

INFORMATION SYSTEMS
ANALYSIS AND DESIGN
(2ND EDITION)
SYSTEMS ACQUISITION APPROACH

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Information Systems Analysis and Design (2nd Edition): Systems Acquisition Approach

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*** Electronic teaching materials for this textbook, including model syllabus, sample exams, lecture PPT, and video clips, are available upon request at swang@umassd.edu*

PREFACE

Theme of Information Systems Analysis and Design

Information systems are vital to business. Information systems analysis and design is one of the core courses in the management information systems (MIS) curriculum. It explains the right process of information systems development for business organizations. The course also introduces the tools that can be applied to the information systems development. In the digital era, information technology has become a commodity, and the information systems analysis and design course has become a widely accepted business elective course for all business majors.

The objective of this textbook is to help business students understand the concept of information systems development and develop practical skills of information systems analysis and design. Upon completion of the course, students should be able to analyze and design information systems in a professional manner.

Topics of information systems analysis and design are connected with a wide range of subjects of other MIS courses. Generally, information systems analysis and design involves two interrelated parts: management of information systems development and techniques of information systems development. The techniques of information systems development include five major interrelated technical components: business process modeling, data modeling and database design, networking design, computer programming, and computer hardware and operating systems. Each of these technical components has its unique and plentiful materials to learn. Clearly, a single course or a single textbook is unable to fully cover all these technical components. Commonly, management of information systems development and business process modeling are taught in the information systems analysis and design course, data modeling and database design are taught in the database course, networking design is taught in the data communication and networking course, and computer programming is taught in courses of computer languages. Hence, the primary theme of this textbook is management of information systems development and business process modeling. The secondary topics, including data modeling, networking, computer programming, and computer hardware and operating systems, are discussed succinctly in this textbook when delivering the monolithic concept of information systems development.

Unique features of this textbook

There have been hundreds of textbooks of systems analysis and design on the market. Given the long history of information systems development, many information systems analysis and design textbooks were written decades ago and then revised for numerous times. The volumes of those systems analysis and design textbooks are usually huge since they contain many secondary contents that might be useful to know decades ago but are no longer essential for information systems development today. Many of those textbooks contain chapters that are rarely fully used by students. Traditionally, systems analysis and design has been dominated by the computer software builders-centered approaches which were borrowed from the software engineering discipline. For instance, countless textbooks of systems analysis and design on the market still describe the Unified Modeling Language (UML) in great detail. In fact, UML was a major topic of systems analysis and design before the 2000s, but is no longer significant for systems analysis and design today. On the other hand, the fast growth of ERP systems and commercial business software packages on the software market has shifted the strategies of information systems development from systems construction to systems acquisition in ordinary business organizations. Contemporary topics such as systems design for systems acquisition and acquisition decision making are lacking in the existing textbooks. This textbook emphasizes the concept of business-centered systems acquisition by including the contemporary topics, and aims to enhance students' practical skills of systems analysis and design.

This book maintains a good balance between the core concepts and the secondary concepts, as well as a good balance between the basic concepts and the practical skills in systems analysis and design. The unique features of this textbook are summarized as follows.

(1) Emphasize information systems acquisition instead of systems construction

The strategies of information systems development in the ordinary business organizations have been changed over the past several decades. Nowadays, except for information technology service companies, few ordinary business organizations build their information systems by doing programming and testing, because

commercial off-the-shelf software packages, services in the cloud, and ERP systems are widely available at low costs. This textbook emphasizes information systems acquisition, and provides synopses of information systems construction as supplementary knowledge. In presenting the contents, the textbook clearly distinguishes the two different systems development strategies.

(2) Emphasize the systems acquisition tools instead of the system construction tools

Many tools for information systems analysis and design have been invented during the past several decades. The most commonly used tools in this field are: Data Flow Diagram (DFD), the Unified Modeling Language (UML), and Business Process Model and Notation (BPMN). The literature indicates that UML is a good set of software engineering tools for systems construction, but is difficult to use in the systems acquisition cases. Similarly, BPMN is a good tool for describing business processes at a detailed level for system construction, but provides little about system perspectives. DFD has been with us for a long time. DFD is not perfect, but is an excellent tool for students to develop system thinking skills for information systems analysis and design. As explained in the textbook, DFD is particularly powerful in the context of information systems acquisition which is much relevant to today's information technology environment in business.

