CHAPTER

12

Making the Business Case for Information Systems and Managing Projects

LEARNING OBJECTIVES

After reading this chapter, you will be able to answer the following questions:

12-1 How should managers build a business case for the acquisition and development of a new information system?

12-2 What are the core problem-solving steps for developing a new information system?

12-3 What are the alternative methods for building information systems?

12-4 How should information systems projects be managed?

12-5 How will MIS help my career?

CHAPTER CASES

- Angostura Builds a Mobile Sales System
- Systems Development Is Different for Mobile Apps
- Arup Moves Project Management to the Cloud
- Maersk's TradeLens: Digitizing the Global Supply Chain

VIDEO CASES

- NASA Project Management Challenges
- IBM: Business Process Management in a SaaS Environment
- IBM Helps the City of Madrid with Real-Time BPM Software

Instructional Videos:

- What Is PaaS? What Is Predix?
- BPM: Business Process Management Customer Story

MyLab MIS

- Discussion Questions: 12-5, 12-6, 12-7
- Hands-On MIS Projects: 12-8, 12-9, 12-10, 12-11

ANGOSTURA BUILDS A MOBILE SALES SYSTEM

House of Angostura (also known as Angostura Limited), headquartered in Laventille, Trinidad, is one of the Caribbean's leading rum producers and the world market leader for bitters used in many cocktails. Angostura has 330 full-time employees and an annual revenue of approximately $100 million.

Angostura still takes care of local distribution of its products in Trinidad and Tobago, with a team of 16 sales representatives taking orders out in the field. Although this arrangement worked well in the past, the process was heavily manual, tedious, and time-consuming and sometimes produced inaccurate orders.

Each day, the 16 sales reps in the field had to copy the orders on paper and return to the office to hand off the order forms to a customer service representative, who would then manually input the order data into Angostura's SAP enterprise resource planning (ERP) system. Because the orders were handwritten, information could be read and entered incorrectly, which could result in the wrong goods being sent to a customer. Such inaccurate orders were often returned, creating more paperwork and higher costs. Angostura also used manual processes for reporting and tracking invoices and accounts receivable information, which could create additional delays and errors.

The sales representatives were also working with data on product availability that might be out of date. If the sales reps were away from the office, they would not be able to tell whether an order could actually be fulfilled. They would have to call Angostura's warehouse to find out if fulfilling an order was possible.

In 2012 Angostura's management decided that the sales process needed to be more streamlined and efficient and that it should use mobile technology. The company identified a set of detailed information requirements for the improved sales process and spent more than a year evaluating system solutions from five mobile vendors. One important requirement was that the application should be able to automatically update the availability of purchased products from the company's overall inventory and integrate with the firm's back-end SAP ERP system. Another requirement was that the mobile system be able to operate offline so that a sales representative could still input an order on a mobile device even if there

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was no online connectivity. Once online, the device could then send the order through to the ERP system.

The vendor selected was the one that could best develop the mobile application to the company's specifications and stay within the budget established by management. In 2013 Angostura partnered with IDS Scheer and itCampus consultants to develop a mobile sales solution running on Apple iPads. The solution includes an offline customer database, product catalog, customer-specific pricing, order entry, order preview, and integration with Bluetooth wireless printers. It was quickly created using SAP NetWeaver Gateway technology to connect various devices and platforms to SAP software. A pilot application was ready for testing that June, and the entire application went live January 2014.

Each of Angostura's 16 sales representatives was issued an iPad that includes not only the order application but other mobile apps to make the sales process more efficient, such as email, Google Maps, and a video and PDF document uploader to display the Angostura product line. The sales application integrates with the corporate ERP system, providing the sales reps with up-to-date information on the availability of products in the warehouse.

With the Angostura Mobile Sales App, an order can be created in less than 30 seconds, depending on the size of the order, making the ordering process two times faster. There is a 20 percent time savings per salesperson because the sales reps now have the ability to send orders remotely as they place them rather than waiting until they return to the office. The amount of time customer service representatives would typically spend on data entry—which was considerable—has been reduced by 75 percent, freeing up time for more useful tasks. Returned orders have been reduced by 30 percent.

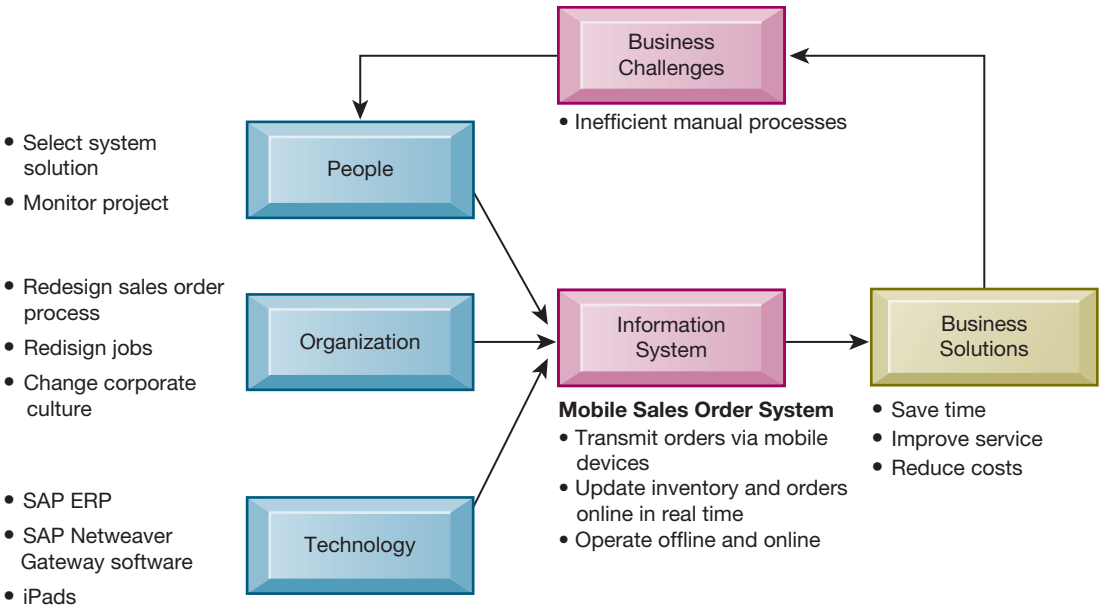
Sources: Natalie Miller, "Generations-Old Company with a Modern Twist on Sales," *SAP Insider Profiles*, January 2016; www.angostura.com, accessed February 10, 2019; and IDS Scheer Consulting Group, "Angostura's iPad-Based SAP Mobile Sales Solution," 2014.

Angostura's experience illustrates some of the steps required to plan, build, and implement new information systems. Building a new system for mobile sales orders entailed analyzing the organization's problems with existing systems, assessing information requirements, selecting appropriate technology, and redesigning business processes and jobs. Angostura's system builders had to make a convincing business case for investing in a new sales system, namely that it would solve the firm's order entry problems. Management had to oversee the systems-building effort and evaluate benefits and costs. The information requirements were incorporated into the design of the new system, which represented a process of planned organizational change. Angostura succeeded with this project because its management clearly understood that strong project management and attention to organizational change were essential to success.

The chapter-opening case calls attention to important points raised by this case and this chapter. Angostura's ability to handle sales orders was hampered by outdated and inefficient manual processes, which raised costs, slowed down work, and limited the company's ability to serve its customers.

The solution was to redesign the sales order process to use mobile devices and software and allow orders to be entered through iPads and transmitted to the firm's backend ERP system. Angostura's information requirements were incorporated into the system design. The solution encompassed not just the application of new technology but changes to corporate culture, business processes, and job functions. Angostura's sales operations have become much more efficient and far less error prone.

Here are some questions to think about: How did Angostura's Mobile Sales App meet its information requirements? How effective a solution was Angostura's Mobile Sales App? Why? How much did the new system change the way Angostura ran its business?



12-1 How should managers build a business case for the acquisition and development of a new information system?

Companies typically are presented with many alternatives for solving problems and improving their performance, including the development of new information systems or enhancement of existing ones. There are far more ideas for systems projects than there are resources. Your company will need to select the systems projects investment that promise the greatest benefit to the business. And you will need to make the business case for why the solution you select provides the greatest value to the firm when compared to other solutions.

A **business case** is a proposal to management seeking approval for an investment. The business case for an IT investment describes the problem facing the organization that can be solved by investing in a proposed system solution. It provides an analysis of all the costs, benefits, and risks associated with that investment and the justification for that proposed course of action. The business case describes the rationale for proceeding with an investment, and shows how the investment supports the firm's strategic goals and business objectives and how it fits in with the overall information systems plan of the the firm. It also provides the information necessary to make an informed decision about whether to proceed with the investment and in what form. The business case explains how this investment will provide value for the business, and identifies any risks that could negatively affect outcomes. The business case identifies alternative solutions, along with the deciding factors for selecting the preferred option. A good business case will also describe how the proposed solution may require changes in organizational culture, systems, processes, and jobs.

Figure 12.1 summarizes the seven major factors that are used in making the business case for a specific new system. (Review the discussion of business drivers of information systems in Chapter 1.) These factors are: (1) long-term strategic (lowering production costs, differentiation of products and services, increasing the scope of the firm (e.g. global expansion), and matching or exceeding competitor capabilities); (2) improved decision making; (3) customer and supplier relationships; (4) survival (required by the market); (5) new products and services; (6) financial rationale; and (7) fitting with the long-term IT plan of the firm. Smaller systems that focus on a single problem, like the Angostura mobile order entry system described in the opening

Figure 12.1
Factors to Consider in Making the Business Case.
There are seven major factors that should be addressed when making the business case for a new information system.

case, will focus on just a few of these elements, such as "improved decision making," "customer relationships," and "lowering costs," whereas larger system projects may well include all of these factors in making the business case.

THE INFORMATION SYSTEMS PLAN

In order to identify the information systems projects that will deliver the most business value, organizations need a corporate-wide **information systems plan** that supports their overall business plan, with strategic systems incorporated into top-level planning. The IS firm plan is developed by the Chief Information Officer, and is approved annually by the CEO and often the Board of Directors. The plan serves as a road map indicating the direction of systems development (the purpose of the plan), the rationale, the state of current systems, new developments to consider, the management strategy, the implementation plan, and the budget (see Table 12.1). Without a comprehensive firm-wide IS plan, it is difficult, if not impossible to evaluate the worth of proposals for developing specific individual systems. You cannot make the case for a specific new system without understanding the larger context of all the many systems in the firm.

The plan contains a statement of corporate goals and specifies how information technology will support the attainment of those goals. It explains how general goals will be achieved by specific systems projects. It identifies specific target dates and milestones that can be used later to evaluate the plan's progress in terms of how many objectives were actually attained in the time frame specified in the plan. The plan indicates the key management decisions, technology, and required organizational change.

In order to plan effectively, firms will need to inventory and document all of their information system applications, IT infrastructure components, and long- and short-term information requirements. For projects in which benefits involve improved decision making, managers should try to identify the decision improvements that would provide the greatest additional value to the firm (see Chapter 11). They should then develop a set of metrics to quantify the value of more timely and precise information on the outcome of the decision

The plan should describe organizational changes, including management and employee training requirements; changes in business processes; and changes in authority, structure, or management practice. When you are making the business case for a new information system project, you show how the proposed system fits into that plan.

