CHAPTER 5

Business Process Modeling Approaches and Diagrams

Many issues in connection with business process redesign have been addressed since the 1990s, in large part in response to important questions raised by business process reengineering. Success factors and preconditions for effective business process redesign have been identified, new methods and techniques for managing change in connection with business process redesign projects have been proposed, potentially damaging "myths" have been identified, the role of information technology in business process redesign efforts has been clarified, and new insights on the implementation of new business process designs have been gained. Several of these issues are addressed in this book, many in later chapters.

One area that has received relatively little attention, however, is that of business process modeling approaches and their impact on business process redesign. This is an area where important questions remain to be answered. Business process modeling approaches influence the way in which business process redesign practitioners look at processes. That is, those approaches define the representational "lenses" through which people see business processes, which arguably are likely to have a strong influence on how business processes are redesigned. For example, as previously discussed in this book, a focus on the flow of activities in a business process (or "workflow") is likely to lead to changes in how *activities* flow in the process, whereas a focus on the flow of information in a business process is likely to lead to changes in how *information* flows in the process.

In this chapter, several business process modeling approaches are discussed, as well as respective representative diagrams. For each approach, a discussion of its main focus is provided, as well as a comparative discussion within the context of the communication flow–oriented business redesign methodology proposed in this book. Main approaches covered here include activity flow–oriented approaches, the data flow diagramming approach used in traditional systems analysis and design, the communication flow–oriented approach (which can be seen as a modified version of the data flow diagramming approach discussed before it), object-oriented approaches, and holistic systems approaches.

Why Model Business Processes?

As a concept becomes more abstract, so does generally the discrepancy in the ways different people may construe the concept. A concept that refers to a tangible object, like that of a wooden four-legged chair, for example, is likely to be understood more or less in the same way by two people. There will be visualization differences between the two people, which may be reconciled by further description (e.g., exact color of the chair, whether it is new or old), but those differences will not be as big as differences in connection with a concept that refers to an intangible item.

An intangible item is generally seen as an abstraction, something that exists in our minds and nowhere else. There are different levels or degrees of abstraction, with some abstract concepts being more abstract than others. For example, while a person is a tangible item, since he or she can be touched and exists in reality, a team of people is not. One does not bump into a team of people; he or she bumps into a person, who is a member of the team. In this instance, the team is an abstraction. But, since the abstract concept of a team of people is made up of tangible items, namely the team members, its level of abstraction is lower than that of the concept of team spirit, for example. The latter is not an abstract collection of tangible items. It is a somewhat ethereal quality that the team is supposed to have.

Business processes are abstract concepts that are in between the team and team spirit concepts discussed above in terms of degree of abstraction. With abstract concepts such as that of a business process, shared mental visualizations are much less likely to be achieved without substantial effort and clarification. One of the reasons for this difficulty is that abstractions are not perceived by our five senses as real objects like a chair is (e.g., we can see and touch a chair) and therefore must be understood based on abstract models. If these models do not exist or are too rough and incomplete, then a sense of perplexity ensues.

Business processes, as most abstract entities, need to be modeled in some way to be understood by different people. And, more importantly, two or more people must understand a business process in roughly the same way if they intend to be successful at redesigning it. Models, however, irrespective of how complex they are, are in most cases limited representations of whatever they are supposed to depict, whether those are real objects or abstract entities. In the same way that an airplane model (used for simulations) does not incorporate all of the elements of a real airplane (only the elements that are the most relevant for a particular simulation exercise), a business process model will not incorporate all of the elements of the process it is representing.

Several main types of business process modeling approaches, or views, are discussed in this chapter. Those views lead, as discussed previously, to incomplete representations of business processes and therefore should be understood in terms of their pros and cons in today's information- and knowledge-intensive organizational environments. From the perspective taken in this book, perhaps the most important criterion with which one could assess the practical value of a particular model is the likelihood that the model will serve as a solid basis for a successful business process redesign project.

A Business Process Example: Predictive Car Maintenance

Before we go any further into the discussion of business process modeling approaches, let us set the stage for that discussion with a business process example. The example refers to the predictive car maintenance process of a rental company. It involves obtaining and properly using information from customers of the car rental company about problems with the cars. The problems that are relevant are those that can be prevented in the future through predictive maintenance of cars, that is, through maintaining the cars (e.g., replacing certain parts) before the problems occur in the future. The example will be referred to in the discussion of each business process modeling approach.

The business process example starts with a customer filing a complaint online regarding problems with a car that the customer supposedly rented in the past. The details of the complaint filed by the customer are stored in an online file of car rental complaints. The assistant manager of the rental company then downloads the information about the complaint using a Web-based computer system called RentalWizard, which automatically generates a complaint form to be used for internal processing of the complaint. The assistant manager then places that complaint form in a box for later processing, together with other complaint forms.

Once every week, the assistant manager of the rental company reviews each complaint form, using a manual containing several rules for reviewing complaints. Those rules had been devised so that certain complaints could be filtered out (e.g., complaints not related to car maintenance problems) before they progressed any further in the business process. Once the assistant manager is finished reviewing each complaint form, he hand delivers a reviewed complaint form to the rental company's manager, briefly explaining why the complaint should proceed in the process.

The rental manager then hand delivers the reviewed complaint form to the assistant maintenance manager, again briefly explaining why the complaint should be processed. The assistant maintenance manager is the main point of contact for the rental company's manager in the company's maintenance department, which is the organizational unit that processes reviewed customer complaints.

The assistant maintenance manager then, upon receipt of a reviewed complaint form, places the form in a box for processing by the quality control specialist. The quality control specialist is an employee who formerly worked for a software development company that owns and commercializes a computer system called SmartFleet. The computer system cost the rental company approximately $800,000. It incorporates artificial intelligence algorithms that operate on predictive maintenance rules, which are both used and updated by SmartFleet based on each new complaint processed through the system and on details about previous maintenance activities. The algorithms allow the SmartFleet system to create a schedule of predictive maintenance activities (called "jobs") that reduces maintenance costs to a minimum while also reducing the likelihood of future car problems occurring while the cars are with the customers of the car rental company.

The schedule of predictive maintenance jobs generated by SmartFleet is a printed set of pages (one page per job), organized according to the order of execution prescribed by the computer system. The quality control specialist then places those pages in a box with other predictive maintenance jobs. The box is located at the entrance of the workshop used by the maintenance department. A team of mechanics from the maintenance department then processes each predictive maintenance job. Upon completion of each job, the team enters the details about each completed job into a fleet maintenance details file, using a data entry screen of the SmartFleet computer system.

Activity Flow–Oriented Approaches

Activity flow–oriented approaches are the most commonly used in business process redesign. Activity flow–oriented representations are also frequently referred to as "workflow" representations of business processes. Business process redesign approaches that build on activity flow representations are often referred to as workflow-oriented approaches to business process redesign.

Because of their popularity, many different activity flow–oriented business process representation conventions exist, each with its own set of standard symbols. A particularly popular set of business process representation conventions is that discussed by J. Harrington in his book *Business Process Improvement*. There, several different activity flow diagrams are discussed, among which is one of the most characteristic of the activity flow orientation in business process modeling: the functional flowchart.

Activity flow diagrams are aimed at clearly showing the chronological and sequential order of execution of the activities that make up a business process. Human beings tend to perceive business processes as representations of "action" in a physical sense. Therefore, activity flow diagrams are often perceived as being among the easiest to generate and understand, and certainly easier to generate and understand than diagrams placing emphasis on communication flow elements. A recent doctoral dissertation by Azim Danesh drives this point home, providing some empirical evidence in support of this perception. The dissertation is titled *IT-Enabled Process Redesign: Using Communication Flow Optimization Theory in an Information Intensive Environment* and was completed at Temple University.

This perception is not really caused by a higher complexity, in terms of number of symbols used in the diagram, of activity flow diagrams. The most likely reason for the perception is that activity flow diagrams are better aligned with the way human beings envision "action," particularly in the physical sense. The problem with this perception is that most business processes operate on intangible elements, particularly information, and also have intangible elements as their outputs.

Among activity flow–oriented business process representations, one of the most popular is the functional flowchart. Representing business processes through functional flowcharts generally involves using the set of symbols shown in Figure 5.1 to show how activities are carried out chronologically. The serial sequence of activities is highlighted in the representation, and so is parallelism among activities, when sets of serially linked activities are carried out at the same time and more or less independently.

