timing of any of these updates, go back to the appropriate business process unit and review them. Logically, each business event from a feeder process can be posted directly, individually, and immediately to the general ledger. As a practical matter, physical implementations vary. For example, the flows from the feeder processes could comprise summaries of a number of business events posted periodically at the end of a day, week, or month. For example, the RC process may collect data related to sales and send it to the general ledger. The resulting summarized entry to the general ledger would include postings to sales and accounts receivable.

In an enterprise system, these business event data are recorded separately for each sale within the module designed for that business process (e.g., sales). In some enterprise system implementations, these business event data could be batched during sales processing and then used to update the general ledger database at one point. However, the enterprise system maintains data for each individual business event in the underlying business process database, which, for sales, corresponds to the Order-to-Cash process. At this point, however, let’s continue to concentrate on the logical connections of
the individual feeder processes with the general ledger.

• We would want to check business event updates to make sure that they come from the correct feeder process. Do you agree that this check addresses the information system goal of ensuring event data input validity?

• We also want to make sure that no business event updates have been overlooked (recall the discussion of input completeness in each business process unit). Bubbles 4.0, 5.0, and 6.0 are also worth examining more carefully in this figure.

• For general distribution, the business reports in bubble 4.0 and related information are often posted to the entity’s Web site. Frequently, at this stage, the financial statements are reformatted to take advantage of embedded links that can be placed into the Web page. For instance, some companies provide hot links in the financial statements directly to the financial statement notes to make it easier for users to tie the notes with specific financial statement accounts.

• Process 5.0, “Record budget,” provides one example of how the business reporting process can fuel reporting systems that rely on information that has been aggregated in the system—in this case, providing information related to both budgeted and actual results.

• Process 6.0, like some that you encountered in previous units, is triggered by a temporal event (i.e., the data flow into the process from the general ledger master data), rather than by a data flow from another process or from an external entity. Specifically, at an appropriate time, the condition of the general ledger accounts indicates that the accounts should be closed before repeating the accounting cycle for the next accounting period.

The General Ledger Master Data

The **general ledger master data** contain summarized information of all company event data. The main inputs to the general ledger consist of totals, extracted by event type, from the business event data captured in the various feeder processes discussed earlier. One piece of data on each general ledger entry is a code that identifies the source of the entry and provides a beginning point of reference for developing a proper **audit trail**. The code gives the auditor a means of tracing back to the individual business events that have been aggregated into the general ledger balances. Note that in addition to storing the entries of the current period (both monthly and yearly activity are usually maintained in general ledger systems), beginning-of-period and year-to-date balances also are available. In an enterprise system, the user can select any beginning and ending date to accumulate information for a period of time of interest, because the source business event data are maintained.

Thus, if a manager wants to examine sales over a two-week period or a three-month period or any other period, the information can be aggregated through a query to provide the manager the precise information of interest.

Limitations of the General Ledger Approach

Recall in Unit 3 the discussion regarding the limitations of traditional file processing approaches and the emerging focus on event-driven systems. The discussion focused on the limitations that come from having disjointed files for financial and nonfinancial information. The traditional general ledger approach has been a primary suspect as the source of many of these problems. While other business event information may be captured in separate systems operated by other departments, such as marketing, any such nonfinancial information becomes separated from the financial information. Once the end-of-period closings are completed for the general ledger, the detailed business event-level data are eventually purged from the general ledger system—the interest being only in maintaining correct current balances for each account. It is at this point that, even if there were a link between financial and nonfinancial information in the business event data, the relationships are lost as soon as the periodic closings are completed and the financial data discarded. From that point on, information for decision making is limited to only that information captured in the account files. If you decide you want more detailed information than these accounts provide, historical business events usually cannot be reconstructed.

You will recall that in Unit 3 we noted the evolution toward database-driven systems—and in particular, event-driven systems. This discussion explains why the rapidly expanding information needs of management created conflict with traditional general ledger structures. The move toward enterprise systems accelerated because of the frustration of managers who needed access to integrated financial and nonfinancial data.

Technology-Enabled Initiatives in Business Reporting

We begin with three topics related to enterprise systems. The first is simply a brief look at the financial reporting module in an enterprise system, while the second and third topics relate to contemporary extensions of enterprise systems to accommodate recent business reporting interests—i.e., balanced scorecard and business intelligence (as discussed in Unit 5). The fourth topic is also related in some ways to enterprise systems (i.e., major vendors are currently working to build in the functionality), but it is more specifically focused on business reporting via the Internet and the standardization of this reporting for all entities.