TABLE 12.1

Information Systems Plan

1. **Purpose of the Plan**
   - Overview of plan contents
   - Current business organization and future organization
   - Key business processes
   - Management strategy
2. **Strategic Business Plan Rationale**
   - Current situation
   - Current business organization
   - Changing environments
   - Major goals of the business plan
   - Firm's strategic plan
3. **Current Systems**
   - Major systems supporting business functions and processes
   - Current infrastructure capabilities
     - Hardware
     - Software
     - Database
     - Networking and Internet
     - Cloud services
   - Difficulties meeting business requirements
   - Anticipated future demands
4. **New Developments**
   - New system projects
     - Project descriptions
     - Business rationale
     - Applications' role in strategy
   - New infrastructure capabilities required
     - Hardware
     - Software
     - Database
     - Networking and Internet
     - Cloud services
5. **Management Strategy**
   - Acquisition plans
   - Organizational realignment
   - Management controls
   - Major training initiatives
   - Human Resources strategy
6. **Implementation of the Plan**
   - Anticipated difficulties in implementation
   - Progress reports and milestones
7. **Budget Requirements**
   - Resources
   - Potential savings
   - Financing
   - Acquisition cycle

PORTFOLIO ANALYSIS AND SCORING MODELS

Once you have determined the overall direction of systems development in the firm by establishing a firm-wide IS Plan, **portfolio analysis** is one tool that can help you evaluate alternative system projects. Portfolio analysis inventories all of the firm's information systems projects and assets, including infrastructure, outsourcing contracts,

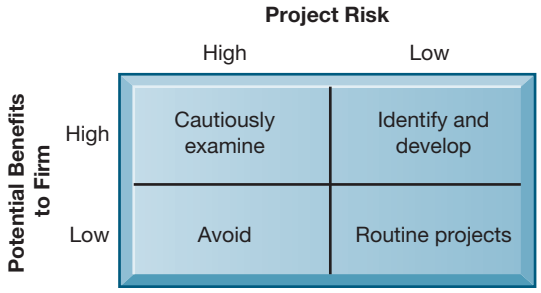


Figure 12.2
A System Portfolio.
Companies should examine their portfolio of projects in terms of potential benefits and likely risks. Certain kinds of projects should be avoided altogether and others developed rapidly. There is no ideal mix. Companies in different industries have different information systems needs.

and licenses. This portfolio of information systems investments can be described as having a certain profile of risk and benefit to the firm (see Figure 12.2), similar to a financial portfolio. Each information systems project carries its own set of risks and benefits. Firms try to improve the return on their information system portfolios by balancing the risk and return from their systems investments.

Obviously, you begin first by focusing on systems of high benefit and low risk. These promise early returns and low risks. Second, high-benefit, high-risk systems should be examined; low-benefit, high-risk systems should be totally avoided; and low-benefit, low-risk systems should be reexamined for the possibility of rebuilding and replacing them with more desirable systems having higher benefits. By using portfolio analysis, management can determine the optimal mix of investment risk and reward for their firms, balancing riskier, high-reward projects with safer, lower-reward ones.

Another method for evaluating alternative system solutions is a **scoring model**. Scoring models give alternative systems a single score based on the extent to which they meet selected objectives. Table 12.2 shows part of a simple scoring model that Angostura could have used in evaluating proposed system solutions for improving the sales process. The first column lists the criteria that decision makers use to evaluate the systems. Table 12.2 shows that Angostura attaches the most importance to capabilities for sales order processing, ease of use, ability to support individual sales reps taking orders, and system access from mobile platforms. The second column in Table 12.2 lists the weights that decision makers attached to the decision criteria. Columns 3 and 5 show the percentage of requirements for each function that each alternative system solution meets. Each alternative's score is calculated by multiplying the percentage of requirements met for each function by the weight attached to that function. Solution alternative 2 has the highest total score.

DETERMINING SOLUTION COSTS AND BENEFITS

As we pointed out earlier, the business case for a system solution includes an assessment of whether each solution represents a good investment for the company.

Even if a systems project supports a firm's strategic goals and meets user information requirements, it needs to be a good investment for the firm. The value of systems from a financial perspective essentially revolves around the issue of return on invested capital. Does a particular information system investment produce sufficient returns to justify its costs?

Table 12.3 lists some of the more common costs and benefits of systems. **Tangible benefits** can be quantified and assigned a monetary value. **Intangible benefits**, such as more efficient customer service or enhanced decision making, cannot be immediately quantified but may lead to quantifiable gains in the long run. Transaction and clerical systems that displace labor and save space always produce more measurable, tangible benefits than management information systems, decision-support systems, and systems for collaborative work (see Chapter 2). Some of the tangible benefits Angstura obtained were increased productivity and lower operational costs resulting from streamlining the ordering process and reduced errors. Intangible benefits included customer satisfaction, more timely information, and improved operations.

TABLE 12.2

Example of a Scoring Model for the Angostura Mobile Sales System

Criteria	Weight	Alternative 1 (%)	Alternative 1 Score	Alternative 2 (%)	Alternative 2 Score
1.1 Order processing					
1.2 Online order entry	5	67	335	83	415
1.3 Order tracking by sales rep	5	81	405	75	375
1.4 Order tracking by customer	5	30	150	80	400
Total order processing			890		1,190
2.1 Ease of use					
2.2 System access from mobile platforms	5	55	275	92	460
2.3 Short training time	4	79	316	85	340
2.4 User-friendly online screens and data entry	4	65	260	87	348
Total ease of use			851		1,148
3.1 Costs					
3.2 Software costs	3	51	153	65	195
3.3 Hardware (cloud services) costs	4	57	228	90	360
3.4 Maintenance and support costs	4	42	168	89	356
Total costs			549		911
Grand Total			2,290		3,249

Chapter 5 introduced the concept of total cost of ownership (TCO), which is designed to identify and measure the components of information technology expenditures beyond the initial cost of purchasing and installing hardware and software. TCO analysis, however, provides only part of the information needed to evaluate an information technology investment because it typically does not deal with benefits, cost categories such as complexity costs, and "soft" and strategic factors discussed later in this section.

Capital Budgeting for Information Systems

To determine the benefits of a particular project, you'll need to calculate all of its costs and all of its benefits. Obviously, a project where costs exceed benefits should be rejected. But even if the benefits outweigh the costs, additional financial analysis is required to determine whether the project represents a good return on the firm's invested capital. **Capital budgeting** models are one of several techniques used to measure the value of investing in long-term capital investment projects.

Capital budgeting methods rely on measures of cash flows into and out of the firm; capital projects generate those cash flows. The investment cost for information systems projects is an immediate cash outflow caused by expenditures for hardware, software, and labor. In subsequent years, the investment may cause additional cash outflows that will be balanced by cash inflows resulting from the investment. Cash inflows take the form of increased sales of more products (for reasons such as new products, higher quality, or increasing market share) or reduced costs in production and operations. The difference between cash outflows and cash inflows is used for calculating the financial worth of an investment. Once the cash flows have been

TABLE 12.3

Costs and Benefits of Information Systems

Costs
Hardware
Networking
Software
Services
Personnel
Tangible Benefits (Cost Savings)
Increased productivity
Lower operational costs
Reduced workforce
Lower computer expenses
Lower outside vendor costs
Lower clerical and professional costs
Reduced rate of growth in expenses
Reduced facility costs
Intangible Benefits
Improved asset utilization
Improved resource control
Improved organizational planning
Increased organizational flexibility
More timely information
Improved customer experience
Increased organizational learning
Legal requirements attained
Enhanced employee goodwill
Increased job satisfaction
Improved decision making
Higher client satisfaction
Better corporate image

established, several alternative methods are available for comparing different projects and deciding about the investment.

The principal capital budgeting models for evaluating IT projects are the payback method, the accounting rate of return on investment (ROI), net present value, and the internal rate of return (IRR). Figure 12.3 illustrates part of the capital budgeting analysis for an online ordering system similar to Angostura's. You can find out more about how these capital budgeting models are used to justify information system investments in the Learning Tracks for this chapter.

Limitations of Financial Models

The traditional focus on the financial and technical aspects of an information system tends to overlook the social and organizational dimensions of information systems that may affect the true costs and benefits of the investment. Many companies' information systems investment decisions do not adequately consider costs from organizational disruptions created by a new system, such as the cost to train end users, the impact that users' learning curves for a new system have on productivity, or the time managers need to spend overseeing new system-related changes. Intangible benefits such as more timely decisions from a new system or enhanced employee learning and expertise may also be overlooked in a traditional financial analysis. You can find out more about how these capital budgeting methods are used to justify information system investments in our Learning Tracks.

	A	B	C	D	E	F	G	H
1	Estimated Costs & Benefits - Mobile Online Ordering System							
2	**Year**		**0**	**1**	**2**	**3**	**4**	**5**
3			**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
4	**Costs**							
5	**Hardware**							
6	50 iPads @$500		$25,000					
7	Cloud IaaS		$4,000	$2,000	$2,000	$2,000	$2,000	$2,000
8	**Networking**		$1,500	$1,500	$1,500	$1,500	$1,500	$1,500
9	**Software**							
10	Mobile ordering app		$35,000					
11	Integration with ERP		$25,000					
12	**Human Resources**							
13	Business Staff		$10,000					
14	IT Staff + Consultants		$45,000	$2,000	$2,000	$2,000	$2,000	$2,000
15	**Training**		$7,000	$1,000	$1,000	$1,000	$1,000	$1,000
16	**Maintenance and Support**			$5,000	$5,000	$5,000	$5,000	$5,000
17		**Annual Costs**	$1,52,500	$11,500	$11,500	$11,500	$11,500	$11,500
18		**Total Costs**	$2,10,000					
19	**Benefits**							
20	Reduced labor costs			$52,000	$52,000	$52,000	$52,000	$52,000
21	Reduced errors and returns			$70,000	$70,000	$70,000	$70,000	$70,000
22		**Annual Net Cash Flow**	-$1,52,500	$1,10,500	$1,10,500	$1,10,500	$1,10,500	$1,10,500
23		**Total Benefits**	$4,00,000					
24								
25		**Net Present Value**	$2,68,407					
26		**ROI**	4.1%					
27		**Internal Rate of Return**	17.0%					

Figure 12.3
Capital Budgeting for an Information System Investment.
This worksheet illustrates a simplified capital budgeting analysis for a mobile sales ordering system

12-2 What are the core problem-solving steps for developing a new information system?

A new information system is built as a solution to a problem or set of problems the organization perceives it is facing. The problem may be one in which managers and employees believe that the business is not performing as well as expected, or it may come from the realization that the organization should take advantage of new opportunities to perform more effectively.

The problem-solving process introduced in Chapter 1 provides the facts and findings needed to develop a strong business case and to implement the right solution. Figure 12.4 illustrates the four steps we would need to take: (1) define and understand the problem, (2) develop alternative solutions, (3) choose the best solution, and (4) implement the solution.

Before a problem can be solved, first it must be properly defined. Members of the organization must agree that a problem actually exists and that it is serious. The problem must be investigated so that it can be better understood. Next comes a period of devising alternative solutions, then one of evaluating each alternative and selecting the best solution. The final stage is one of implementing the solution, in which a detailed design for the solution is specified, translated into a physical system, tested, introduced to the organization, and further refined as it is used over time.

In the information systems world, we have a special name for these activities. Figure 12.4 shows that the first three problem-solving steps, when we identify the problem, gather information, devise alternative solutions, and make a decision about the best solution, are called **systems analysis**.

DEFINING AND UNDERSTANDING THE PROBLEM

Defining the problem may take some work because various members of the company may have different ideas about the nature of the problem and its severity. What caused the problem? Why is it still around? Why wasn't it solved long ago? Systems analysts typically gather facts about existing systems and problems by examining documents, work papers, procedures, and system operations and by

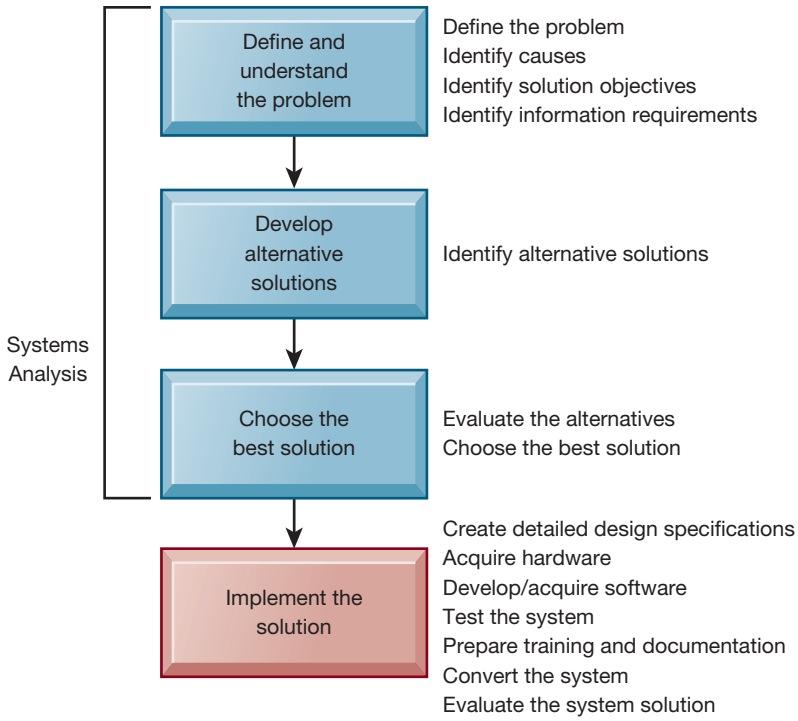


Figure 12.4
Developing an Information System Solution.
Developing an information system solution is based on the problem-solving process.

interviewing key users of the system, including employees, managers, and customers if they will be users of the system.