In Figure 5.1, a rectangular shape represents an activity. Arrows indicate the flow of execution of activities. As mentioned before, when seen as a group, several arrows connecting a set of activities also serve to indicate the chronological order of execution of the set of activities. This is a distinguishing characteristic of activity flow–oriented business process representations that serves to differentiate them from other types of representations of business processes (e.g., data flow diagrams, discussed later in this chapter).

In Figure 5.1, the organizational function that executes an activity or set of activities is described at the top of a column containing the activity or activities. In addition to organizational functions (e.g., warehouse manager, quality control inspector), activities may also be executed by groups of organizational functions (e.g., warehousing department, quality control committee) or organizations external to the organization that houses the business process (e.g., a supplier or customer organization).

The aforementioned symbols are used in Figure 5.2 to represent the business process whose example was discussed earlier, which refers to a car rental company's predictive maintenance process. It is important to stress a point that will become clear as we progress through this chapter: While the diagram in Figure 5.2 may be seen as a good representation of how communication takes place in the predictive maintenance process, arguably that is not the case.

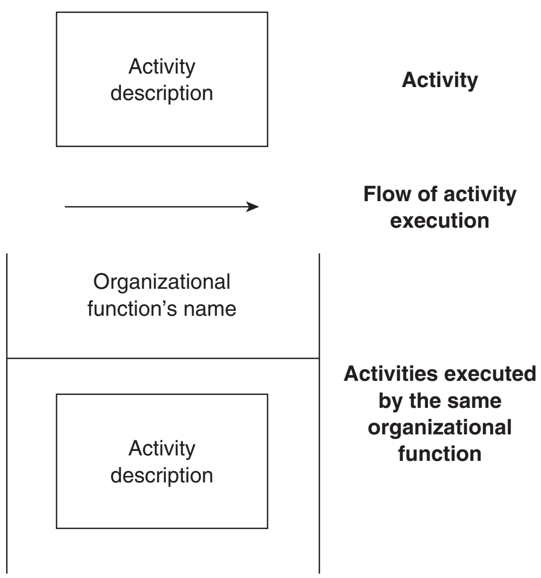

Figure 5.1 Activity Flow Representation Symbols

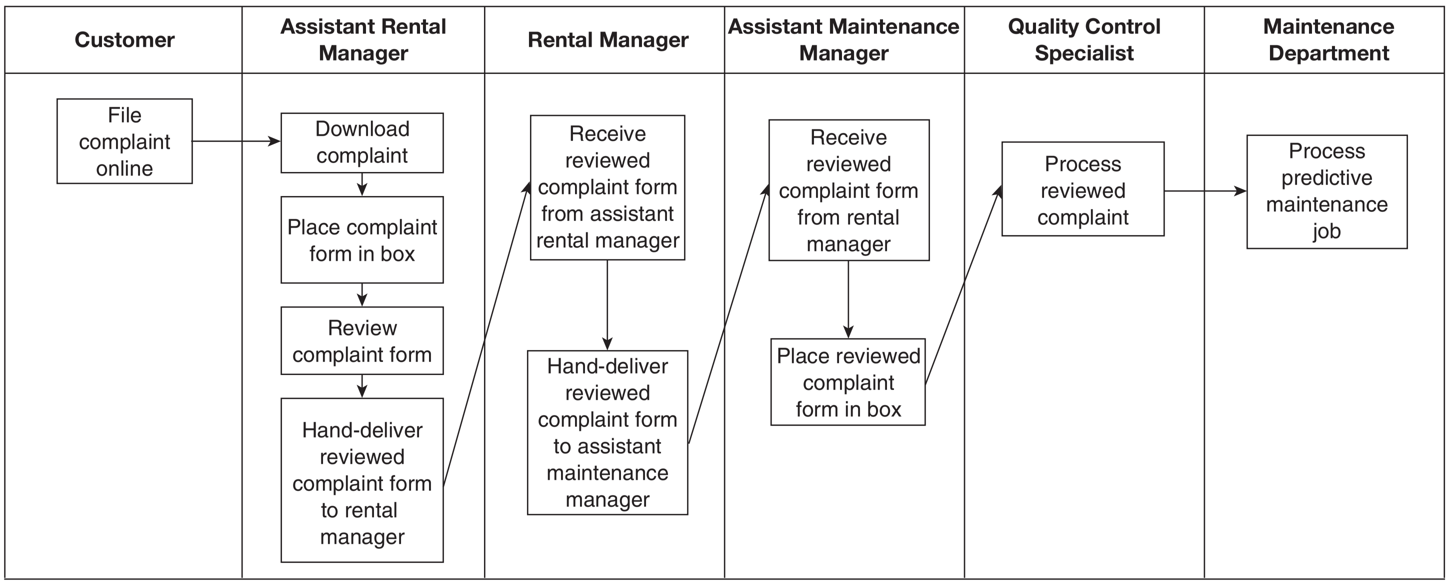

Figure 5.2 Activity Flow Representation Example

In fact, one of the key omissions of activity flow diagrams is that they do not provide much detail about business process data, neither in terms of flow nor in terms of storage. This makes an activity flow diagram a somewhat incomplete representation of the car rental company's predictive maintenance process, especially when compared with the communication flow–oriented representation approaches discussed later in this chapter. Nevertheless, many would probably view the activity flow representation shown in Figure 5.2 as a fairly clear and intuitively appealing representation of the car rental company's predictive maintenance process.

Activity flow–oriented representations of business processes, such as the one shown in Figure 5.2, are among the most popular in business process redesign circles, even though their use poses some serious obstacles to business process redesign practitioners. For example, they show practically no detail in connection with the web of communication interactions that make up most business processes today. And, as previously demonstrated in this book, most business process problems seem to stem from communication configurations that are suboptimal.

In the past, some adaptations of activity flow–oriented representations have been proposed with the goal of allowing for the representation of communication flow–related elements, such as data flows. However, because of the different nature of activity flow representations, those adaptations can sometimes be a little confusing from a business process representation standpoint. For example, one could try to represent the flow of data by associating it with the arrows shown in an activity flow representation (e.g., the one in Figure 5.2). However, strictly speaking, data do not flow from one activity to another. They flow from one data source to a data destination, for example, from one organizational function to another. Because of that, representing data as flowing between activities may be somewhat misleading when the time comes for business process redesign.

There are a number of variations of activity flow representations similar to the one shown in Figure 5.2. The workflow in Figure 5.2 is itself based on an adaptation of the American National Standards Institute's (ANSI) standard flowchart and has been extensively used in projects involving business process redesign groups. Flowchart variations are the block diagram, functional timeline flowchart, and geographic flowchart; see, for example, Harrington's book *Business Process Improvement* and the follow-up book *Business Process Improvement Workbook,* by Harrington and colleagues, for a more detailed discussion of those flowchart variations.

It has been argued that the use of activity flow representations of business processes is generally less advisable than the use of communication flow representations, particularly when the goal is business process redesign. However, there is at least one notable exception to this rule. Activity flow representations are probably better than communication flow representations when the business processes being modeled are manufacturing processes. This is particularly true for business processes that involve the assembly of a complex product (e.g., a car engine) based on a number of parts that are sequentially added to the unfinished product in an assembly line (until it becomes a finished product, of course). In the vast majority of other types of business processes, however, it is reasonable to argue that communication flow representations provide a better and more complete view of the elements that should be considered in a business process when the process is being redesigned.

The Data Flow Diagramming Approach

The traditional systems analysis and design approach, also known as the structured systems analysis and design approach, has served as the basis for hundreds of thousands of software development projects. This approach's main business process modeling diagram is the data flow diagram (or DFD).

Different sets of symbols and notations have been proposed in the past for data flow diagramming. Among the most important ones are those proposed by DeMarco and Yourdon and by Gane and Sarson, with the latter being used more extensively. Figure 5.3 shows the symbol set proposed by Gane and Sarson.

In Figure 5.3, a rectangular shape represents a data source or destination. A data source or destination represented through a rectangular shape may be an organizational function (e.g., warehouse manager, quality control inspector), a group of organizational functions (e.g., warehousing department, quality control committee), or an organization external to the organization that houses the business process (e.g., a supplier or customer organization).