Enterprise System Financial Module Capability

Although we discussed earlier in this unit the integration of business reporting in enterprise systems (as well as integration of information from other business process activities), conceptually this integration may still be a bit foggy. For purposes of clarification, let's take a closer look at integration within several modules. Figure 14.7 shows the entry level screen for JDEdwards OneWorld enterprise software. We have exploded the menu options for the financial section to show you the wide range of options that are available in the software just for the financial module. Note that the software interface looks like a very typical Microsoft Windowsbased application. Indeed, the "JDEdwards OneWorld Explorer" interface screen works very similarly to Microsoft's "Windows Explorer." Pointing and clicking with the mouse on higher-level options drills down to lower level menu options. Note on the left hand side that the "Financials" option is highlighted. Directly above the "Financials" option, you see another option at the same level. The "Foundation Systems" option allows the user to set security options, change the way in which information flows through the system, and many other such systems' management- and maintenance-related activities.

With the "Financials" option highlighted on the left side of the screen, note on the right side of the screen that all of the first-level menu options for the financials module appear. These options include information processing capabilities related to all of the business processes we have discussed in this text. Note also that these options clearly go beyond just general ledger activities to include a variety of other information processing and business reporting issues such as cost accounting, billing options, and expense reimbursements. If you think back to the situation at FW Murphy in the opening vignette, it becomes apparent how this functionality would help FW Murphy better monitor their cost processes. Back on the left side of the screen, see that all of the menu options for accounts receivable have been exploded out and are visible. The main processing activities take place in the sub-menus of daily and periodic processing. However, there are also options for configuring the processing of accounts receivable. You may see that the last few menu options in the accounts receivable area include setups for European community countries for value-added tax issues

("EC VAT Processing") and Italian tax-related issues ("Italian IVA Processing"). These options facilitate the operations of multinational corporations. Most large multinational corporations have instituted enterprise systems, in part because of the ease by which cross-border and multi-currency issues can be facilitated within the systems. While we have not exploded the further menus for the other areas beyond accounts receivable, you can see on the left side of Figure 14.7 that the sub-menu options for "Daily Processing," "Periodic Processing,""Advanced and Technical Operations," and "System Set-up," are consistent for all of the areas (i.e., Accounts Payable, General Accounting, etc.)

Take some time to check over the options provided, to see how completely the functionality covers the types of operational business event processing and reporting within each area. Figure 14.8 (page 508)depicts the menu for the distribution and logistics functions offered by JD Edwards. Traditional inventory and procurement processes are augmented by e-commerce capabilities. Business event transactions as well as reporting are supported by the menu items on this initial screen. In Figure 14.9 (page 509), payroll and human resource management activities are listed along with the many reports needed by the government, unions, and internal management. Manufacturing activities are provided by the menu choices in Figure 14.10 (page 510), in which manufacturing processes are tracked, forecasts are generated, and planning is supported.

This multitude of options should give you some feel for the complexity and magnitude of enterprise systems. For security reasons, as well as ease of use, you limit access to menu items to only those needed by a given user to perform his or her responsibilities. You may want to allow a given user to have different privilege levels for different information—i.e., view access, write access, entry access, and/or change access. All of these choices must be carefully specified in the user's profile to set up the system limitations for that specific user. Normally, this profile is set up with the user's ID automatically initiated at log-on.

Balanced Scorecard

The **balanced scorecard** is a methodology for assessing an organization's business performance via four components:

(1) Financial. The financial aspect focuses on more traditional measures of business performance related to how shareholders view the organization's performance.
(2) Internal business processes. The internal business processes relate to the organization's ability to identify its core competencies and to assess how well it performs in these identified areas of competency.
(3) Customers. The customer component focuses on identifying how customers perceive an organization.
(4) Innovation and improvement activities. Innovation and improvement activities are monitored to assess how the organization is continuing to improve and how it is creating additional value.

The concept of balanced scorecard has been around for several years, but it has been only within the last few years that enterprise system vendors have focused on integrating this functionality and in turn making assessment a reasonable possibility. Fundamental to incorporating effective balanced scorecard assessment is the aggregation of varied data in a data warehouse that can then be analyzed using powerful analytical tools—i.e., business intelligence tools as discussed in the next section. Because an enterprise system provides the ability to aggregate the necessary data in its underlying database, linking this data with other data to create the data warehouse is a logical and efficient way to provide balanced scorecard capabilities. In the past two years, all of the major enterprise system vendors have announced new product integration to provide the balanced scorecard functionality. Consider how data captured in the various business processes could be used to support assessment in each of the four areas underlying the balanced scorecard.

Business Intelligence

Fundamental to providing balanced scorecard functionality is the development of business intelligence functionality within enterprise systems. Business intelligence, as presented in Unit 5, is the integration of statistical and analytical tools with decision support technologies to facilitate complex analyses of data warehouses by managers and decision makers. In short, the ideal business intelligence solution within an enterprise system should provide the right tools, the right interface, and access to the right kind of data for effective business decision making.[1] Some examples of successful applications of business intelligence are found in Technology Application 14.2.