Information systems problems in the business world typically result from a combination of people, organization, and technology factors. When identifying a key issue or problem, ask what kind of problem it is: Is it a people problem, an organizational problem, a technology problem, or a combination of these? What people, organizational, and technological factors contributed to the problem?

Once the problem has been defined and analyzed, it is possible to make some decisions about what should and can be done. What are the objectives of a solution to the problem? Are they to reduce costs, increase sales, or improve relationships with customers, suppliers, or employees? Do managers have sufficient information for decision making? What information is required to achieve these objectives?

At the most basic level, the **information requirements** of a new system identify who needs what information, where, when, and how. Requirements analysis carefully defines the objectives of the new or modified system and develops a detailed description of the functions that the new system must perform. A system designed around the wrong set of requirements will either have to be discarded because of poor performance or will need to undergo major modifications. Section 12-2 describes alternative approaches to eliciting requirements that help minimize this problem. In the case of Angostura, the problem is that the traditional ordering process has been excessively manual and time-consuming, with high error rates.

The objectives of a solution for Angostura would be to reduce the amount of time, effort, and errors in the ordering process while making it possible to submit orders online from any location. Information requirements for the solution include the ability to take orders instantly, the ability to track orders by type of product or account, the ability to track the status of orders, and the ability to interact with the company's ERP system.

DEVELOPING ALTERNATIVE SOLUTIONS

What alternative solutions are possible for achieving these objectives and meeting these information requirements? The systems analysis lays out the most likely paths to follow given the nature of the problem. Some possible solutions do not require an information

system solution but instead call for an adjustment in management, additional training, or refinement of existing organizational procedures. Some, however, do require modifications of the firm's existing information systems or an entirely new information system.

EVALUATING AND CHOOSING SOLUTIONS

The systems analysis includes a **feasibility study** to determine whether each proposed solution is feasible, or achievable, from financial, technical, and organizational standpoints. The feasibility study establishes whether each alternative solution is a good investment, whether the technology needed for the system is available and can be handled by the firm's information systems staff, and whether the organization is capable of accommodating the changes the system introduces.

A written systems proposal report describes the costs and benefits and advantages and disadvantages of each alternative solution. Which solution is best in a financial sense? Which works best for the organization? The systems analysis will detail the costs and benefits of each alternative and the changes that the organization will have to make to use the solution effectively. We provide a detailed discussion of how to manage change in the following section. On the basis of this report, management will select what it believes is the best solution for the company.

IMPLEMENTING THE SOLUTION

The first step in implementing a system solution is to create detailed design specifications. **Systems design** shows how the chosen solution should be realized. The system design is the model or blueprint for an information system solution and consists of all the specifications that will deliver the functions identified during systems analysis. These specifications should address all the technical, organizational, and people components of the system solution.

Table 12.4 shows some of the design specifications for the online ordering system discussed earlier, which were based on information requirements for the solution that was selected. These design specifications apply to both the web and mobile app platforms.

Completing Implementation

In the final steps of implementing a system solution, the following activities would be performed:

- *Hardware selection and acquisition.* System builders select appropriate hardware for the application. They would either purchase the necessary computers and mobile devices, lease them from a technology provider, or lease processing services from a cloud computing vendor.
- *Software development and programming.* Software for ordering may be custom programmed in-house or purchased from an external source such as an outsourcing vendor, an application software package vendor, or an online software service provider. The core ordering system and databases are in corporate data centers or in remote servers accessed through the Internet.
- *Testing.* The system is thoroughly tested to ensure that it produces the right results. The testing process requires detailed testing of individual computer programs, called **unit testing** as well as **system testing**, which tests the performance of the information system as a whole. **Acceptance testing** provides the final certification that the system is ready to be used in a production setting. Information systems tests are evaluated by users and reviewed by management. When all parties are satisfied that the new system meets their standards, the system is formally accepted for installation.

TABLE 12.4

Design Specifications for Online Ordering System

Output	Online reports
	Hard-copy reports
	Online queries
	Order transactions
Input	Order entry forms
	Order status request screen
Database	Database with order file, customer file,
Processing	Calculate order totals by type of product
	Transmit orders to distribution centers
	Track orders by customer
	Track orders by sales rep
	Schedule deliveries
	Update customer data for account changes
Manual procedures	Sales reps contact customers by phone, email, text message
Security and controls	Online passwords
	Only authorized sales reps and company employees can access the system
	Only company-owned mobile devices can be used for entering orders or accessing corporate data
Conversion	Input
	Input customer data
	Test system
Training and documentation	System guide for users
	Online training sessions and tutorials

The systems development team works with users to devise a systematic test plan. The **test plan** includes all the preparations for the series of tests we have just described. Figure 12.5 shows a sample from a test plan that could be used for a mobile ordering system. The condition being tested is online access of the system by an authorized user.

- *Training and documentation.* End users and information system specialists require training so that they will be able to use the new system. Detailed **documentation** in the form of hard copy training manuals or online tutorials showing how the system works from both a technical and end-user standpoint must be prepared.
- *Conversion* is the process of changing from the old to the new system. There are four main conversion strategies: the parallel strategy, the direct cutover strategy, the pilot study strategy, and the phased approach strategy.

In a **parallel strategy**, both the old system and its potential replacement are run together for a time until everyone is assured that the new one functions correctly. The old system remains available as a backup in case of problems. The **direct cutover strategy** replaces the old system entirely with the new system on an appointed day, carrying the risk that there is no system to fall back on if problems arise. The **pilot study** strategy introduces a new system to only a limited area of the organization, such as a single department or operating unit. Once this pilot version is working smoothly, it is installed throughout the rest of the organization. A **phased approach** introduces the system in stages, such as first implementing payroll processing for hourly workers who are paid weekly and later for salaried employees paid monthly.

Test Case Number: GS02-010

Prepared by: A. Patterson	**Date:** February 19, 2020

Objective: This subtest checks for an authorized user accessing the system.

Platform: iOS

Procedure Description:
Select Sign In
Select Username
Enter Username
Select Password
Enter Password
Select Submit

Expected Result:
When user selects Sign In, the Sign In menu appears
When user selects User Name, the cursor moves to the User Name field
When user enters that person's system user name the user name appears on the screen
When user selects Password, the cursor moves to the Password field.
When user enters that person's password, the password appears on the screen as asterisks
When user selects Submit, the system verifies the entered data and allows the user to access the system
When user enters an incorrect (or unauthorized) username or password, the error message "Wrong User Name or Password" appears

Test Results:
All OK

Figure 12.5
A Sample Test Plan for a Mobile Ordering System.
When developing a test plan, it is imperative to include the various conditions to be tested, the requirements for each condition tested, and the expected results. Test plans require input from both end users and information systems specialists. Illustrated here is a test case for accessing the mobile ordering system for an authorized user.

- *Production and maintenance.* After the new system is installed and conversion is complete, the system is said to be in **production**. During this stage, users and technical specialists review the solution to determine how well it has met its original objectives and to decide whether any revisions or modifications are in order. Changes in hardware, software, documentation, or procedures to a production system to correct errors, meet new requirements, or improve processing efficiency are termed **maintenance**.

Managing the Change

Developing a new information systems solution is not merely a matter of installing hardware and software. The business must also deal with the organizational changes that the new solution will bring about—new information, new business processes, and perhaps new reporting relationships and decision-making power. A well-designed solution may not work unless it is introduced to the organization very carefully. The process of planning change in an organization so that it is implemented in an orderly and effective manner is so critical to the success or failure of information system solutions that we devote Section 12-4 to a detailed discussion of this topic.

12-3 What are the alternative methods for building information systems?

There are alternative methods for creating system solutions by using the basic problem-solving model we have just described. These alternative methods include the traditional systems life cycle, prototyping, end-user development, application software packages, and outsourcing.

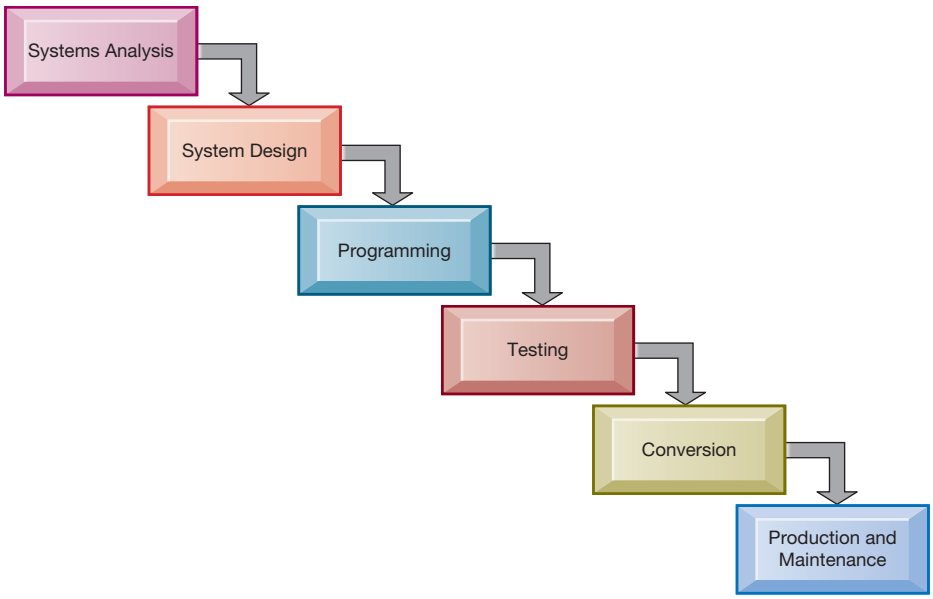


Figure 12.6
The Traditional Systems Development Life Cycle.
The systems development life cycle partitions systems development into formal stages, with each stage requiring completion before the next stage can begin.

TRADITIONAL SYSTEMS DEVELOPMENT LIFE CYCLE

The **systems development life cycle (SDLC)** is the oldest method for building information systems. The life cycle methodology is a phased approach to building a system, dividing systems development into a series of formal stages, as illustrated in Figure 12.6. Although systems builders can go back and forth among stages in the life cycle, the systems life cycle is predominantly a waterfall approach in which tasks in one stage are completed before work for the next stage begins.

This approach maintains a formal division of labor between end users and information systems specialists. Technical specialists, such as systems analysts and programmers, are responsible for much of the systems analysis, design, and implementation work; end users are limited to providing information requirements and reviewing the technical staff's work. The life cycle also emphasizes formal specifications and paperwork, so many documents are generated during the course of a systems project.

The systems life cycle is still used for building large, complex systems that require rigorous and formal requirements analysis, predefined specifications, and tight controls over the systems-building process. However, this approach is also time-consuming and expensive to use. Tasks in one stage are supposed to be completed before work for the next stage begins. Activities can be repeated, but volumes of new documents must be generated and steps retraced if requirements and specifications need to be revised. This encourages freezing of specifications relatively early in the development process. The life cycle approach is also not suitable for many small desktop systems and apps, which tend to be less structured and more individualized.

PROTOTYPING

Prototyping consists of building an experimental system rapidly and inexpensively for end users to evaluate, and then revising the prototype based on user feedback. The prototype is a working version of an information system or part of the system, but it is intended as only a preliminary model. Users interact with the prototype to get a better idea of their information requirements, refining the prototype multiple times. When the design is finalized, the prototype will be converted to a polished production system. Figure 12.7 shows a four-step model of the prototyping process.

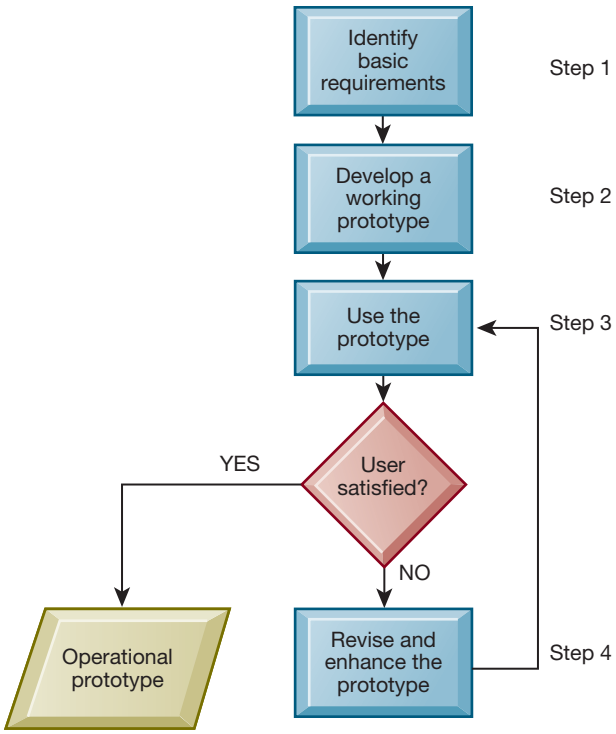


Figure 12.7
The Prototyping Process.
The process of developing a prototype consists of four steps. Because a prototype can be developed quickly and inexpensively, systems builders can go through several iterations, repeating steps 3 and 4, to refine and enhance the prototype before arriving at the final operational one.