As indicated in Figure 5.3, arrows indicate the flow of data, which are described by freestanding text located beside or near the arrows. Open rectangle shapes represent data repositories. Rectangular shapes with round edges represent activities,

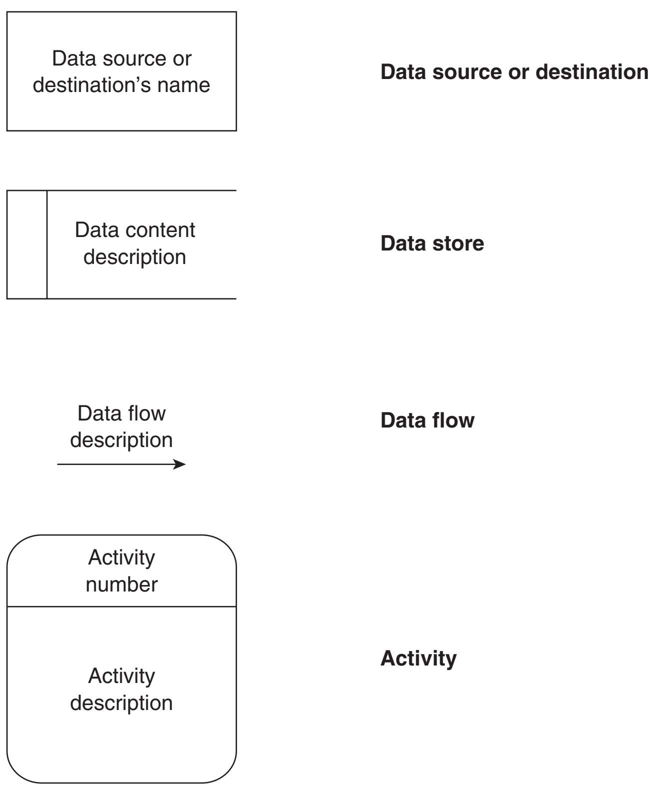

Figure 5.3 Data Flow Diagram Symbols

with the number of the activity being shown at the top of the shape. That number serves as a unique identifier for the activity and also indicates the approximate order of execution of the activity in relation to the other activities in the same business process representation.

Similar to the activity flow approach discussed in the previous section, activities are often referred to as business processes, or subprocesses, because they themselves can often be broken down into component activities. In this sense, the inner details of one activity in a business process can be represented as a separate business process diagram. The new diagram is at a different conceptual level of representation than the original diagram, where the business process was represented as a single activity. This is an issue that is discussed in more detail in this chapter, as well as later in the book.

In Figure 5.4, the aforementioned symbols are used to represent the business process example discussed earlier, which refers to a car rental company's predictive maintenance process. Certain types of relationships cannot be represented through data flow diagrams without the violation of widely accepted standardized diagramming rules and thus are not shown in Figure 5.4. This makes it a somewhat incomplete representation of the car rental company's predictive maintenance process.

Among the elements that are not shown in the data flow diagram in Figure 5.4 are the following: a customer providing information about car rental complaints, the knowledge repositories containing complaint review rules and predictive maintenance rules, the communication interaction between the rental manager and the

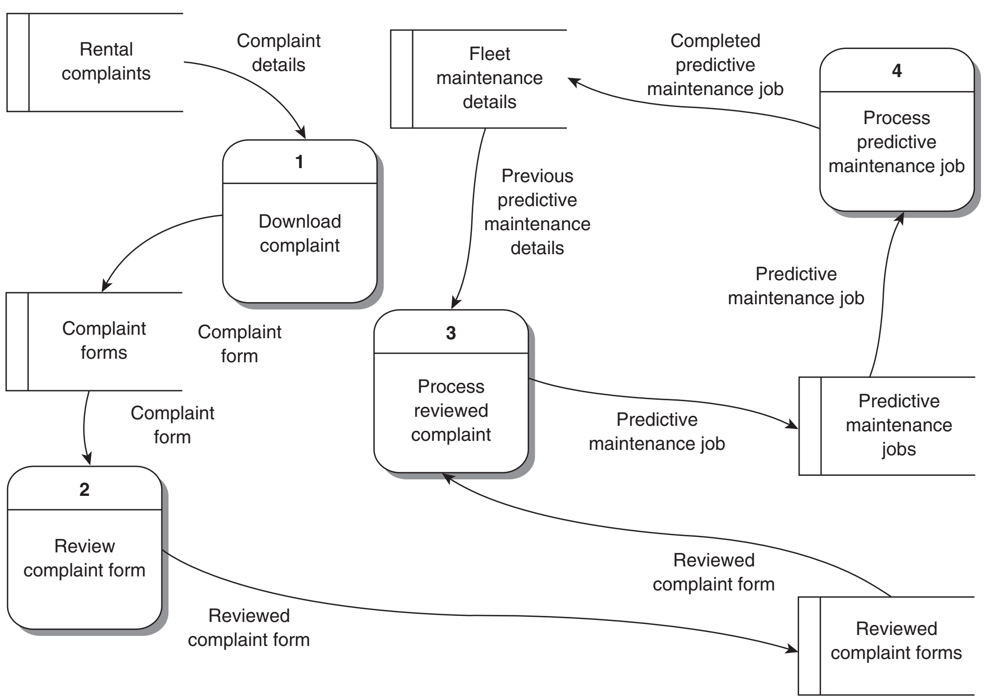

Figure 5.4 Data Flow Diagram Example

assistant maintenance manager, the indication in the activity symbols of which organizational function carries out each activity, and the indication in the activity symbols of which nontrivial tool or tools are used by an organizational function to carry out each activity.

The symbols showing a customer providing information about car rental complaints are not in Figure 5.4 because it would be a violation of standard data flow diagramming rules to represent a flow of data between a data source or destination and a data store. The same is true for the communication interaction between the rental manager and the assistant maintenance manager, since it would be a violation of data flow diagramming rules to represent a data exchange between two data sources or destinations. The knowledge repositories containing complaint review rules and predictive maintenance rules are not shown in Figure 5.4 because there are no data flow diagramming symbols that can be used to represent knowledge.

Arguably, the data flow diagram shown in Figure 5.4 also leaves out some details that are very important from a business process redesign perspective. For example, it will be seen later in this book that synchronous information communication interactions between two organizational functions (which involve a same-time interaction and do not usually rely on information repositories) are not very efficient ways of communication business process–relevant information. One example of synchronous information communication interaction is the one between the rental manager and the assistant maintenance manager. These types of interactions should usually be replaced with asynchronous communication interactions, where one employs an information repository for time-disconnected communication (e.g., an e-mail box, a voice messaging system). This would arguably streamline the business process and thus make it more efficient.

Generally speaking, business process problems such as the one just mentioned cannot usually be identified without the development of business process representations that make those process problems explicit. This is one of the main reasons why one would want to develop a slightly modified communication flow representation that incorporates many of the aspects of data flow diagrams but also eliminates some of its shortcomings (one such representation is discussed in the next section).

Often it becomes apparent that traditional data flow diagrams are difficult to be successfully used for representing problematic business processes, that is, business processes that badly need redesign, when modelers try to use computer-aided software engineering (or CASE) tools. The reason is that many of those tools attempt to enforce rather strictly standard data flow diagramming rules, which prevents business process modelers from representing processes as they really are.

The Communication Flow–Oriented Approach Proposed Here

This section discusses a modified communication flow–oriented representation, which to a large extent is based on data flow diagramming ideas. One of the key differences between the communication flow–oriented approach proposed in this section and standard data flow diagrams is that the communication flow representation approach discussed here attempts to overcome some of the limitations just discussed in connection with the traditional data flow diagrams. It does so employing a more relaxed set of diagramming rules. This added flexibility enables business process modelers to explicitly show more process inefficiencies that need to be addressed prior to automation through redesign.