(3) Emphasize contemporary contents instead of legacy contents

Since the focal point of information systems analysis and design has been shifted from system construction to system acquisition in the modern information technology environment, this textbook eliminates legacy contents, such as object-oriented analysis and design, which might be worth knowing for system construction but are no longer essential for business students. On the other hand, this textbook emphasizes contemporary contents of systems analysis and design in two areas. First, given the fact that information systems acquisition is the primary strategy of information systems development in the business organizations, this textbook provides a complete set of tools and guidelines for information systems acquisition projects. Second, after years of development of large-scale enterprise information systems such as ERP, CRM, and SCM systems, business apps development has

become a main stream in the business information systems development sector. Accordingly, a chapter of this textbook discusses the differences between organizational information systems development and business apps development, provides a tool for business apps development, and presents typical types of business apps and their development patterns.

(4) Emphasize project skills

This textbook emphasizes the practical project skills. It provides comprehensive and methodological instructions for practical systems acquisition projects. Appendix A specifies the general requirements of systems acquisition projects. Appendix B demonstrates the major components of a real-world information system analysis and design project.

(5) Eliminate secondary materials

This textbook eliminates secondary materials that is not essential for business students in all majors to learn systems analysis and design. All chapters and appendices of this textbook are necessary for the systems analysis and design course. The textbook has little overlap with other independent information systems subjects, such as database design and implementation, data communication and computer networking, and computer programming languages, which study various techniques of information systems construction.

The organization of this textbook

The textbook has eight chapters and two appendices. Chapter 1 introduces students into the information systems analysis and design field, and discusses the roles of systems analysts in business organizations. Chapter 2 discusses information systems development strategies, and presents an overview of the project management for information systems development. Chapter 3 explains the systems planning phase. Chapter 4 provides details of the systems analysis process and a powerful tool for systems analysis. Chapter 5 presents details of the systems design process and tools. Chapter 6 explains the systems implementation and conversion process. Chapter 7 is an overview of post-project activities and information systems maintenance.

Preface

Chapter 8 discusses business apps development, which is a new primary stream in information systems development, from the perspective of systems analysis and design. Each chapter includes a list of key terms that convey the important concepts of information systems analysis and design. Exercise instructions for course projects are listed at the end of each relevant chapter. The two appendices provide instructions for students to conduct course projects of systems analysis and design.

In summary, this textbook delivers comprehensive and succinct materials of information systems analysis and design to business students in all majors.

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CHAPTER 1. INTRODUCTION

1.1. Context of Information Systems Analysis and Design

An **information system** is an organized collection of people, information technology, information resources, and all coordinated activities to achieve certain objectives in the business organization. Conceptually, an information system may or may not be computerized. For instance, in a manual inventory process system, the set of the inventory bookkeepers, calculators, and pencils and papers are the information system. Practically, nowadays computers have become an indispensable element of contemporary information systems. As information technology is essential and vital to business, the development of an information system in the organization becomes crucial for the success of the organization. This textbook disseminates theories and methodologies of information systems development process.

Information systems analysis and design refers to the process of completing an information system development project. **Information systems development** covers a wide range of technical areas including business process modeling, data modeling and database design, networking design, computer programming, and computer hardware and operating systems. Each of these areas discusses its subjects of information systems in addition to information systems development, and has abundant and unique materials to learn. For instance, the theories of data modeling and database design can be applied to data resource management and business intelligence in addition to information systems development. The fact is that it is impossible for a single course or a single textbook to fully cover all these areas with details. On the other hand, as discussed in Chapter 2, nowadays, the majority of business organizations other than firms in the information technology sector apply the information systems acquisition strategy, instead of the information systems construction strategy, to the development of their information systems. Accordingly, this textbook focuses on two major components of information systems development: management of information systems development and business process modeling. To deliver the monolithic concept of information systems development, the textbook briefly discusses other areas in relation to information systems construction techniques. The context of this textbook of systems analysis and design

is depicted in Figure 1.1.