Step 1: *Identify the user's basic requirements.* The system designer (usually an information systems specialist) works with the user only long enough to capture the user's basic information needs.

Step 2: *Develop an initial prototype.* The system designer creates a working prototype quickly, using tools for rapidly generating software.

Step 3: *Use the prototype.* The user is encouraged to work with the system to determine whether the prototype meets his or her needs and to suggest improvements for the prototype.

Step 4: *Revise and enhance the prototype.* The system builder notes all changes the user requests and refines the prototype accordingly. After the prototype has been revised, the cycle returns to step 3. Steps 3 and 4 are repeated until the user is satisfied.

Prototyping is especially useful in designing an information system's user interface. Because prototyping encourages intense end-user involvement throughout the systems development process, it is more likely to produce systems that fulfill user requirements.

However, rapid prototyping may gloss over essential steps in systems development, such as thorough testing and documentation. If the completed prototype works reasonably well, management may not see the need to build a polished production system. Some hastily constructed systems do not easily accommodate large quantities of data or a large number of users in a production environment.

END-USER DEVELOPMENT

End-user development allows end users, with little or no formal assistance from technical specialists, to create simple information systems, reducing the time and steps required to produce a finished application. Using user-friendly query, reporting, website development, graphics, and PC software tools such as Excel or Access, end users can access data, create reports, and develop simple applications on their own with little or no help from professional systems analysts or programmers. For example, CEMEX,

an international supplier of products for the construction industry, used InformationBuilders' WebFOCUS to create a self-service reporting portal to visualize financial and operational data.

On the whole, end-user-developed systems are completed more rapidly than those developed with conventional programming tools. Allowing users to specify their own business needs improves requirements gathering and often leads to a higher level of user involvement and satisfaction with the system. End-user development tools, however, still cannot replace conventional tools for some business applications because they cannot easily handle the processing of large numbers of transactions or applications with extensive procedural logic and updating requirements.

End-user development also poses organizational risks because systems are created rapidly, without a formal development methodology, testing, and documentation. To help organizations maximize the benefits of end-user applications development, management should require cost justification of end-user information system projects and establish hardware, software, and quality standards for user-developed applications.

APPLICATION SOFTWARE PACKAGES, SOFTWARE SERVICES, AND OUTSOURCING

Chapter 5 points out that much of the software underlying contemporary information systems is not developed in-house but is acquired from external sources. Firms can rent the software from an online software service provider, purchase a software package from a commercial vendor to run in-house, or have an in-house application developed by an external outsourcing firm. Selection of the software or software service is often based on a **Request for Proposal (RFP)**, which is a detailed list of questions submitted to external vendors to see how well they meet the requirements for the proposed system.

Application Software Packages and Cloud Software Services

Systems are increasingly based on commercially available application software packages or cloud software as a service (SaaS). For example, companies can choose to implement Oracle enterprise resource planning, supply chain management, or human capital management software in-house or pay to use this software running on the Oracle Cloud platform. Microsoft Office desktop productivity software comes in both desktop and cloud (Office 365) versions.

If a cloud software service or software package can fulfill most of an organization's requirements, the company does not have to write its own software. The company saves time and money by using the prewritten, predesigned, pretested software programs from the package and SaaS vendors, who also provide ongoing maintenance and upgrades for the system. Many packages include capabilities for customization to meet unique requirements not addressed by the prewritten software. **Customization** features allow prewritten software to be modified to meet an organization's unique requirements without destroying the integrity of the software. If extensive customization is required, however, additional programming and customization work may become so expensive and time-consuming that it negates many of the advantages of software packages or services. If the software cannot be customized, the organization will have to adapt by changing its procedures.

Outsourcing

If a firm does not want to use its internal resources to build or operate information systems, it can outsource the work to an external organization that specializes in providing these services. The outsourcing vendor might be domestic or in another country. Domestic outsourcing is driven primarily by the fact that outsourcing firms possess skills, resources, and assets that their clients do not have. Installing a new supply chain management system in a very large company might require hiring an

additional 30 to 50 people with specific expertise in supply chain management software. Rather than hire permanent new employees and then release them after the new system is built, it makes more sense, and is often less expensive, to outsource this work for a 12-month period.

In the case of offshore outsourcing, the decision tends to be driven by cost. A skilled programmer in India or Russia earns about US $10,000 to $20,000 per year, compared to $80,000 or more per year for a comparable programmer in the EU and United States. The Internet and low-cost communications technology have drastically reduced the expense and difficulty of coordinating the work of global teams in faraway locations. In addition to cost savings, many offshore outsourcing firms offer world-class technology assets and skills. For example, leading companies such as Hilton, NBC, Fox News, and Yahoo have outsourced website design and development work to India-based Profit By Outsourcing, which provides expertise in areas such as custom programmed content management, e-commerce solutions, mobile application development, and application development using Java and other tools that are not available internally in most companies. However, wage inflation outside the United States has eroded some of these advantages, and some jobs have moved back to the United States.

Your firm is most likely to benefit from outsourcing if it takes the time to evaluate all the risks and make sure outsourcing is appropriate for its particular needs. Any company that outsources its applications must thoroughly understand the project, including its requirements, method of implementation, source of expected benefits, cost components, and metrics for measuring performance.

Many firms underestimate costs for identifying and evaluating vendors of information technology services, for transitioning to a new vendor, for improving internal software development methods to match those of outsourcing vendors, and for monitoring vendors to make sure they are fulfilling their contractual obligations. Outsourcing offshore incurs additional costs for coping with cultural differences that drain productivity and dealing with human resources issues, such as terminating or relocating domestic employees. These hidden costs undercut some of the anticipated benefits from outsourcing. Firms should be especially cautious when using an outsourcer to develop or operate applications that give some type of competitive advantage.

Figure 12.8 shows best- and worst-case scenarios for the total cost of an offshore outsourcing project. It shows how much hidden costs affect the total project cost. The best case reflects the lowest estimates for additional costs, and the worst case reflects the highest estimates for these costs. As you can see, hidden costs increase the total cost of an offshore outsourcing project by an extra 15 to 57 percent. Even with these extra costs, many firms will benefit from offshore outsourcing if they manage the work well.

TOTAL COST OF OFFSHORE OUTSOURCING

Cost of outsourcing contract			$10,000,000	
Hidden Costs	Best Case	Additional Cost ($)	Worst Case	Additional Cost ($)
1. Vendor selection	0.2%	20,000	2%	200,000
2. Transition costs	2%	200,000	3%	300,000
3. Layoffs & retention	3%	300,000	5%	500,000
4. Lost productivity/cultural issues	3%	300,000	27%	2,700,000
5. Improving development processes	1%	100,000	10%	1,000,000
6. Managing the contract	6%	600,000	10%	1,000,000
Total additional costs		1,520,000		5,700,000
	Outstanding Contract ($)	Additional Cost ($)	Total Cost ($)	Additional Cost
Total cost of outsourcing (TCO) best case	10,000,000	1,520,000	11,520,000	15.2%
Total cost of outsourcing (TCO) worst case	10,000,000	5,700,000	15,700,000	57.0%

Figure 12.8
Total Cost of Offshore Outsourcing.
If a firm spends $10 million on offshore outsourcing contracts, that company will spend 15.2 percent in extra costs even in the best-case scenario. In the worst-case scenario, when there is a dramatic drop in productivity along with exceptionally high transition and layoff costs, a firm can expect to pay up to 57 percent in extra costs on top of the $10 million outlay for an offshore contract.

MOBILE APPLICATION DEVELOPMENT: DESIGNING FOR A MULTISCREEN WORLD

Today, employees and customers expect, and even demand, to be able to use a mobile device of their choice to obtain information or perform a transaction anywhere and at any time. To meet these needs, companies will need to develop mobile websites, mobile apps, and native apps as well as traditional information systems.

Once an organization decides to develop mobile apps, it has to make some important choices, including the technology it will use to implement these apps (whether to write software for a native app or mobile web app) and what to do about a mobile website. A **mobile website** is a version of a regular website that is scaled down in content and navigation for easy access and search on a small mobile screen. (Access Amazon's website from your computer and then from your smartphone to see the difference from a regular website.)

A **mobile web app** is an Internet-enabled app with specific functionality for mobile devices. Users access mobile web apps through their mobile device's web browser. The web app resides primarily on a server, is accessed through the Internet, and doesn't need to be installed on the device. The same application can be used by most devices that can surf the web, regardless of their brand.

A **native app** is a stand-alone application designed to run on a specific platform and device. The native app is installed directly on a mobile device. Native apps can connect to the Internet to download and upload data, and they can operate on these data even when not connected to the Internet. For example, an e-book reading app such as Kindle software can download a book from the Internet, disconnect from the Internet, and present the book for reading. Native mobile apps provide fast performance and a high degree of reliability. They can also take advantage of a mobile device's particular capabilities, such as its camera or touch features. However, native apps are expensive to develop because multiple versions of an app must be programmed for different mobile operating systems and hardware such as Android and Apple's iOS.

Developing applications for mobile platforms is quite different from development for PCs and their much larger screens. The reduced size of mobile devices makes using fingers and multitouch gestures much easier than typing and using keyboards. Mobile apps need to be optimized for the specific tasks they are to perform. They should not try to carry out too many tasks, and they should be designed for usability. The user experience for mobile interaction is fundamentally different from using a desktop or laptop PC. Saving resources—bandwidth, screen space, memory, processing, data entry, and user gestures—is a top priority.

When a full website created for the desktop shrinks to the size of a smartphone screen, it is difficult for the user to navigate through the site. The user must continually zoom in and out and scroll to find relevant material. Therefore, companies need to design websites specifically for mobile interfaces and create multiple mobile sites to meet the needs of smartphones, tablets, and desktop browsers. This equates to at least three sites with separate content, maintenance, and costs. Currently, websites know what device you are using because your browser will send this information to the server when you log on. Based on this information, the server will deliver the appropriate screen.

One solution to the problem of having multiple websites is to use **responsive web design**. Responsive web design enables websites to change layouts automatically according to the visitor's screen resolution, whether on a desktop, laptop, tablet, or smartphone. Responsive design uses tools such as flexible grid-based layouts, flexible images, and media queries to optimize the design for different viewing contexts. This eliminates the need for separate design and development work for each new device. HTML5, which we introduced in Chapter 5, is also used for mobile application development because it can support cross-platform mobile applications. The Interactive Session on Technology describes how some companies have addressed the challenges of mobile development we have just identified.

Systems Development Is Different for Mobile Apps

Just about all businesses today want to deploy mobile apps and they want these apps developed in a short time frame. That's not so easy.

Developing successful mobile apps poses some unique challenges. The user experience on a mobile device is fundamentally different from that on a PC. There are special features on mobile devices such as location-based services that give firms the potential to interact with customers in meaningful new ways. Firms need to be able to take advantage of those features while delivering an experience that is appropriate to a small screen. There are multiple platforms for mobile software, including iOS, Android, and Windows 10, and a firm may need a different version of an application to run on each of these as well as on devices of different sizes and capabilities. Mobile devices might be tiny and worn on the wrist or they might be large high-definition tablet displays. They might include sensors and audio output and even displays combining real and virtual images. System builders need to understand how, why, and where customers use mobile devices and how these mobile experiences change business interactions and behavior. You can't just port a website or desktop application to a smartphone or tablet. It's a different systems development process. Many enterprises require applications that link to corporate systems and function on the desktop as well as on mobile devices.

Take, for example, Great-West Financial, the second largest retirement services company in the United States with approximately $461 billion in assets under its administration. Company employees spend more time serving customers in the field rather than in the office and needed a connection to the company's ERP Financials system from wherever they are working to process accounts payable invoice approvals. Great-West decided to deploy the Dolphin Mobile Approvals app for this purpose.