Several different symbols are used to represent business processes through the communication flow–oriented approach proposed here (see Figure 5.5). A rectangular shape represents a data source or destination, where the data may carry information, knowledge, or both. A data source or destination represented through

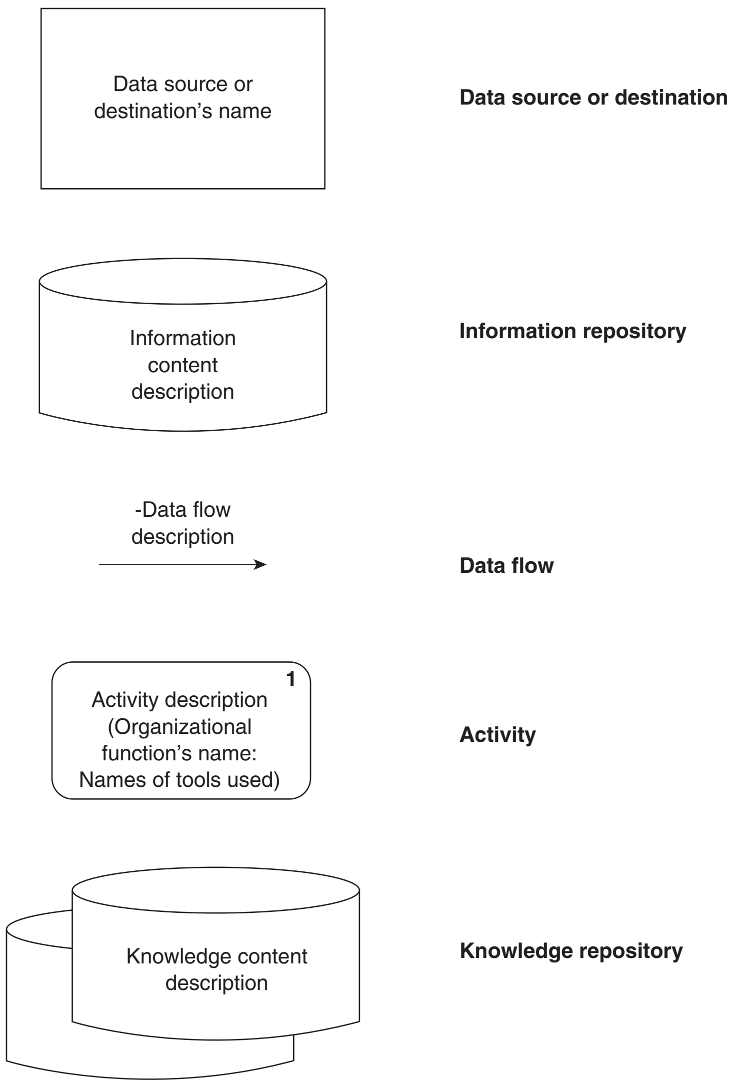

Figure 5.5 Communication Flow Representation Symbols

a rectangular shape may be an organizational function (e.g., warehouse manager, quality control inspector) or a group of organizational functions (e.g., warehousing department, quality control committee).

A data source or destination represented through a rectangular shape may also be an organization external to the organization that houses the business process. For example, it may be a supplier of car parts, where the business process under consideration is the car assembly line process in an automaker that outsources car parts manufacturing to several suppliers.

As noted in Figure 5.5, arrows indicate the flow of data, which is described by freestanding text located beside or near the arrows. When two arrows are near each other, an appropriate arrangement of the text is necessary to avoid confusion as to which arrow each piece of text description refers. Rectangular shapes with round edges represent activities. A number on the upper right corner indicates the approximate order of execution of the activity in relation to the other activities in the same business process representation. As with other types of business process representations, these activities are often referred to as business processes, or subprocesses, because they themselves can often be broken down into component activities. Drum shapes represent information repositories. Double drum shapes represent knowledge repositories.

The set of symbols shown in Figure 5.5 expands on the symbol set used earlier in this book in connection with standard data flow diagrams. That symbol set is expanded even further later in this book, with the goal of providing a richer and differentiated representation of information and knowledge flows and repositories in business processes. The reasons for expanding further the set of symbols used will be clearer then. For now, the comparison of different business process modeling approaches is primarily based on the symbol set shown in Figure 5.5.

In Figure 5.6, the aforementioned symbols are used to represent the business process example discussed earlier in this chapter, which refers to a car rental company's predictive maintenance process. In the business process representation shown in Figure 5.6, RentalWizard is the Web-based computer system that the assistant manager of the rental company uses to download information about user complaints. SmartFleet is the artificial intelligence–based computer system that creates a schedule of predictive maintenance activities on cars based on each new complaint processed through the system and on details about previous maintenance activities.

Note that, in Figure 5.6, the order of execution of activities is fairly clearly indicated through the numbers at the upper right corner of the activity symbols, which go from 1 to 4. This is not always the case with communication flow representations, because this type of representation is aimed primarily at making explicit the web of communication interactions that takes place in a business process. Some information- or knowledge-processing activities may take place recurrently, sometimes before *and* after other activities, which makes it difficult to figure out how to number them. In these cases, the decision on how to number them is a subjective one, which is left to the business process modeler or modeling team.

Also, the activity representations in Figure 5.6 have inside them the description of each activity. That description is followed, within parentheses, by the organizational function that carries out the activity and, in the case of activity numbers 2, 3,

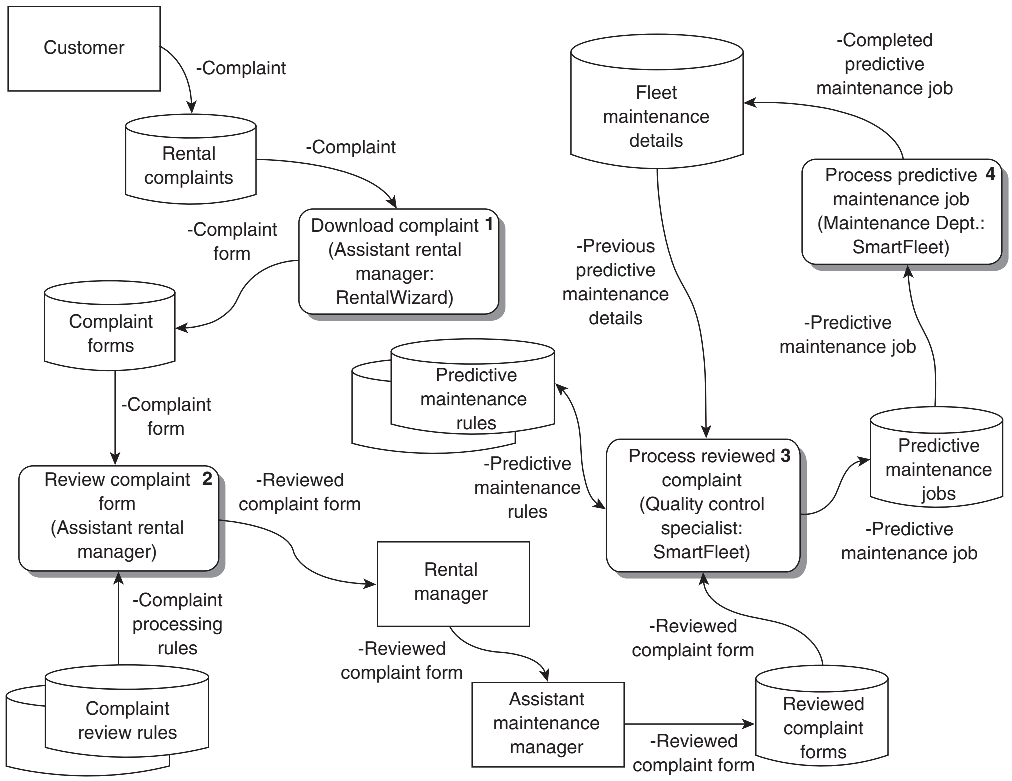

Figure 5.6 Communication Flow Representation Example

and 4, the main tool used by the organizational function to carry out the activity. Here, only specific and nontrivial tools are mentioned, such as specific computer systems, as opposed to nonspecific and somewhat trivial tools such as pen and paper. This is why no tool is mentioned in connection with activity number 1. The description of the activity is presented as a verb in the infinitive form followed by the object of the verb. For example, in activity number 1, the verb is *review* and the verb's object is *complaint form.*

Previously, this book discussed business process–oriented approaches to organizational improvement from a historic perspective. That discussion revealed several historic facets of business process redesign, including a preference toward activity flow–oriented approaches. The book then discussed some tests of the notion that a shift in focus from an activity flow to a communication flow orientation would lead to better results in terms of business process redesign.