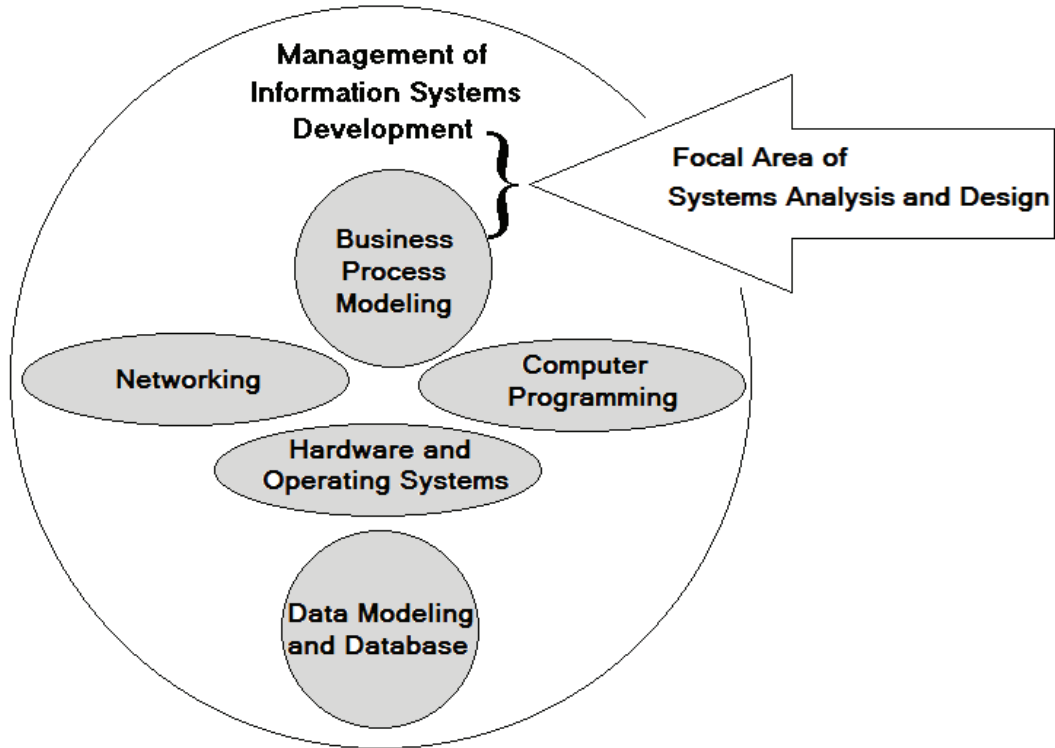


Figure 1.1. The Context of This Book of Systems Analysis and Design

1.2. Central Objective of Information Systems

The central objective of an information system is to create **value** for the organization using information technology. For most business firms, value means profits. For non-for-profit organizations and government agencies, value can mean much more than monetary measures.

There have been countless success stories as well as many failure cases of information systems development reported in the information systems literature. There are many factors that can have impact on the outcomes of information systems

development. The literature has indicated numerous commonly considered **success factors** for information systems development projects, as listed below.

- Alignment of the information system and the business strategy
- Top management support
- User involvement
- Effective information system development project management
- Organizational collaboration.

In terms of success factors, an information systems development project is not much different from any types of projects, such as highway projects or green energy projects. However, information systems development projects are usually significantly different from other types of projects in that the value created by an information system is difficult to measure before the information system actually takes place. On the other hand, to endorse an information system development project, the organization must estimate the potential value produced by the new information system. The process of systems analysis and design is to provide an accurate estimation and a meaningful justification of the potential value of the new information system.

1.3. Systems Analysts

A **systems analyst** is a person who is responsible for the development of an information system of the organization. The systems analyst must understand three aspects of information systems development: the business, information technology, and the people. They must possess business skills, information technology skills, and human interaction skills to fill their job responsibilities.

1.3.1. Business skills

The systems analyst of an organization must have a clear vision of the business environment and the business strategy of the organization. They must understand the nature of the business and the business processes in the organization. When

working on the system development project, the systems analyst must consider the factors of the business environment and an alignment of the information system with the business strategy.

1.3.2. Information technology skills

The systems analyst of an organization must have solid knowledge of contemporary information technology applicable to the organization, as well as fluent practical skills of systems analysis and design. The team of systems analysts of the organization possesses the best knowledge about how the organization can apply information technology to support the day-to-day operations, administrative functions, and decision making at all managerial levels to achieve the organization's goal.

1.3.3. Human interaction skills

The systems analyst of an organization must understand the users' needs for the information system and be able to involve the users in the information system development process. The jobs of systems analysts include dealing the relationships with users, training users, and conducting surveys and interviews for the information systems development.