Great-West selected Dolphin because it could handle all of its SAP workflows in a single app, so that employees did not have to go to one place to approve invoices and another to approve everything else. Great-West configured the app to make its look and feel as similar as possible to the application users accessed on their desktops. The user sees the same data fields on the invoice header and line item on a mobile device as on a desktop computer screen, and the steps in the invoice approval process are the same. Given the difficulty of jumping back and forth between different screens on a mobile device, however, the mobile app incorporates the necessary invoice approval codes into its line-item detail rather than displaying these codes on a PDF attachment. On a desktop, users must sign into the SAP system in order to see an invoice and will receive notification that an invoice is available for approval via email. A pop-up notification on the mobile app eliminates the need for users to log into the app before knowing about an invoice.

Before deploying the mobile app, Great-West had to set up an appropriate mobile infrastructure, considering factors such as security, sign-on, and back-end integration. Since this was the company's first mobile app interfacing to the SAP system, the company had to make sure the mobile app could incorporate the entire workflow from the SAP system and that all the data was encrypted and secure. Great-West purchased 1,000 licenses for the mobile approvals app (which is compatible with both iOS and Android devices) and issued company-owned devices to senior executives and the heaviest invoice users. Remaining users are allowed to use the app on their own devices as long as they conform to the firm's BYOD policy.

For the past few years, United Parcel Service (UPS) has provided customers with a UPS Mobile app to track their shipments and obtain pricing information using smartphones and tablets. UPS developers initially wrote and maintained multiple versions of UPS Mobile, including one for iOS in Objective-C and another for Android in Java. This meant twice the work for UPS mobile developers. The different versions of the app might not be updated at the same time, so customers with different types of devices didn't always have access to the latest features at the same time.

UPS was able to move the UPS Mobile app to a single development platform, but this entailed an enormous amount of work. The company selected Visual Studio Tools for Xamarin for this purpose because it allowed developers to share one C++ code base across platforms and deliver fully native apps to customers. Xamarin also had better integration with mobile devices' unique hardware and capabilities. Although UPS had to rebuild more than 130,000 lines of code that had been written over a four-year period, management realized that rewriting UPS Mobile would produce dramatic time and cost savings in the long run. The company went ahead with developing on a single platform.

Much of the Xamarin code would need to be developed only once and it could support multiple platforms with great efficiency in the years to come. UPS mobile developers rewrote all versions of UPS Mobile with Visual Studio Tools for Xamarin. UPS can now add a new feature across all mobile devices in weeks and days instead of months.

Sources: Rob Bamforth, "Developers at the Mobile Edge," *Computer Weekly,* January 30–February 5, 2018; Mary K. Pratt and Linda Tucci, "Enterprise Mobile App Development: No Easy Answers," searchCIOtechtarget.com, accessed February 20, 2018; Microsoft, "UPS Paves the Way for Better Service with Faster Development and Artificial Intelligence," September 28, 2017; www.greatwest.com, accessed February 20, 2018; and Ken Murphy, "Great-West Financial Establishes Its Mobile Footprint," *SAP Insider Profiles*, October 31, 2016.

CASE STUDY QUESTIONS

1. What people, organization, and technology challenges need to be addressed when building a mobile application?
2. How does user requirement definition for mobile applications differ from traditional systems analysis?
3. Describe how Great-West's invoice approvals process changed after the mobile application was deployed.

RAPID APPLICATION DEVELOPMENT FOR E-BUSINESS

Technologies and business conditions are changing so rapidly that companies are adopting shorter, more informal development processes for many of their mobile and web-based applications. The term **rapid application development (RAD)** refers to the process of creating workable systems in a short period of time. RAD includes the use of visual programming and other tools for building graphical user interfaces, iterative prototyping of key system elements, the automation of program code generation, and close teamwork among end users and information systems specialists. Simple systems often can be assembled from prebuilt components. The process does not have to be sequential, and key parts of development can occur simultaneously.

Sometimes a technique called **joint application design (JAD)** will be used to accelerate the generation of information requirements and to develop the initial systems design. JAD brings end users and information systems specialists together in an interactive session to discuss the system's design. Properly prepared and facilitated, JAD sessions can significantly speed up the design phase and involve users at an intense level.

Agile development focuses on rapid development and frequent delivery of working software, with continual user involvement. It breaks down a large project into a series of small subprojects that are completed in short periods of time using iteration and continuous feedback. Improvement or addition of new functionality takes place within the next iteration as developers clarify requirements.

For example, UPS used Agile techniques when it modified its package tracking application (described in the Chapter 1 Interactive Session on Technology). Instead of trying to migrate all legacy applications off the corporate mainframe, project scope was limited to the tracking application, which constituted a small portion of the total UPS IT infrastructure. The work took place in iterative phases. The first phase captured tracking data stored using IBM's Db2 DBMS on the mainframe and transformed them for storage in an open source Couchbase database. While addressing data transformation, the UPS team broke the project down further to work on the mobile version of the tracking app first, which offered faster feedback on features. The team first updated international customers' mobile app interfaces, followed by US mobile customers. From there, the team moved on to update the desktop version of the package-tracking app (Pariseau, 2019).

Component-Based Development, Web Services, and Cloud-Based Development

To expedite software creation further, groups of objects have been assembled into software components for common functions, such as a graphical user interface or online ordering capability, and these components can be combined to create large-scale business applications. This approach to software development is called **component-based development**. Businesses are using component-based development to create their e-commerce applications by combining commercially available components for shopping carts, user authentication, search engines, and catalogs with pieces of software for their own unique business requirements.

Chapter 5 introduced web services as loosely coupled, reusable software components based on Extensible Markup Language (XML) and other open protocols and standards that enable one application to communicate with another with no custom programming required. In addition to supporting internal and external integration of systems, web services provide nonproprietary tools for building new information system applications or enhancing existing systems.

Platform as a service (PaaS), introduced in the Chapter 5 discussion of cloud computing, also holds considerable potential for helping system developers quickly write and test customer- or employee-facing applications. These online development environments come from a range of vendors, including Oracle, IBM, Salesforce.com (Force.com), and Microsoft (Azure). These platforms automate tasks such as setting up a newly composed application as a web service or linking to other applications and services. Some also offer a cloud infrastructure service, or links to cloud vendors such as Amazon, so that developers can launch what they build in a cloud infrastructure.

12-4 How should information systems projects be managed?

Your company might have developed what appears to be an excellent system solution. Yet when the system is in use, it does not work properly or it doesn't deliver the benefits that were promised. If this occurs, your firm is not alone. There is a high failure rate among information systems projects because they have not been properly managed. A joint study by McKinsey and Oxford University found that large software projects on average run 66 percent over budget and 33 percent over schedule. Over 50 percent of businesses surveyed by cloud portfolio management provider Innotas in 2016 had experienced an IT project failure within the previous 12 months (Florentine, 2016). Firms may have incorrectly assessed the business value of the new system or were unable to manage the organizational change the new technology required. That's why it's essential to know how to manage information systems projects and the reasons they succeed or fail.

PROJECT MANAGEMENT OBJECTIVES

A **project** is a planned series of related activities for achieving a specific business objective. Information systems projects include the development of new information systems, enhancement of existing systems, or projects for replacing or upgrading the firm's information technology (IT) infrastructure.

Project management refers to the application of knowledge, skills, tools, and techniques to achieve specific targets within specified budget and time constraints. Project management activities include planning the work, assessing risk, estimating resources required to accomplish the work, organizing the work, acquiring human and material resources, assigning tasks, directing activities, controlling project execution, reporting progress, and analyzing the results. As in other areas of business, project management for information systems must deal with five major variables: scope, time, cost, quality, and risk.

Scope defines what work is or is not included in a project. For example, the scope of a project for a new order processing system might include new modules for inputting orders and transmitting them to production and accounting but not any changes to related accounts receivable, manufacturing, distribution, or inventory control systems. Project management defines all the work required to complete a project successfully and should ensure that the scope of a project does not expand beyond what was originally intended.

Time is the amount of time required to complete the project. Project management typically establishes the amount of time required to complete major components of a project. Each of these components is further broken down into activities and tasks. Project management tries to determine the time required to complete each task and establish a schedule for completing the work.

Cost is based on the time to complete a project multiplied by the daily cost of human resources required to complete the project. Information systems project costs also include the cost of hardware, software, and work space. Project management develops a budget for the project and monitors ongoing project expenses.

Quality is an indicator of how well the result of a project satisfies the objectives management specified. The quality of information systems projects usually boils down to improved organizational performance and decision making. Quality also considers the accuracy and timeliness of information the new system produces and ease of use.

Risk refers to potential problems that would threaten the success of a project. These potential problems might prevent a project from achieving its objectives by increasing time and cost, lowering the quality of project outputs, or preventing the project from being completed altogether. We discuss the most important risk factors for information systems projects later in this section.

MANAGING PROJECT RISK AND SYSTEM-RELATED CHANGE

Some systems development projects are more likely to run into problems or to suffer delays because they carry a much higher level of risk than others. The level of project risk is influenced by project size, project structure, and the level of technical expertise of the information systems staff and project team. The larger the project—as indicated by the dollars spent, project team size, and how many parts of the organization will be affected by the new system—the greater the risk. Very large-scale systems projects have a failure rate that is 50 to 75 percent higher than that for other projects because such projects are complex and difficult to control. Risks are also higher for systems where information requirements are not clear and straightforward or the project team must master new technology.

Implementation and Change Management

Dealing with these project risks requires an understanding of the implementation process and change management. A broader definition of **implementation** refers to all the organizational activities working toward the adoption and management of an innovation, such as a new information system. Successful implementation requires a high level of user involvement in a project and management support.

If users are heavily involved in the development of a system, they have more opportunities to mold the system according to their priorities and business requirements and to control the outcome. They also are more likely to react positively to the completed system because they have been active participants in the change process.

The relationship between end users and information systems specialists has traditionally been a problem area for information systems implementation efforts because of differing backgrounds, interests, and priorities. These differences create a **user–designer communications gap**. Information systems specialists often have a highly

TABLE 12.5
The User–Designer Communications Gap

User Concerns	Designer Concerns
Will the system deliver the information I need for my work?	What demands will this system put on our servers?
Can we access the data on our mobile phones, tablets, and PCs?	What kind of programming demands will this place on our group?
What new procedures do we need to enter data into the system?	Where will the data be stored? What's the most efficient way to store them?
How will the operation of the system change employees' daily routines?	What technologies should we use to secure the data?

technical orientation to problem solving, focusing on technical solutions in which hardware and software efficiency is optimized at the expense of ease of use or organizational effectiveness. End users prefer systems that are oriented toward solving business problems or facilitating organizational tasks. Often the orientations of both groups are so at odds that they appear to speak in different tongues. These differences are illustrated in Table 12.5.

If an information systems project has the backing and commitment of management at various levels, it is more likely to receive higher priority from both users and the technical information systems staff. Management backing also ensures that a systems project receives sufficient funding and resources to be successful. Furthermore, to be enforced effectively, all the changes in work habits and procedures and any organizational realignments associated with a new system depend on management backing. According to the Project Management Institute, having executive sponsors who are actively engaged is the leading factor in project success (Project Management Institute, 2014).