In the aforementioned tests, communication flow representations that incorporated fewer of the elements shown in Figure 5.6 were used (e.g., activities were not numbered, and knowledge repositories were not represented). Nevertheless, those tests provided support for the notion that a shift toward a communication flow orientation would lead to improvements in business process redesign performance. This leads to the conclusion that the type of representation discussed above is likely to lead to comparable, if not better, results in similar tests. Among other reasons is that the new elements provide a richer view of business processes, while at the same time they appear to add little in terms of extra effort (although it seems that some extra effort is required) from the business process modelers to be used in the generation of the diagrams.

Object-Oriented Approaches

Ivar Jacobson has been one of the main proponents of the object-oriented view of business processes. He developed a methodology to model business processes as data objects, where the word "object" has a very specific and somewhat technical meaning. Jacobson's methodology, which is discussed in detail in the book *The Object Advantage* (by Jacobson and colleagues), is based on the concept of a software object (often referred to as simply "object"). A software object is essentially a data repository with several operations, or programming functions, associated with it. They are defined in such a way that any changes in the data repository's contents can only be carried out through those operations. The operations are also referred to as "methods" in the technical jargon of object-oriented programming. A software object typically stores data in its attributes, which are analogous to the attributes of real objects, like a chair. For example, the attributes of the object "chair" could be its "color," "weight," and "number of legs."

Object-oriented business process modeling has evolved as a component of object-oriented analysis and design, which in turn owes much of its existence to the success of object-oriented programming. One of the main goals of object-oriented analysis and design, as discussed earlier in this book, is to provide computer systems developers with methods and tools that allow them to move more quickly from analysis and design to coding using object-oriented programming techniques.

Different flavors of object-oriented analysis and design methodologies have emerged over time. Those methodologies were often differentiated from each other based on the standard notations for diagramming that each of them proposed for modeling business processes and other computer systems components, such as software objects. The different standard notations have been incorporated into several diagram types. Soon, a new set of standard notations for object-oriented analysis and design was developed, with the goal of unifying three existing methodologies. The three methodologies were the ones developed by Ivar Jacobson, Grady Booch, and James Rumbaugh. The new set of standard notations became known as the unified modeling language, or UML.

The unified modeling language consists of 12 types of diagrams and respective diagramming rules. The 12 diagram types are organized into three major categories: structural diagrams, behavior diagrams, and model management diagrams. Structural diagrams represent the structure and static relationship of software objects, such as the data and operation modules that are shared by software objects. Behavior diagrams represent the operation of a computer system in terms of its objects, such as the interaction of software objects with each other when the computer system is being executed. Model management diagrams represent the organization of computer system modules around software objects.

The cornerstone of object-oriented systems analysis and design employing the unified modeling language is the use-case diagram. The set of symbols shown in Figure 5.7 is the one commonly used to generate use-case diagrams. A humanlike stick figure represents an organizational function, called an "actor" in the technical lingo of use-case diagramming. A line, called an association, links an organizational function with one or more use-case symbols. An oval represents a use-case, which is similar to an activity in communication flow diagrams (the meaning is essentially the same as in the other diagrams discussed in this chapter as well). A rectangle is used to encase the set of symbols that are supposed to be part of, or associated with, the same computer system. Normally, this is done whether a computer system exists or not at the time of business process modeling, an approach similar to that followed in the traditional systems analysis and design approach.

Figure 5.8 employs the symbols discussed above to represent the business process example discussed earlier related to a car rental company's predictive maintenance process. As can probably be seen from Figure 5.8, the use-case diagram is, among the diagrams already discussed in this chapter, one of the most heavily oriented toward computer systems implementation. Rather than showing details that can be used for business process redesign, such as the communication interactions

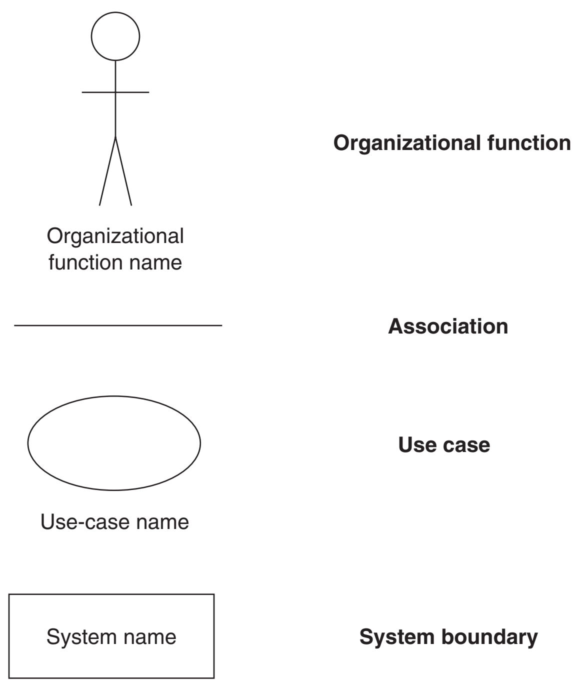

Figure 5.7 Use-Case Diagram Symbols

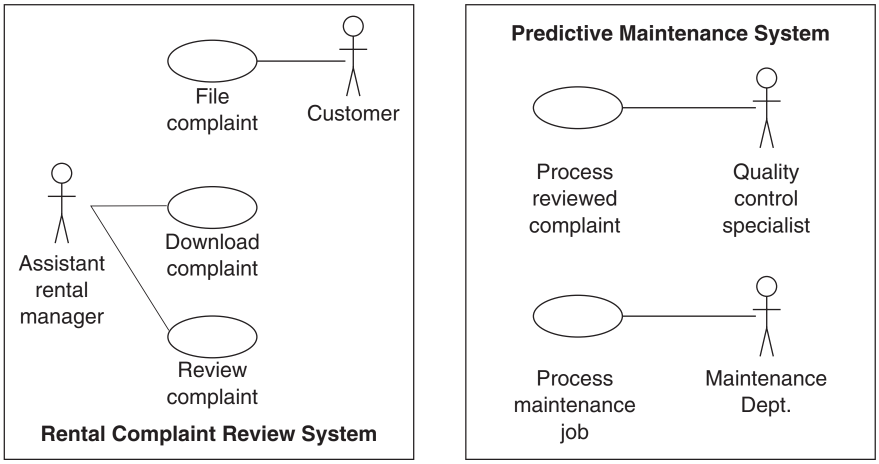

Figure 5.8 Use-Case Diagram Example

between different organizational functions, the use-case diagram organizes different activities and related elements into "systems." The separate sets of activities and related elements are encased in rectangles to signal that they are part of the same system. In this sense, use-case diagrams are a step forward in terms of pre-implementation analysis when compared with data flow diagrams, used in the traditional systems analysis and design approach. However, from a business process redesign perspective, use-case diagrams may be seen as a backward step, because they push systems analysts into thinking in terms of how to automate a business process before the business process is redesigned.

The object-oriented view of business processes can in fact be seen as an extension of the view provided by the traditional systems analysis and design approach. In this extended view, data repositories, often represented in data flow diagrams by open-ended rectangles, are subsumed by the activities that change the contents of those repositories. The data repositories and activities that change them become part of the same structure, which is then subsequently automated as a software object.

From a technology automation–focused perspective, especially where automation is conducted through in-house software development, there is a clear advantage in adopting object-oriented approaches to business process analysis and design. Many believe that object-oriented programming is increasingly becoming the dominant software development paradigm, particularly given that it has been adopted by most of the major players in the software development industry since the 1990s. And, as mentioned before, the object-oriented view of business processes allows for a relatively inexpensive transition between (a) business process analysis and redesign and (b) the development of new computer systems, using object-oriented programming techniques, to support the implementation of the new business processes.

However, business process redesign may end up suffering, or not being done at all, when one's focus is to move quickly from business process analysis to computer automation. In addition to this problem, there is an associated concern in connection with the somewhat technical, software programming orientation of object-oriented approaches. That orientation is highlighted by the fact that object-oriented approaches have been criticized by what some see as their excessively technical complexity. That complexity is often perceived as preventing users who are unfamiliar with object-oriented concepts and related technical jargon from effectively understanding those approaches and adopting them in business process redesign projects. Business process representation approaches based on the object-oriented paradigm, such as the unified modeling language, are often seen as too complex to be widely accepted and used in organizations, in spite of the fact that the unified modeling language has been endorsed by heavyweights of the computer community.