Business Intelligence Systems for Aiding the Strategic Planner

Many of the reporting options discussed so far center around ensuring the effective and efficient operations of a company's business processes. The information system supporting the BR process can play an important role in the development of a company's strategic plan in addition to monitoring ongoing operations to measure attainment of the plan. This section discusses the upfront and ongoing assistance that the strategic planner obtains from the information system.

During the strategic planning process, data from the entity-wide database or data warehouse can be compared to data about the competition to determine an organization's relative strengths and weaknesses. For example, these data might include sales trends, gross margin on sales, age of capital assets, skills of existing personnel, and so on. These data can be presented in reports from the existing IS applications, such as sales/marketing, human resources management, fixed assets, finance and inventory, or via the OLAP models incorporated in the BI system. Recall from Unit 5 that data from the environment can also be incorporated into the BI system output. Strategic planners can combine environmental data with those obtained internally to assess the organization's competitive position.

In addition to assisting in the planning phase, the IS can be used to follow up by reporting certain key performance indicators that illustrate the status of processes and critical success factors. For example, the number of customers along with the level of sales and number of customer complaints for each should indicate the status of an organization's sales network. Other key performance indicators might be the number of new products, the cost to manufacture the products, and their selling price. If the data warehouse is developed in light of the strategic plan, many of the data for the key performance indicators should be readily available. Clearly, business intelligence tools are invaluable for companies like FW Murphy (discussed at the beginning of the unit) as they work to manage relationships with key customers like Caterpillar.

EXTENSIBLE BUSINESS REPORTING LANGUAGE (XBRL)

Perhaps the most exciting technology-driven advancement to hit business reporting in its history is that of XBRL. **EXtensible Business Reporting Language (XBRL)** is an XML-based language consisting of a set of tags that are used for business reporting to provide a single, underlying format that can be read by XMLequipped software packages and can be searched by XML-enabled Web browsers. Recall from Unit 4 that XML (eXtensible Markup Language) is a generic Web-based programming standard that interprets a set of user-defined tags to determine the context of information on a Web site and to provide a key to the tags that can be applied by Web users to search a given site easily. XBRL is a specialized business-reporting taxonomy that is based on XML, where the tags are predefined for users so each have a common understanding of the tag's meaning. In this case, XBRL provides uniformity for users of financial statements and other business reporting information. Such uniformity simplifies delivery of information via the Web, enhances the searchability of information, and enables easy uploading, downloading, and comparison of the information within other software packages for mandated reporting, analysis, and so forth.[2]

XBRL has been developed by an international consortium of accounting bodies, software vendors, providers of information, and information-intensive industry representatives in a united effort towards uniformity of business reporting information. Participants in the consortium include many of the international professional accounting bodies, the Big Four professional service firms, Microsoft, IBM, Oracle, SAP, Fidelity, Moody's, and many business intelligence software vendors.

The intent is that with a unified format, enterprise system vendors (and other BR software vendors) can add functionality that will automatically generate XBRL-based reports as well as any other business report. This feature eases the cost and complexity of delivering business information via the Web. Thus, accessibility of information increases for external users of business reports, the information is easier to decipher and analyze, and the information can easily be downloaded for use by other software packages such as spreadsheets, database packages, or data analysis packages. In Technology Excerpt 14.1 we present an article that describes how you can generate your own XBRL statements now if you wish. This article should give you some sense of how XBRL works and how it can facilitate the reporting, reading, and analysis of business information.

Conclusions

The good news is that the integration that makes enterprise systems so vital for organizations has the embedded side benefit of supporting automatic updates through the feeder processes that combine to make the electronic inputs work.

There is very little need for human-generated inputs to the general ledger or other BR components. But what about system outputs? We've come a long way from the days where mandated financial reports were the only "business reporting" application emitting from the IS function. Now, decision makers have access to a wide range of information generated within the organization as well as external data found over the Internet. Will we ever see the day when business reporting will do away with paper reports and use only "electronic reports?" The answer is an emphatic "Yes!" The advent of XBRL is one clear indicator that major changes are on the way.

REVIEW QUESTIONS

1. Define business reporting process and its requirement.
2. Explaing about the Business Intelligence Systems for Aiding the Strategic Planner.
3. Write a short Note On Extensible Business Reporting Language.
4. Discuss about the Balanced Scorecard methodology for assessing a business organisation.
5. What are the Limitations of the General Ledger Approach.

FURTHER READINGS

- Information System Tecnology- Ross Malaga
- Information System Today-Leonard Jessup
- An Illustrated Information Technology-Alan Witchcomb
- Information Technology For Management Henry C.Lucas
- Information Technology in Business Management Dr. Mukesh Dhunna, J.B. Dixit

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- Information Technology For Management-Kathy Schwalbe