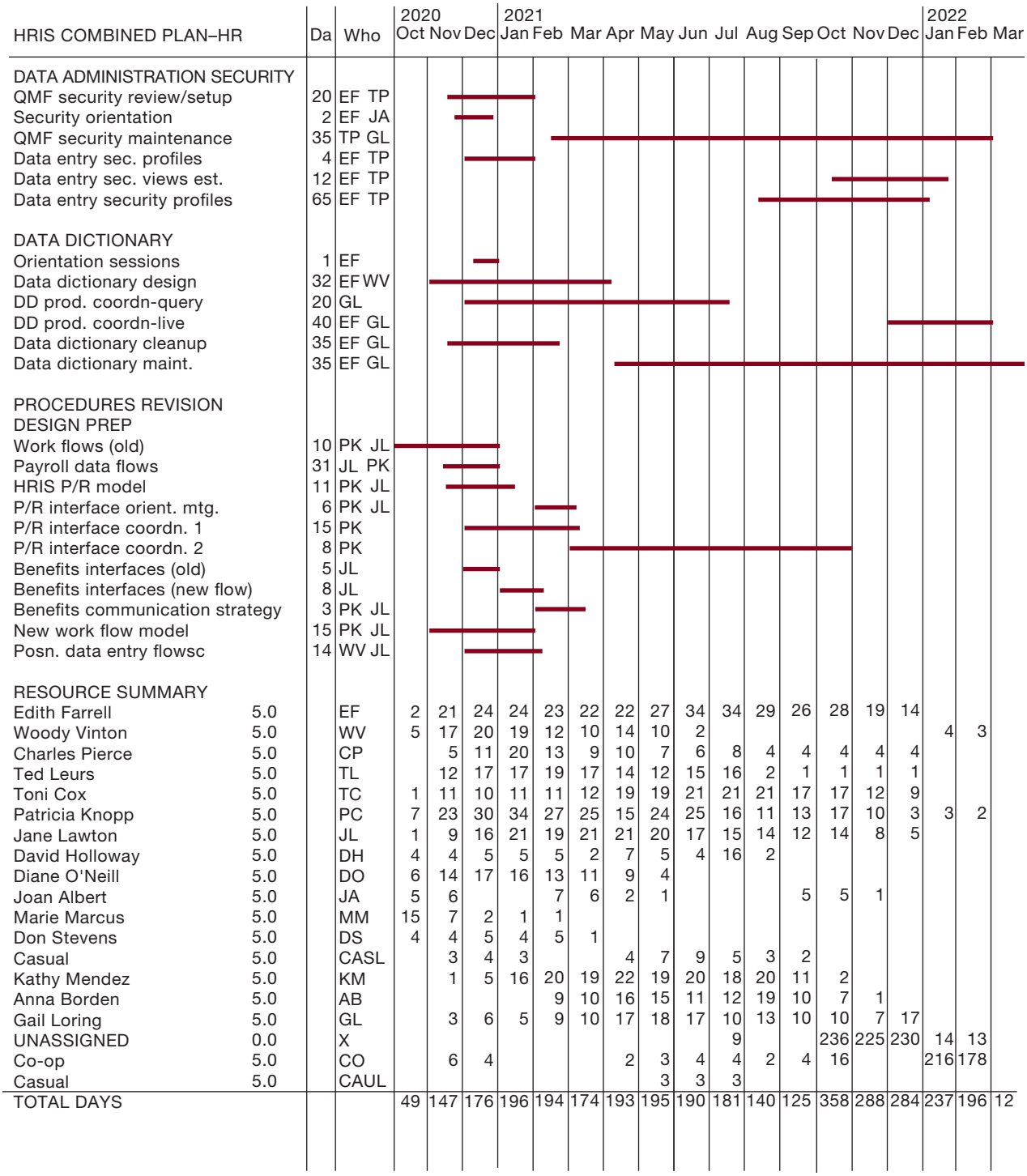
Controlling Risk Factors

There are strategies you can follow to deal with project risk and increase the chances of a successful system solution. If the new system involves challenging and complex technology, you can recruit project leaders with strong technical and administrative experience. Outsourcing or using external consultants are options if your firm does not have staff with the required technical skills or expertise.

Large projects benefit from appropriate use of **formal planning and control tools** for documenting and monitoring project plans. The two most commonly used methods for documenting project plans are Gantt charts and PERT charts. A **Gantt chart** lists project activities and their corresponding start and completion dates. The Gantt chart visually represents the timing and duration of different tasks in a development project as well as their human resource requirements (see Figure 12.9). It shows each task as a horizontal bar whose length is proportional to the time required to complete it.

Although Gantt charts show when project activities begin and end, they don't depict task dependencies, how one task is affected if another is behind schedule or how tasks should be ordered. That is when **PERT charts** are useful. PERT stands for Program Evaluation and Review Technique, a methodology the US Navy developed during the 1950s to manage the Polaris submarine missile program. A PERT chart graphically depicts project tasks and their interrelationships. The PERT chart lists the specific activities that make up a project and the activities that must be completed before a specific activity can start, as illustrated in Figure 12.10.

The PERT chart portrays a project as a network diagram consisting of numbered nodes (either circles or rectangles) representing project tasks. Each node is numbered and shows the task, its duration, the starting date, and the completion date.



HRIS COMBINED PLAN–HR		Da	Who	2020 Oct	Nov	Dec	2021 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2022 Jan	Feb	Mar
DATA ADMINISTRATION SECURITY																					
QMF security review/setup		20	EF TP																		
Security orientation		2	EF JA																		
QMF security maintenance		35	TP GL																		
Data entry sec. profiles		4	EF TP																		
Data entry sec. views est.		12	EF TP																		
Data entry security profiles		65	EF TP																		
DATA DICTIONARY																					
Orientation sessions		1	EF																		
Data dictionary design		32	EF WV																		
DD prod. coordn-query		20	GL																		
DD prod. coordn-live		40	EF GL																		
Data dictionary cleanup		35	EF GL																		
Data dictionary maint.		35	EF GL																		
PROCEDURES REVISION																					
DESIGN PREP																					
Work flows (old)		10	PK JL																		
Payroll data flows		31	JL PK																		
HRIS P/R model		11	PK JL																		
P/R interface orient. mtg.		6	PK JL																		
P/R interface coordn. 1		15	PK																		
P/R interface coordn. 2		8	PK																		
Benefits interfaces (old)		5	JL																		
Benefits interfaces (new flow)		8	JL																		
Benefits communication strategy		3	PK JL																		
New work flow model		15	PK JL																		
Posn. data entry flowsc		14	WV JL																		
RESOURCE SUMMARY																					
Edith Farrell	5.0		EF	2	21	24	24	23	22	22	27	34	34	29	26	28	19	14			
Woody Vinton	5.0		WV	5	17	20	19	12	10	14	10	2							4	3	
Charles Pierce	5.0		CP		5	11	20	13	9	10	7	6	8	4	4	4	4	4			
Ted Leurs	5.0		TL		12	17	17	19	17	14	12	15	16	2	1	1	1	1			
Toni Cox	5.0		TC	1	11	10	11	11	12	19	19	21	21	21	17	17	12	9			
Patricia Knopp	5.0		PC	7	23	30	34	27	25	15	24	25	16	11	13	17	10	3	3	2	
Jane Lawton	5.0		JL	1	9	16	21	19	21	21	20	17	15	14	12	14	8	5			
David Holloway	5.0		DH	4	4	5	5	5	2	7	5	4	16	2							
Diane O'Neill	5.0		DO	6	14	17	16	13	11	9	4										
Joan Albert	5.0		JA	5	6			7	6	2	1				5	5	1				
Marie Marcus	5.0		MM	15	7	2	1	1													
Don Stevens	5.0		DS	4	4	5	4	5	1												
Casual	5.0		CASL		3	4	3			4	7	9	5	3	2						
Kathy Mendez	5.0		KM		1	5	16	20	19	22	19	20	18	20	11	2					
Anna Borden	5.0		AB					9	10	16	15	11	12	19	10	7	1				
Gail Loring	5.0		GL		3	6	5	9	10	17	18	17	10	13	10	10	7	17			
UNASSIGNED	0.0		X										9			236	225	230	14	13	
Co-op	5.0		CO		6	4				2	3	4	4	2	4	16			216	178	
Casual	5.0		CAUL								3	3	3								
TOTAL DAYS				49	147	176	196	194	174	193	195	190	181	140	125	358	288	284	237	196	12

Figure 12.9
A Gantt Chart.
The Gantt chart in this figure shows the task, person-days, and initials of each responsible person as well as the start and finish dates for each task. The resource summary provides a good manager with the total person-days for each month and for each person working on the project to manage the project successfully. The project described here is a data management project.

The direction of the arrows on the lines indicates the sequence of tasks and shows which activities must be completed before the commencement of another activity. In Figure 12.10, the tasks in nodes 2, 3, and 4 do not depend on each other and can be undertaken simultaneously, but each depends on completion of the first task.

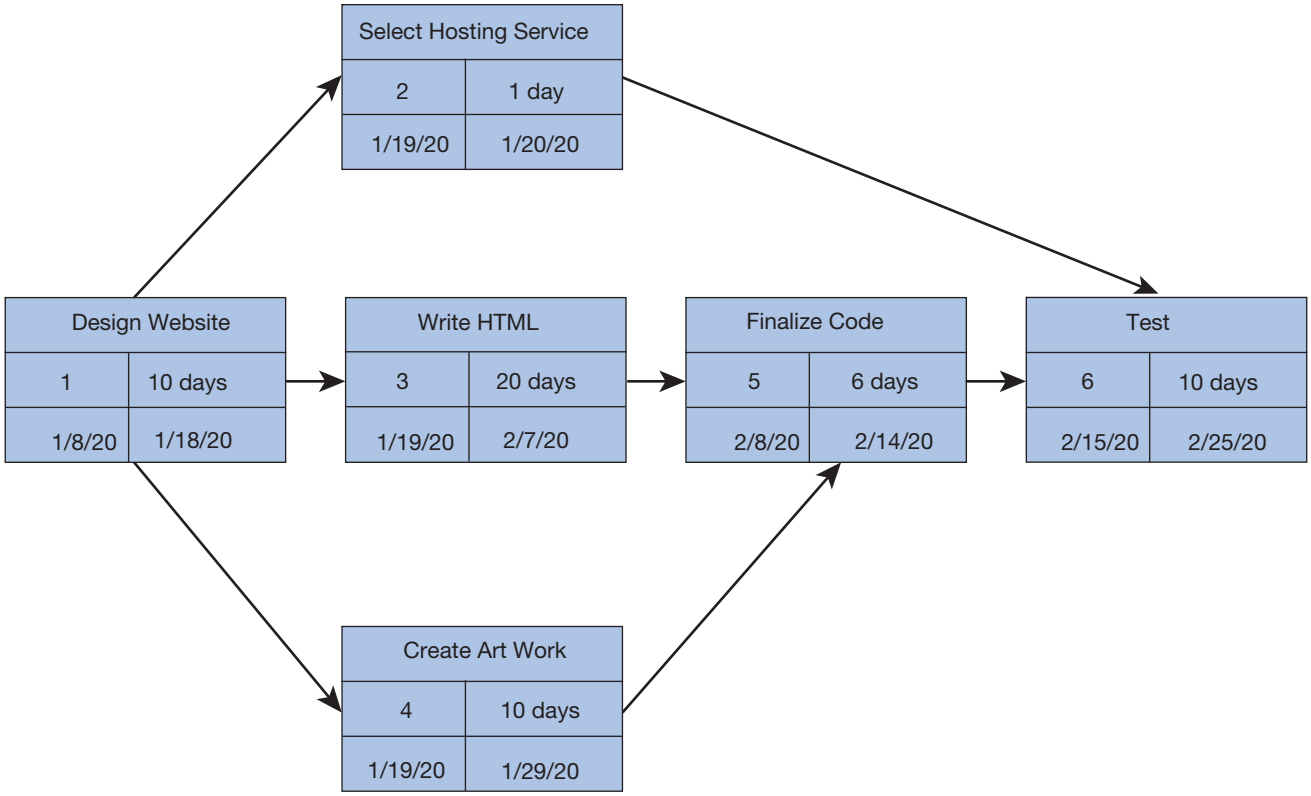


Figure 12.10
A PERT Chart.
This is a simplified PERT chart for creating a small website. It shows the ordering of project tasks and the relationship of a task with preceding and succeeding tasks.

Project Management Software

Commercial software tools are available to automate the creation of Gantt and PERT charts and facilitate the project management process. Project management software typically features capabilities for defining and ordering tasks, assigning resources to tasks, establishing starting and ending dates for tasks, tracking progress, and facilitating modifications to tasks and resources. The most widely used project management tool today is Microsoft Project, but there are also lower-cost tools for small projects and small businesses. Many of today's project management tools are cloud-based. The Interactive Session on Organizations describes some capabilities of Microsoft Project Online. We should also point out that these traditional project management tools are being supplemented with some of the social business tools described in Chapter 2.

Overcoming User Resistance

You can overcome user resistance by promoting user participation (to elicit commitment as well as improve design), by making user education and training easily available, and by providing better incentives for users who cooperate. End users can become active members of the project team, take on leadership roles, and take charge of system installation and training.

You should pay special attention to areas where users interface with the system, with sensitivity to ergonomics issues. **Ergonomics** refers to the interaction of people and machines in the work environment. It considers the design of jobs, health issues, and the end-user interface of information systems. For instance, if a system has a series of complicated online data entry screens that are extremely difficult or time-consuming to work with, users will reject the system if it increases their workload or level of job stress.