Holistic Systems Approaches

What is called here the "holistic systems" view of business processes is based on the traditional concept of system, that is, that of an assembly of interdependent parts that cannot be understood very well as only a function of its components. In this light, a system can be characterized by its emergent properties, which are system properties and therefore meaningless in terms of the individual parts or elements that make up the system. Peter Checkland and Jim Scholes illustrate the system concept in their very important book *Soft Systems Methodology in Action*: "The vehicular potential of a bicycle is an emergent property of the combined parts of a bicycle when they are assembled in a particular way to make the structured whole."

According to a strict interpretation of the holistic systems view and its application to business process analysis, one could operationally define business processes as abstract entities that represent the transformation of inputs into outputs. A business process's suppliers provide inputs. The business process's customers consume the outputs generated through the process, which have a value-added component to them, when compared with the inputs. That is, transformation of inputs into outputs is aimed at adding value to the customers of the business process. According to this interpretation of the holistic systems view, a business process representation would look somewhat like Figure 5.9 for the business process example discussed earlier related to a car rental company's predictive maintenance process.

As is probably obvious from Figure 5.9, the main problem with using only the holistic systems approach to business process modeling is that it provides little in terms of details about the inner workings of a business process. Nevertheless, the holistic systems approach is often successfully used as a precursor to a more operational approach, such as the data flow diagramming and communication flow–oriented approaches discussed earlier in this chapter. In fact, a specific class of data flow diagrams that are similar to the holistic system diagram shown in Figure 5.9 are part of well-established data flow diagramming standards, such as the one proposed by Gane and Sarson and discussed earlier in this chapter. They are often referred to as "Level 0" data flow diagrams, or "context diagrams." Their development regularly precedes the development of data flow diagrams that show in more detail the inner workings of business processes.

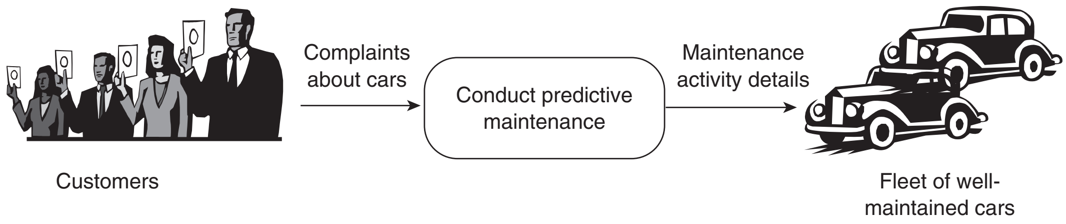

Figure 5.9 Holistic System Diagram Example

It is reasonable to argue that the holistic systems approach, when used in isolation, may be of little use to those whose job is to try to change a business process. In the holistic systems view, business processes are defined by means of sets of key emergent properties that characterize them, with the relationship between their inside activities and related components being of relatively small importance.

Nevertheless, the holistic systems view has proved to be quite useful in the analysis of very complex and messy business processes, even when used alone and separately from other business process views. One type of business process that is often complex and messy is that related to strategic decision making, where senior managers make decisions based on incomplete information about their organizations' operations and past performance. Strategic decision-making business processes are not usually amenable to modeling using communication flow–oriented or other operational approaches, such as the ones discussed earlier in this chapter, because the number of activities and related symbols required to fully represent them is often too large to allow for effective modeling.

For example, in a consulting project, a systems analyst tried to model one such process in an advertising company and ended up with a very complicated diagram made up of more than 150 activities and related symbols. One could reasonably argue that, in this case, taking a holistic systems approach would have led to a better understanding of the business process in question. However, given several constraints on time and financial resources, which often go unmentioned in popular business books, the management of the advertising company and the system analyst simply decided to move on to other more analyzable business processes and leave the complex and messy strategic management process alone.

What does the holistic system diagram in Figure 5.9 tell us about the car rental company's predictive maintenance process? One could argue that it tells us almost nothing, simply because it (the diagram) is too simplified a representation of the real process. Nevertheless, simplified representations may sometimes free our minds from unnecessary details that could prevent us from coming up with a creative solution to a serious problem. To illustrate this, let us look at the surprising ending of the car rental company's case—the case was introduced earlier in this chapter. This surprising ending is based on a case of a real car rental company.

In spite of the SmartFleet computer system, which cost the rental company approximately $800,000 and which incorporated artificial intelligence algorithms, the car rental company was still lagging behind the competition. Among other things, the company's operating costs were higher, and customer satisfaction with the cars was lower than the competition's!

Then, someone looking at a diagram similar to (but with a few more inputs and outputs than) the holistic diagram example shown in Figure 5.9 concluded that the car rental company was paying a whole lot of attention to the maintenance of their fleet. Car maintenance, the person argued, should not be one of the core competencies of any car rental company. In other words, that person argued that car maintenance was better left to the service departments of car dealerships, and that the car rental company should focus on the intricacies of the car rental service—which is not as easy a service to deliver with quality as it may look like at first glance.

To make a long story short, the car rental company decided to essentially throw away their SmartFleet computer system (which may sound somewhat unbelievable to some readers) and radically change their approach to dealing with customer complaints. They simply did what many of the large car rental companies do, which arguably is one of the best ways of running a car rental business. They started buying brand-new cars and selling them right before the manufacturer's warranty expired. This allowed the car rental company to virtually close down its car maintenance division and replace it with a car sales division. Brand-new cars were then purchased through bulk deals with manufacturers, and all the maintenance was subsequently run by dealerships associated with each particular car brand; for example, a local Ford dealership for the Ford car models purchased by the car rental company.

In the end, the car rental company realized that the costs of maintaining their fleet of cars were actually higher than the depreciation costs they had to incur by buying new cars and selling the cars right before the warranties expired. Moreover, having a fleet of newer cars increased customer satisfaction, not only because new cars do not usually present many problems, but also because customers usually prefer to drive new cars—the newer the car, the better, in the eyes of most customers. This is probably the type of conclusion that would not have been achieved without a holistic systems approach to business process redesign, where the business process ended up comprising activities cutting across the entire car rental company.

Types of Business Process Diagramming Tools

There are a number of commercial software tools that support the development of business process representations, and that number seems to be increasing by the day. Generally, those tools can be seen as belonging to one or both of two broad types. The first type is that of what is referred to here as "lean" diagramming tools, which are independent of specific CASE tools. As mentioned before in this chapter, CASE stands for computer-aided software engineering. CASE tools often allow one to move from business process representation to software development with mining coding. The second type of commercial software tools that support the development of business process representations is that of diagramming tools that are part of CASE tools.

Examples of the first type of business process diagramming tools mentioned above are Chartist, SmartDraw, DiagramStudio, is/Modeler, and Visio. Also in this category are diagramming tools that have other functions, such as PowerPoint, which was originally developed to be used as a professional slide creation and presentation tool.

Examples of the second type of business process diagramming tools mentioned above are System Architect and Silverrun. The main difference between the first and second types of diagramming tools is that tools in the latter type provide the functionality to generate software automatically based on business process diagrams, while the former usually does not. CASE tool–dependent diagramming tools are usually data oriented, supporting data flow diagrams as well as other types of diagrams that go beyond business process representations (e.g., entity-relationship diagrams, which are discussed later in this book).

One of the problems with using diagramming tools of the second type is that they usually enforce diagramming rules, such as the ones previously discussed in this chapter in connection with data flow diagrams. This can make it difficult to use Type 2 diagramming tools to represent all of the inefficiencies present in business processes that are being targeted for redesign. On the other hand, Type 2 diagramming tools may be quite useful to represent business processes that have undergone changes and that are ready for implementation through computer software automation.

CASE-independent business process diagramming tools may be quite complex and feature-rich, such as Chartist, from Novagraph, Inc., which allows for the development of just about any type of diagram (including the ones discussed in this chapter). Another example is Visio, from Microsoft Corporation, which began as a robust Type 1 diagramming tool. Over time, it has steadily moved toward becoming a full-fledged Type 2 diagramming tool, through the increasing incorporation of functionality to generate software automatically. These developments refer particularly to the generation of software for technologies that are part of the Microsoft Office Suite (e.g., Access).