1.3.4. Managerial skills

The systems analyst of an organization needs to manage people, pressure, and risks. They must demonstrate the leadership in the project team as well as the analytical capability of problem solving. The systems analyst must work with co-workers, managers, and systems users fairly, honestly, and ethically.

Apparently, the skill set of systems analysts is an integration of soft-skills (e.g., human interactions) and hard-skills (e.g., systems analysis and design). The job titles of systems analysts vary depending on the focal skills needed for the special programs. Business analyst, program analyst, change management analyst, and information technology specialist are the alternative job titles of systems analysts. The business analyst focuses on the business issues surrounding the information system. Program analyst is a broad job title. If a position of program analyst is set

for information systems development, the program analyst focuses on business processes and coordination among functional areas in the course of information systems development. The change management analyst focuses on the issues of changes caused by the new information system, including the new policies, new procedures, user training, and system support in the organization. Information technology specialist is another broad job title for specialists of modern digital technology. Upper management positions in the career path of systems analysts include information systems project manager, information systems manager, and chief information officer (CIO).

Key Terms

Information system

Information systems analysis and
design

Information systems development

Value

Success factors for information
systems development

Systems analyst

Skill set of system analysts

CHAPTER 2. INFORMATION SYSTEMS DEVELOPMENT

This chapter provides an overview of the systems development life cycle model and an overview of information systems development project management. It discusses three fundamental information systems development strategies: systems acquisition, systems construction, and outsourcing.

2.1. Systems Development Life Cycle

The **systems development life cycle (SDLC)** is a conceptual model of the phases an information system goes through. The typical systems development life cycle model suggests five fundamental phases of information systems development process: planning, analysis, design, implementation, and maintenance, as depicted in Figure 2.1.

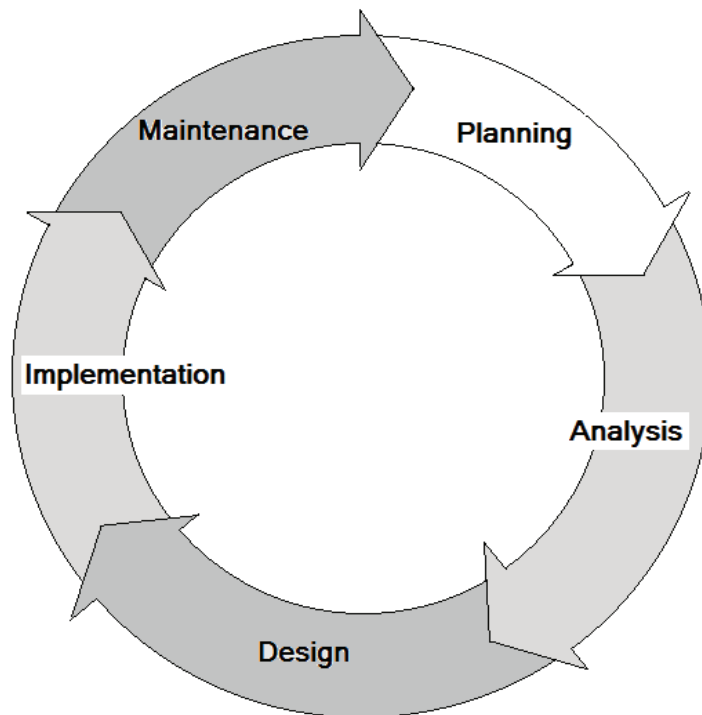


Figure 2.1. Systems Development Life Cycle (SDLC)

The SDLC model provides a general guideline for the information systems development in two aspects.

(1) The system development process of an information system must move through these five phases. Although the pattern of progression of these phases depends on the approach used for the information system development, as discussed in detail in the subsequent chapters of this book, a successful information systems development process can never omit any of these five phases.

(2) Each of these five phases produces a set of products, called **deliverable**, which is used as the input to its successor phase. Each phase elaborates on the work of its predecessor phase. The structures and forms of the deliverable of each phase can vary depending on the approaches used for the information system development. The quality of the deliverables affects the quality of the entire information system development project.

The **planning phase** is a process of preliminary investigation to understand *why* a new information system should be created for the organization. The deliverable of the planning phase includes a report of the feasibility study and the workplan for the new information system development project. Once the organization decides to create a new information system, a full-scale project of information system development is then started.