Arup Moves Project Management to the Cloud

Arup Group Limited is a multinational professional services firm headquartered in London that provides engineering, design, planning, project management, and consulting services for all aspects of structures and environments of human construction. Founded in 1946, Arup now has over 13,000 staff based in 85 offices across 35 countries throughout the globe. The company defines itself as one where professionals of diverse disciplines—engineers, planners, designers, financial experts, consulting specialists, and sustainability professionals—can work together to deliver projects and services of greater quality than by working in isolation. Arup has worked on projects in over 160 countries, including the Pompidou Center in Paris, the Sydney Opera House, the high-speed railway between London and Paris, and the National Aquatics Center for the 2008 Beijing Olympics.

Arup is an intensive user of information technology in all aspects of its work, including working with clients, designing buildings, running structural simulations, and coordinating projects. Its management wants to ensure that Arup's information systems group is working on all the right IT projects for furthering the business and is doing so in the right way. Arup's systems have to be stable, leading edge, and available at all times, with employees able to access the information they need at any time and any place.

Until recently Arup's IT staff relied on Microsoft Excel spreadsheets or Microsoft Word documents as their project management tools. Reports were sporadic and in diverse formats, collaboration was limited, project delivery styles were inconsistent, and there was no central visibility into what was happening with each project. Arup set up a Global IT Portfolio Management Office to oversee its entire portfolio of IT projects, but it was hampered by having to manually create reports using spreadsheets and email updates from regional offices.

Working with Program Framework consultants who specialize in project portfolio management, Arup decided to adopt Microsoft Project Online to improve project management. Project Online is Microsoft's cloud-based project management tool, and it helps organizations efficiently plan projects, track status, and collaborate with others from any location and any device. Members of Arup's global workforce have immediate access to project data at any time wherever they are working. The cloud solution also makes it possible to report on projects using live data, with the system able to tie in to other processes such as service and change management. Program Framework consultants helped Arup implement Project Online and train employees. They also developed a customized Project and Program Status Reporting capability for Project Online.

In the past, Arup's Global IT Portfolio Management Office had to spend 40 hours per month compiling reports manually. By the time it created a status report, the report was already out of date. Project Online gives Arup instant views into the status of all of its IT projects. Regional employees can view their own portfolios of projects, while Arup's Global IT Portfolio Management Office has immediate views of all global projects. Arup's management can examine and classify projects throughout the entire enterprise based on their red, green, and amber status indicators. (Red designates projects with critical status, while amber designates those at risk.) The ability to see Arup's entire project portfolio gives management better insight into project delivery. The Global IT Portfolio Management Office can obtain key project status summaries, and highlight reporting of individual projects where it can drill down for further detail, enabling it to make better decisions based on up-to-date data. Project Online has become essential for supporting a common approach to Arup's project management across the globe. There is less duplication of effort and more strategic value in Arup's overall project portfolio.

Project Online is part of Microsoft's cloud-based Office 365 software suite, so it works seamlessly with other Microsoft productivity and communication tools such as OneDrive for Business (cloud storage), Skype for Business (voice, video, chat), Yammer (enterprise social networking), and Visual Studio Team Foundation Server, which Arup uses for software development projects. Arup also plans to implement additional Project Online capabilities for demand and capacity planning, portfolio prioritization, and portfolio balancing. Users can easily copy information from Project and paste it into Office applications like PowerPoint and Word.

Arup uses Project Online for its IT Project Pipeline, a central repository of ideas for future development. Each idea recorded in the Pipeline requires that the initiator furnish information

such as project description, budget, and resource needs. Arup's Global IT Portfolio Management Office sends this information to Arup's management committee members to review and prioritize for new initiatives.

When ideas are approved, their Project Pipeline information can easily be transferred to active projects. It only takes a few minutes for Project Pipeline to create a project or program within Project Online. Each has its own Project Details Pages, which include a built-in schedule template and a connected Microsoft SharePoint Server site with document repository and status reporting. This capability saves Arup's Global IT Portfolio Management Office manager Carolyn Bundey several days of work for each new project, creating significant time savings for an annual portfolio of approximately 180 IT projects.

Several years ago, Project Online had about 150 users, but Arup is thinking about providing the tool for all of its employees. Arup licenses three different versions of Project Online. Project managers, owners, and administrators use Project Online with Project Professional for Office 365, enabling them to create and edit project plans inside or outside a web browser. Arup executives use Project Online to review project status. Project team members can view assignments or collaborate with other team members using the lower-cost Project Lite version.

Sources: "Engineering Firm Uses Cloud-Based Solution to Generate, Execute, and Monitor IT Projects," www.microsoft.com, accessed January 2, 2018; "Leading Arup at the Forefront of Innovation in Today's Built Environment," www.gineersnow.com, accessed January 3, 2018; and www.arup.com, accessed January 2, 2018.

CASE STUDY QUESTIONS

1. What is the relationship between information technology, project management, and Arup's business model and business strategy?
2. How does Microsoft Project Online support Arup's business strategy? How did it change the way the company works?
3. What people, organization, and technology issues did Arup have to address when selecting Project Online as its global project portfolio management tool?

Users will be more cooperative if organizational problems are solved prior to introducing the new system. In addition to procedural changes, transformations in job functions, organizational structure, power relationships, and behavior should be identified during systems analysis, using an **organizational impact analysis**.

12-5 How will MIS help my career?

Here is how Chapter 12 and this book will help you find an entry-level job as an IT project management assistant.

THE COMPANY

XYZ Multimedia Emtertainment, a large multinational mass media and entertainment company, headquartered in Paris, is looking for an entry-level IT project management assistant. XYZ Multimedia creates films, TV shows, recordings, streaming Internet content, interactive games, and consumer products for a worldwide audience. It is an intensive user of leading-edge information technology in its products, services, and operations.

POSITION DESCRIPTION

The IT project management assistant will help IT project managers with planning, budgeting, and overseeing all aspects of information technology projects for the firm. Job responsibilities include:

- Performing tasks designed to enhance the functions and services provided by the firm's centralized Project Management Office. This might include identifying and documenting best practices, investigating available tools, making recommendations for improving processes and procedures.
- Collaborating with project managers to ensure that the scope and direction of each technical project is on schedule.
- Working with other project stakeholders for support.

JOB REQUIREMENTS

- Bachelor's degree in Computer Science, Computer Engineering, Management Information Systems, Project Management, or a related field.
- Knowledge of project management process (PMI) teachings
- Knowledge of process documentation (process flow charting)
- Proficiency with Microsoft Word, Excel, PowerPoint
- Strong interviewing and research skills
- Experience with SharePoint and/or Microsoft Project desirable.

INTERVIEW QUESTIONS

1. Have you ever worked on an IT project? What did you do? Did you work with any project management tools such as Microsoft Project?
2. Did you ever work on a non-IT project? What were your responsibilities? Did you use project management software for your work?
3. Have you taken course work in project management?
4. What is your proficiency level with Microsoft Office tools and with Microsoft Project and SharePoint?

AUTHOR TIPS

1. Review this chapter and also Chapter 3 on building information systems to familiarize yourself with project management and systems development techniques and methodologies.
2. Use the web to do more research on project management methodologies and tools. Try to find information on how projects are managed at this company.
3. Inquire what project management methodologies and tools are used at this company. If possible, show you are familiar with these tools and approaches.
4. Provide examples of any project management work you have done in your courses or on a job. Alternatively, provide examples of your writing and verbal communication skills.

Review Summary

12-1 **How should managers build a business case for the acquisition and development of a new information system?** The business case for an IT investment describes the problem facing the organization that can be solved by investing in a proposed system solution. It provides an analysis of whether an information system project is a good investment by calculating its costs and benefits. Tangible benefits are quantifiable, and intangible benefits cannot be immediately quantified but may provide quantifiable benefits in the future. Benefits that exceed costs should then be analyzed using capital budgeting methods to make sure they represent a good return on the firm's invested capital. Organizations should develop an information systems plan that describes how information technology supports the company's overall business

plan and strategy. Portfolio analysis and scoring models can be used to evaluate alternative information systems projects.

12-2 **What are the core problem-solving steps for developing a new information system?** The core problem-solving steps for developing new information systems are: (1) define and understand the problem, (2) develop alternative solutions, (3) evaluate and choose the solution, and (4) implement the solution. The third step includes an assessment of the technical, financial, and organizational feasibility of each alternative. The fourth step entails finalizing design specifications, acquiring hardware and software, testing, providing training and documentation, conversion, and evaluating the system solution once it is in production.

12-3 **What are the alternative methods for building information systems?** The systems life cycle requires information systems to be developed in formal stages. The stages must proceed sequentially and have defined outputs; each requires formal approval before the next stage can commence. The system life cycle is rigid and costly but useful for large projects.

Prototyping consists of building an experimental system rapidly and inexpensively for end users to interact with and evaluate. The prototype is refined and enhanced until users are satisfied that it includes all their requirements and can be used as a template to create the final system. End-user-developed systems can be created rapidly and informally using user-friendly software tools. End-user development can improve requirements determination and reduce application backlog.

Application software packages and SaaS eliminate the need for writing software programs when developing an information system. Application software packages and SaaS are helpful if a firm does not have the internal information systems staff or financial resources to custom-develop a system.

Outsourcing consists of using an external vendor to build (or operate) a firm's information systems. If it is properly managed, outsourcing can save application development costs or enable firms to develop applications without an internal information systems staff.

Rapid application design, agile development, joint application design (JAD), cloud-based platforms, and reusable software components (including web services) can be used to speed up the system's development process. Mobile application development must address multiple platforms, small screen sizes, and the need to conserve resources.

12-4 **How should information systems projects be managed?** Information systems projects and the entire implementation process should be managed as planned organizational change using an organizational impact analysis. Management support and control of the implementation process are essential, as are mechanisms for dealing with the level of risk in each new systems project. Project risks are influenced by project size, project structure, and the level of technical expertise of the information systems staff and project team. Formal planning and control tools (including Gantt and PERT charts) track resource allocations and specific project activities. Users can be encouraged to take active roles in systems development and become involved in installation and training.

Key Terms

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Agile development, 470
Business case, 453
Capital budgeting, 457
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Customization, 466
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Documentation, 462
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Review Questions

12-1 How should managers build a business case for the acquisition and development of a new information system?

- Define and describe the components of a business case for a proposed systems investment
- List and describe the major components of an information systems plan.
- Explain the difference between tangible and intangible benefits.
- List six tangible benefits and six intangible benefits of an IT investment.
- Describe how portfolio analysis and scoring models can be used to establish the worth of systems.

12-2 What are the core problem-solving steps for developing a new information system?

- List and describe the problem-solving steps for building a new system.
- Define information requirements and explain why they are important for developing a system solution.
- List the various types of design specifications required for a new information system.
- Explain why the testing stage of systems development is so important. Name and describe the three stages of testing for an information system.
- Describe the roles of documentation, conversion, production, and maintenance in systems development.

12-3 What are the alternative methods for building information systems?

- Explain why the systems life cycle is inappropriate for many small businesses.
- Identify the two groups that can work together using joint application design (JAD).
- Identify the aspects that can be addressed by carrying out an organizational impact analysis.
- What is a Request for Proposal? What happens next?
- Explain how customization works when services or packages are designed for a specific business or organization.
- Define and describe component-based development.
- Describe the issues that must be addressed when developing mobile applications.

12-4 How should information systems projects be managed?

- Explain the importance of implementation for managing the organizational change surrounding a new information system.
- Define the user–designer communications gap and explain the kinds of implementation problems it creates.
- List and describe the factors that influence project risk and describe strategies for minimizing project risks.

MyLab MIS™

To complete the problems with **MyLab MIS**, go to EOC Discussion Questions in MyLab MIS.

Discussion Questions

12-5 Discuss the role of business end users and information system professionals in developing a system solution. How do both roles differ when the solution is developed using prototyping or end-user development? MyLab MIS

12-6 It has been said that systems fail when systems builders ignore people problems. Why might this be so? MyLab MIS

12-7 Why is building a system a form of organizational problem-solving? MyLab MIS

Hands-On MIS Projects

The projects in this section give you hands-on experience evaluating information systems projects, designing a customer system for auto sales, and analyzing website information requirements. Visit **MyLab MIS** to access this chapter's Hands-On MIS Projects.