Business process redesign, as well as other components of systems analysis and design, often involve individuals who are not geographically colocated and who need to communicate efficiently and effectively with each other. This makes it important that those individuals be able to easily share business process representations among themselves. In this sense, the use of diagramming tools that employ proprietary methods can be a problem, especially when the business process being targeted for redesign cuts across two or more organizations. In this case, different organizations would have to agree on which diagramming tool to use, as well as to purchase and train their employees on the use of the agreed upon diagramming tool. This can be a problem with many diagramming tools, whether they are of Type 1 or 2.

Building Business Process Diagrams Using PowerPoint

Two possible solutions to the aforementioned problem are (a) to employ diagramming tools that generate diagram files in standard public formats, which can be viewed and edited using a variety of different diagramming tools, or (b) to employ proprietary diagramming tools that are widely available. Since standard public formats for diagram files are still emerging, Solution (b) seems more feasible. And, one obvious way to implement Solution (b) is to use a ubiquitous diagramming (and presentation) tool such as PowerPoint. The problem then turns to whether PowerPoint can be used effectively as a diagramming tool, since it does not incorporate several of the features of more sophisticated Type 1 diagramming tools.

The next several paragraphs address this issue and assume some basic knowledge of PowerPoint. The basic knowledge includes the ability to create simple diagrams, store them in different PowerPoint slides, and save them in different PowerPoint files. The features discussed here are available in most versions of PowerPoint. They are illustrated through screen snapshots generated based on the version of PowerPoint that comes as part of the Microsoft Office 2000 Suite, generally known as PowerPoint 2000.

Most novice PowerPoint users face two nagging problems when using it to build diagrams—problems that often turn them away from using PowerPoint and toward more sophisticated Type 1 diagramming tools (often with steep learning curves). The first is the limited set of symbols available from PowerPoint. While nonexisting (and usually more complex) symbols can be built by combining existing (and usually simpler) ones available from PowerPoint's predefined symbols library, the problem then becomes how to make those combinations into one single complex symbol that can be easily resized and moved around the diagram.

Using the "grouping" feature of PowerPoint, which is available in most versions of the software tool, can solve this problem. This feature allows a user to combine any number of basic PowerPoint symbols into new complex symbols, which can then be moved around the diagram and even resized, as though they were basic PowerPoint symbols. Moreover, a new symbol created through the grouping feature of PowerPoint can be copied and pasted into separate diagrams, saved in separate slides.

Figure 5.10 illustrates how two "drum" symbols and a borderless text box (with the text "Predictive maintenance rules" in it) can be combined to create a knowledge repository symbol, which can be used as part of a communication flow representation of a business process. The slide containing those symbols is a blank PowerPoint slide, without any background images or colors, which is provided as a default slide type in most versions of PowerPoint.

The knowledge repository symbol shown at the bottom-right corner of Figure 5.10, which combines three others symbols, can be treated as one single symbol. For example, one click of the mouse on any part of the knowledge repository symbol is enough to select the entire symbol, which can then be moved around the diagram and linked (see discussion below) with other symbols.

The second main nagging problem faced by novice PowerPoint users when using it to build diagrams refers to the use of arrows to connect symbols. Arrows are used in most types of diagrams, including three of the four main diagrams discussed in this chapter. Often, arrows do not "follow" the symbols they are connecting, making it a very laborious process to move symbols around the diagram. When arrows do not "follow" the symbols that they connect, every time one of the symbols is moved to a different position in the diagram, the arrow associated with it has to be moved separately (and often resized so that it can "reach" both symbols).

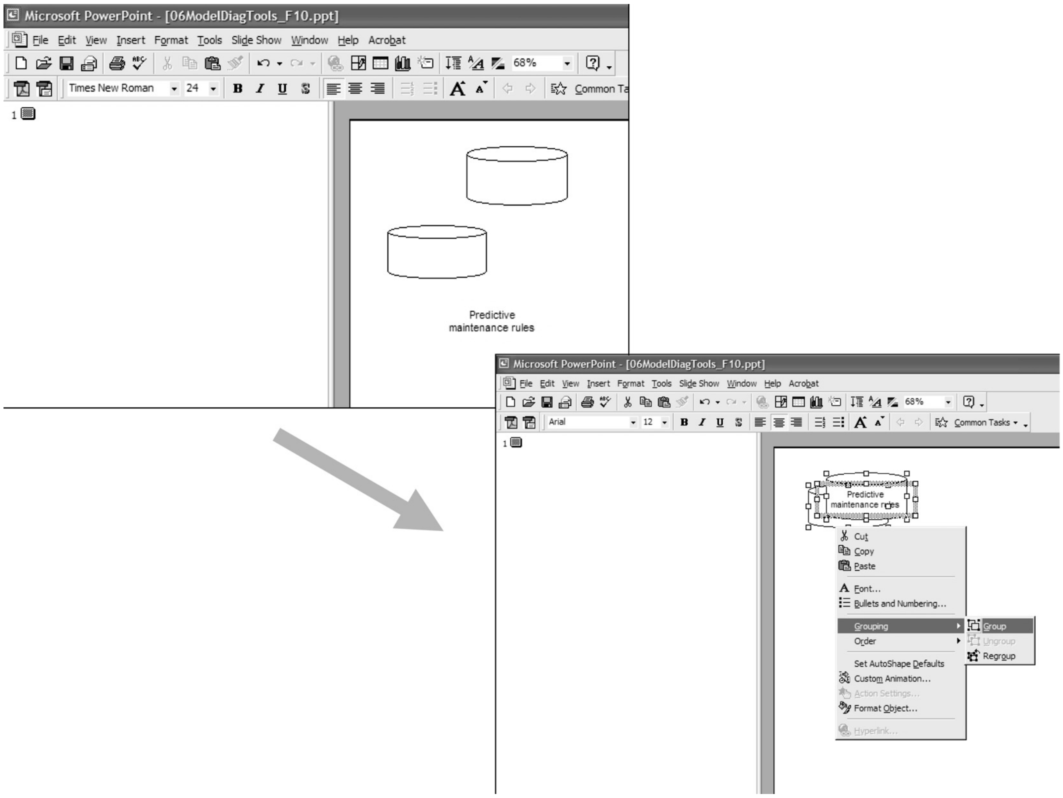

Figure 5.10 Grouping Disconnected Symbols

This problem can be solved by the use of connectors, which are offered in PowerPoint as an alternative to lines or arrows. Once two symbols are linked through a connector, the user does not have to worry about the connection when the symbols are moved around the diagram. The connector follows the symbols around the diagram, moving with them, and resizing itself as needed. Moreover, connectors can be defined as curved, which enables the user to have them go around other symbols in complex diagrams.

Figure 5.11 illustrates the use of connectors. At the top-left corner of Figure 5.11, two separate symbols are shown. They are part of the communication flow representation of the predictive car maintenance process discussed earlier in this chapter. One is a data source or destination symbol that represents a customer. The other is an information repository symbol that represents an online file of car rental complaints. On the right side and at the bottom left of Figure 5.11, we see the two symbols being connected by means of a curved connector.

Using the grouping and connector features, PowerPoint can be used to build relatively complex diagrams. If a business process representation is too large and needs to be broken down into two or more diagrams, those diagrams can be easily combined as part of one PowerPoint slide set and kept in the same file (usually with the .ppt extension).