The **analysis phase** is the first stage of the full-scale information system development project to investigate *what* the new information system will do. In this phase, the project team fully investigates the current information system (or the **as-is** system) of the organization and the specific business needs (or the **system requirements**) for the new information system. The new information system that meets the system requirements is called the **to-be** system. The deliverable of the analysis phase reports on the following major system analysis results.

- The differences between the as-is system and the to-be system
- The system requirements for the to-be system
- The strategy of system development for the design phase.

The deliverable of the system analysis phase presents a blueprint for the new information system.

The **design phase** determines *how* the to-be system will be created and *how* it will be implemented in the aspects of hardware, software, networking, system personnel, and operational procedures. The deliverable of the design phase includes the detailed **system specifications** of system infrastructure and architecture, hardware, software, and networking for the implementation phase. The design phase provides the solution to the to-be system.

In the **implementation phase**, the new information system is installed or constructed based on the system specifications provided by the design phase. The methods applied to the system implementation phase vary depending on the strategies of systems development, as discussed in detail later in this book. By the end of the implementation phase, the new information system replaces the old information system.

The business environment changes constantly. Also, the newly implemented information system might need improvement. The **maintenance phase** improves the new information system. Because of the innovation of information technology and significant changes of the business environment, the next generation of information system in the organization will be inevitable. The information system development starts a new cycle.

2.2. Management of Systems Development Project

The management of information systems development projects has unique characteristics in several aspects in comparison with the management of other types of projects, as discussed below.

2.2.1. Unique characteristics information systems projects

Information systems projects operate in their broad organizational environments. The development of an information system project must involve all stakeholders of the organization. The management of information systems project is highly influenced by the organizational culture and structure. The analysis of cost and

benefit of an information systems project is normally imprecise. The time point of completion of a large information system project is usually ambiguous.

2.2.2. Project sponsor and project approval

An information system project in the organization must have its **project sponsor** who holds a top position in the organization (e.g., CIO). The project sponsor has an interest in the project and is involved in the entire project duration. An information system project must be approved by the organization which will commit the resources and support to the project. The project approval procedure must comply with the rules of the organization.

2.2.3. Project scope definition, project scale estimation, and risk assessment

An information system is an open system which means that it is interconnected to other systems, as the business processes in the organization can be linked to the systems of other organizations. It is necessary to define the scope of the information development project before it starts. The **project scope** defines the range of system requirements for the new information system. For example, a new retail information system project covers the system requirements of sales and purchasing information processes, but does not cover the system requirements of shipping information processes because it outsources shipping jobs to another shipping company. In this example, the project scope includes the functions of sales and purchasing, but excludes the functions of shipping.

A phenomenon called **scope creep** happens when new components are added to the project after the scope has been defined. The phenomenon is common in the information technology industry because some additional components are often hard to ignore for many reasons. Nevertheless, the project administrator must control scope creep to, say, less than about 5% of the original project scope.

Once the project scope has been determined, the **project scale**, in terms of the budget, the time duration, and the manpower which will be involved in the project, must be estimated. For the time being, there is no accurate method used for project scale estimation. A common practice is to survey the industry to find similar information system projects and to collect data for estimating the project scale.

Any project can have a **risk** of failure which indicates that the new information system might fail to operate on time as planned and significant negative consequences might occur. A risk assessment is to document each of the potential risks by explaining the nature of the risk, the likelihood of the risk, the potential damage caused by the failure, and possible solutions.

2.2.4. Project team management

The project team is crucial for the success of a project. Highly qualified and self-motivated team-players with fluent systems analysis and design skills are the prerequisite for the achievable project goals. In the information technology field, the turn-over rates of information systems professionals are high. This fact raises two major challenges for the information systems project management.

(1) The project manager must apply pertinent rewarding methods to motivate the information systems professionals, such as recognition, advancement, and self-regulation.

(2) The project team must promote knowledge sharing and collaboration among the team members using information techniques (e.g., social media, video conferencing, etc.) for the project as well as self-improvement.

2.2.5. Project control and coordination

There are many generic project management software packages on the market (e.g., Microsoft Project) that can be used for the information systems project control and coordination. Many general activities of project control and coordination, such as compiling the workplan of project and generating a Gantt chart or a PERT chart for the time management, can be supported by these generic project management software packages. However, the generic project management software packages have little support for the unique activities of information system projects such as ensuring the **system standards** (e.g., using the consistent formats and terminologies for documentation). Thus, information systems project management tools in addition to the generic project management software packages can be used for the effective information systems development.