MANAGEMENT DECISION PROBLEMS

12-8 The Warm and Toasty Heating Oil Company used to deliver heating oil by sending trucks that printed out a ticket with the number of gallons of oil delivered that was placed on customers' doorsteps. Customers received their oil delivery bills in the mail two weeks later. The company recently revised its oil delivery and billing system so that oil truck drivers can calculate and print out a complete bill for each delivery and leave customers with the bill and a return envelope at the time the delivery takes place. Evaluate the business impact of the new system and the people and organizational changes required to implement the new technology.

12-9 Caterpillar is the world's leading maker of earth-moving machinery and supplier of agricultural equipment. The software for its Dealer Business System (DBS), which it licenses to its dealers to help them run their businesses, is becoming outdated. Senior management wants its dealers to use a hosted version of the software supported by Accenture consultants so that Caterpillar can concentrate on its core business. The system had become a de facto standard for doing business with the company. The majority of the 50 Caterpillar dealers in the EU use some version of DBS, as do about half of the 200 or so Caterpillar dealers in the rest of the world. Before Caterpillar turns the project over to Accenture, what factors and issues should it consider? What questions should it ask? What questions should its dealers ask?

IMPROVING DECISION MAKING: USING DATABASE SOFTWARE TO DESIGN A CUSTOMER SYSTEM FOR AUTO SALES

Software skills: Database design, querying, reporting, and forms
Business skills: Sales lead and customer analysis

12-10 This project requires you to perform a systems analysis and then design a system solution using database software.

Dubai Auto Dealers (DAD) specializes in selling new vehicles from Subaru in Dubai. The company advertises in local newspapers and is listed as an authorized dealer on the Subaru website and other major websites for auto buyers. The company benefits from a good local word-of-mouth reputation and name recognition.

DAD does not believe it has enough information about its customers. It cannot easily determine which prospects have made auto purchases, nor can it identify which customer touch points have produced the greatest number of

sales leads or actual sales so it can focus advertising and marketing more on the channels that generate the most revenue. Are purchasers discovering DAD from newspaper ads, from word of mouth, or from the web?

Prepare a systems analysis report detailing DAD's problem and a system solution that can be implemented using PC database management software. Then use database software to develop a simple system solution. In MyLab MIS, you will find more information about DAD and its information requirements to help you develop the solution.

ACHIEVING OPERATIONAL EXCELLENCE: ANALYZING WEBSITE DESIGN AND INFORMATION REQUIREMENTS

Software skills: Web browser software
Business skills: Information requirements analysis, website design

12-11 Visit the website of your choice and explore it thoroughly. Prepare a report analyzing the various functions provided by that website and its information requirements. Your report should answer these questions: What functions does the website perform? What data does it use? What are its inputs, outputs, and processes? What are some of its other design specifications? Does the website link to any internal systems or systems of other organizations? What value does this website provide the firm?

COLLABORATION AND TEAMWORK PROJECT

Identifying Implementation Problems

12-12 With three or four of your classmates, select a system described in this text. Write a description of the implementation problems you might encounter with such a system and the steps you would take to solve or prevent these problems. If possible, use Google Docs and Google Drive or Google Sites to brainstorm, organize, and develop a presentation of your findings for the class.

BUSINESS PROBLEM-SOLVING CASE

MAERSK'S TRADELENS: DIGITIZING THE GLOBAL SUPPLY CHAIN

Maersk is a container logistics company that operates in more than 120 countries and serves more than 300 ports worldwide. It employs over 79,900 people, and its revenue reached $39 billion in 2018 with an underlying profit of $220 million. As of May 2019, Maersk has a market capitalization of $28.1 billion. Maersk offers a range of shipping and cargo, supply chain, and freight-forwarding services, with the stated aim of connecting businesses globally and making shipping simple. The company has the highest ocean capacity market share; along with the other top ten shipping lines, such as MSC, CMA-CGM, and Hapag-Lloyd, it controls more than 87 percent of the fleet capacity in the container shipping industry.

Competition in this industry is intense. Maersk needs to transform itself and improve earnings to maintain its leading role in the market. However, Maersk's legacy system, which relied heavily on paper-based documents, has been one of the company's biggest burdens, reducing shipping efficiency and incurring extra operational costs. For example, shipping a refrigerated container from Kenya to Europe takes approximately 30 days, and the process involves multiple individuals and organizations. The shipping process typically begins with a cargo owner initiating a booking with the company to send goods overseas. Legal documents need to be filled, submitted, and approved before a piece of cargo is allowed to enter or leave a port. The shipping paper trail could end up with hundreds or thousands of pages in documentation processed by different supply chain parties, including agencies, banks, and customs. A host of other factors, including missing documents, miscommunications, and differences in regulations among organizations and countries may further lengthen the shipping process for Maersk.

Against this backdrop, back in 2010, Maersk started to explore the possibilities of digitizing shipping processes. At the time, customs authorities in the Netherlands had introduced measures to remove excessive paperwork from trade. Maersk's initiatives remained at the ideation stage until 2016, when the concept of blockchain has started to proliferate. Maersk has worked with IBM on a digitization project to enhance document-sharing across the supply chain and reduce complexity for the customers and suppliers. At the initiation stage, Maersk and IBM organized a series of "thinking workshops" to determine the practicability of the blockchain technology in supply chains and to develop pilots. In June 2016, Maersk and IBM carried out their first pilot project in the form of a shipment from Kenya to Holland and followed up in February 2017 when they cooperated with a freight forwarder and a customs authority to test a blockchain-enabled shipment live. In January 2018, encouraged by the success of the pilot tests, Maersk and IBM announced that they were collaborating on a project to build a blockchain-enabled global supply chain solution called TradeLens. In the August of that year, Maersk and IBM announced that TradeLens has been created.

The TradeLens system is capable of enhancing the efficiency and security of global trade, which has been hobbled by data trapped in organizational silos, paper-based processes, and clearance processes that are subject to fraud. TradeLens assumes a strategic role within Maersk and allows it to gather data points to spot inefficiencies within supply chains and suggest solutions to clients. Unlike typical information system projects, TradeLens is meant not only as a solution for Maersk but as a digital revolution in the shipping industry.

However, the implementation of TradeLens and the claims of its benefits to shippers and of improductivity in general have been met with skepticism. Shippers and the broader logistics industry have raised questions about the cost, imminent applicability, and value of this innovation. The success of this blockchain-enabled shipping project heavily relies on the participation of other large carriers who will act as trust anchors and run blockchain nodes on the network—Marvin Erdly, head of TradeLens at IBM Blockchain, emphasized that onboarding other carriers was an necessary condition for TradeLens to succeed. But while TradeLens was being introduced, Maersk and IBM struggled to find partners and succeeded in enticing only one other carrier, Pacific International Lines (PIL), onto the platform. As Maersk is the owner of the joint venture that owns TradeLens, it enjoys a benefit not shared by other participants on this

blockchain solution—so why would Maersks' rivals want to use a platform that would enrich this biggest competitor? Maersk and IBM were aware of these issues during the new system's implementation, and in response they established an operational subsidiary to manage staff on the project and ensure the independence of TradeLens from Maersk's other business units.

Despite this measure, in November 2018, the shipping companies COSCO, CMA CGM, Evergreen Marine, OOCL, and Yang Ming decided to develop their own blockchain solution, named the Global Shipping Business Network (GSBN). Built by CargoSmart, the GSBN has the backing of several terminals and ports worldwide. And there are dozens more global trade-related blockchain initiatives in the pipeline, some of which are backed by Maersk's rivals, raising further doubts about when—or even whether—shippers need to invest in or adopt TradeLens. There have also been questions about the scalability of a blockchain-enabled shipping solution developed by a single liner carrier.

Proponents believe that the blockchain project will allows new and more efficient shipping processes to germinate, but skepticism among shippers still remains. Andrew Nutting, former Director of International Logistics at Bob's Discount Furniture, publicly questioned the claim that the solution could reduce shipping times by 40 percent, while James Stewart, a global account executive with Crane Worldwide Logistics, questioned whether the market can afford it or even needs it. Many other naysayers have predicted that the TradeLens project is doomed to fail.

Despite all the skepticism, Maersk and IBM have had a positive engagement with companies in the industry and have gone on to get more than 100 ecosystem participants actively involved in the project. They sought out scores of participants, including global ports and customs authorities, cargo owners, freight forwarders, and logistics companies, to join the TradeLens platform from other parts of the shipping supply chain. Security concerns and distrust continued to be predominant obstacles to the adoption of the blockchain-based solution, rendering it difficult for Maersk to gain marketing traction for the project. In response, TradeLens is having an audit to certify its compliance with the ISO 27001 family of IT security standards.

To ensure that inputs from the supply chain industry are heard, Maersk and IBM have formed the TradeLens Advisory Board, which provides guidance and feedback to drive open and fair standards. Through this collaboration model, Maersk and IBM hope to ensure that TradeLens is a solution for the industry that is built through collaboration among all participants and stakeholders.

Maersk and IBM are taking the concerns on equity and governance on board and have worked closely with carriers to address them. TradeLens's commitment to open standards and open governance has won more takers among the carriers and is increasingly being seen as a key project to lead the digital transformation in the shipping industry. Rajesh Krishnamurthy, Executive Vice-president of IT & Transformations at the CMA CGM Group, has come out in support of the onboarding of participants from across the supply chain ecosystem and has stated that TradeLens will deliver significant value.

Maersk and IBM's efforts are paying off. Participants believe that Maersk's history of innovation and IBM's technological prowess give TradeLens a high probability of success against other blockchain projects in the market. By July 2019, 11 months after the introduction of TradeLens, Maersk appeared to have overcome the initial concerns from carriers and garnered more support from big players in the shipping industry, including Zim Lines, PIL, CMA CGM, MSC, Hapag Lloyd, and ONE. Hapag-Lloyd and ONE will each operate a blockchain node and assume a critical role for the network by acting as trust anchors or validators. Both companies are also represented on the TradeLens Advisory Board, joining members across the supply chain to ensure the neutrality and openness in the governance of the TradeLens project.

TradeLens's benefits will grow insofar as the system achieves widespread adoption and develops into a single ecosystem. More participants mean better visibility for trade, allowing traders to provide better customer services with greater confidence. Bringing the leading carriers on board TradeLens helps the members of the global supply chain expand and explore the benefits of digitization as well as deliver new opportunities to participants in the ecosystem. With five of the world's six largest carriers and six of the top ten container lines committing to and signing up to use the TradeLens platform, the digital transformation of the global supply chain has been accelerated, with the promise of greater trust, transparency, and collaboration across participants and promotion of global trade.

Through the implementation of TradeLens, Maersk is now processing more than 10 million discrete shipping events and thousands of documents

each week, providing shippers, carriers, freight forwarders, customs officials, port authorities, and other involved trading partners a consistent and unified view of transactions—ensuring its place as a world-leading container logistics company as well as its role in the global supply chain.

Sources: Maersk Official website, www.maersk.com, accessed November 5, 2019; IBM Official website, www.ibm.com, accessed November 5, 2019; TradeLens Official website, www.tradelens.com, accessed November 5, 2019; "Møller-Maersk on the Forbes World's Best Employers List," www.forbes.com, accessed November 5, 2019; MI News Network, "Top 10 Shipping Lines Control Almost 90% of the Deep Sea Market," Marine Insight, October 11, 2019, www.marineinsight.com; Hariesh Manaadiar, "TradeLens Garners More Support," Shipping and Freight Resource, July 8, 2019, shippingandfreightresource.com; Ed Targett, "TradeLens' Two New Mega Members Put 'Half World's Shipping Data' on IBM's Blockchain," *Computer Business Review*, May 29, 2019, www.cbronline.com; Rebecca Hill, "IBM Struggles to Sign Up Shipping Carriers to Blockchain Supply Chain Platform—Reports," October 30, 2018, www.theregister.co.uk; Ian Allison, "IBM and Maersk Struggle to Sign Partners to Shipping Blockchain," CoinDesk, October 26, 2018, www.coindesk.com; Eric Johnson, "Skepticism of Maersk-IBM's TradeLens Hit Bigger Blockchain Questions," JOC.com, August 13, 2018, www.joc.com; A.P. Moller—Maersk, Annual Report 2018, ml-eu.globenewswire.com.

CASE STUDY QUESTIONS

12-13 Assess the importance of the TradeLens project for Maersk.

12-14 What core problem-solving steps has Maersk gone through in developing the new system?

12-15 Describe the problems encountered by the TradeLens project. What management, organization, or technology factors were responsible for these problems?

12-16 What has Maersk done to mitigate the problems of the TradeLens project?

Case contributed by Tommy Chan, Northumbria University, and Zach Lee, Durham University.

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