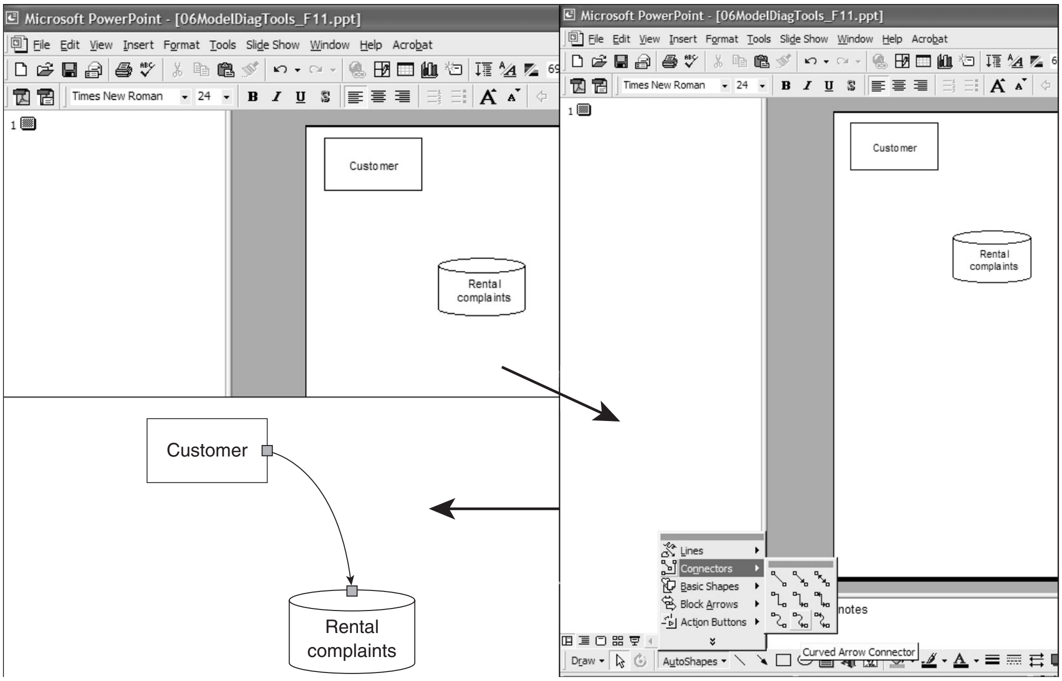

Figure 5.11 Linking Symbols Using Connectors

The same is true for complex business process representations that need to be "exploded" into other representations at different levels (this is an issue that is discussed in more detail later in the book). For example, a communication flow representation of a business process that cuts across an entire organization may not show enough details about certain activities that are carried out by specific divisions or departments of the organization. So it may be necessary to build business process representations of those activities. This is generally called "exploding" an activity into a diagram, by representing the inner details of the activity as a full-fledged business process. The resulting diagrams will be at different organizational representation levels, with the original diagram being what is often referred to as a Level 1 diagram and the resulting "exploded" diagrams being Level 2 diagrams. Diagrams at different levels can be grouped as sets of slides into different PowerPoint files for organization purposes.

PowerPoint is certainly not as powerful as other, more sophisticated, diagramming tools. Its diagramming functionality is more limited than that of Visio, for example. Nevertheless, it has the advantage of being quite widely used, which makes it easier to use for sharing business process representations electronically than other, less frequently used diagramming tools. Moreover, PowerPoint's limited functionality as a diagramming tool may make it easier to be learned, since the number of features that a user will have to learn will be smaller than if a more powerful diagramming tool were used.

Summary and Concluding Remarks

One area that has received relatively little attention within the business process redesign realm is that related to business process modeling approaches and respective diagrams, which in turn are likely to affect, perhaps strongly, how business process redesign is conducted. For example, a focus on the flow of activities in a business process is likely to lead to changes in how *activities* flow in the process, whereas a focus on the web of communication interactions of a business process is likely to lead to changes in how *communication* takes place in the process.

Why should one worry about modeling a business process? One of the main reasons is that, with abstract concepts such as that of a business process, shared mental visualizations are much less likely to be achieved without substantially more mental effort and clarification than with nonabstract concepts. Business processes, as most abstract entities, need to be modeled in some way to be understood by different people. And, more importantly, two or more people involved in the redesign of a business process must understand the process in roughly the same way if they expect to be successful.

Business process models are by and large incomplete representations of the abstract entities they are supposed to depict. This is generally true regardless of their type. In fact, this general rule of thumb applies to just about any type of model of virtually anything. That is, one characteristic that is shared by the vast majority of models is that they are incomplete and somewhat “rough” representations of reality. Each provides a specific “lens” through which we can see reality, which frequently filters out details that are often emphasized by other models.

This chapter discussed several approaches to business process modeling and respective diagramming techniques. The approaches discussed were activity flow–oriented approaches, the data flow diagramming approach used in traditional systems analysis and design, the communication flow–oriented approach proposed in this book (whose several components are discussed in more detail in later chapters), object-oriented approaches, and holistic systems approaches.

In light of this chapter’s discussion of different business process modeling approaches and diagrams, one could be tempted to ask the question: Why not use several different approaches in combination as a basis for business process redesign and subsequent computer automation projects? After all, some approaches seem to be better at highlighting certain aspects of a business process than others. This is indeed advisable in some cases, since the likely outcome is a very complete and multifaceted view of the business process in question. However, it may be problematic in some situations.

The problem with using different approaches in combination is that business process redesign and automation projects usually are not very successful if it takes too long for the project team to complete their work. And, taking too long to generate a model, the business process being targeted for redesign is likely to extend the duration of a business process redesign project beyond what is acceptable.

A recent study of several business process redesign projects conducted by *CIO Magazine*, a leading publication among information technology executives, suggests that the optimal duration of business process redesign projects is somewhere around 3 months, not considering the time to implement the business process changes.

If time were not a constraint and plenty of it were available, it would probably be okay to look at a business process from several different angles. This would be enabled by the use of several different business process modeling approaches and diagrams. However, the reality of business projects in most organizations is often different.

Most business processes cut across two or more departments, which essentially means that a cross-departmental team will often have to be put together for just about any business process redesign project. The cross-departmental team will have to identify problems associated with the business process, as well as clearly delineate the process's boundaries; otherwise, the team may embark in an open-ended project that will never be completed. Then, the team will have to understand the business process in some detail, propose changes in it, and investigate ways in which those changes could be implemented using information technologies.

Arguably, it is very difficult to accomplish all of the above in approximately 3 months if several different business process modeling approaches and diagrams are used. An alternative, which is probably advisable in most business process redesign projects, is for business process redesign teams to choose one or two approaches at most and stick with them for the duration of their project. Based on the above discussion, it would be reasonable to argue that the communication flow–oriented approach should be chosen, in combination with the holistic approach—the former providing a view of the "trees," so to speak, while the other provides a view of the "forest as a whole."

Review Questions

1. Why do business processes need to be modeled?
   (a) Because they are tangible entities that need to be understood in the same way by several people to be successfully improved.
   (b) Because they are abstract entities that need to be understood in the same way by several people to be successfully improved.
   (c) Because they are abstract entities that do not need to be understood in the same way by several people to be successfully improved.
   (d) Because they are abstract entities that do not need to be understood more or less in the same way by several people to be successfully improved.

2. Which of the following statements does not refer to a difference between the business process and chair concepts?
   (a) The former is a concept that refers to an abstract entity.
   (b) The latter is a concept that refers to a tangible entity.
   (c) Both are concepts that refer to abstract entities.
   (d) One of them is a concept that refers to an abstract entity; the other is not.

3. In the communication flow–oriented approach proposed here:
   (a) A rectangular shape represents an entity that may send or receive information, knowledge, or both.
   (b) A rectangular shape represents an activity that may carry information, knowledge, or both.
   (c) A rectangular shape represents an activity that may lead to the exchange of information, knowledge, or both.
   (d) A rectangular shape represents a repository of information, knowledge, or both.

4. In the communication flow–oriented approach proposed here, a number on the upper right corner of a rectangular shape does not represent:
   (a) The approximate order of execution of an activity in relation to the other activities in the same business process representation.
   (b) The most likely order of execution of an activity in relation to the other activities in the same business process representation.
   (c) The approximate order of execution of an activity, from an activity flow perspective, in relation to the other activities in the same business process representation.
   (d) The approximate order of storage of information in an activity in relation to the other activities in the same business process representation.

5. Data flow diagrams have been developed primarily to:
   (a) Represent business process activities as they would most likely be after computer automation.
   (b) Represent business processes as they would most likely be with computer automation.
   (c) Represent data tables and relationships as they would most likely be after computer automation.
   (d) Represent business processes in such a way that makes it very easy to identify all possible opportunities for redesign.

6. Which of the statements below describes a relationship that cannot be represented through data flow diagrams without breaking widely accepted diagramming rules?
   (a) An assistant manager downloading a complaint from the Web.
   (b) A manager processing a complaint downloaded from the Web.
   (c) A knowledge repository containing complaint review rules.
   (d) A manager processing a complaint received in paper form.

7. Activity flow–oriented approaches:
   (a) Are the most commonly used in business process redesign.
   (b) Are the least commonly used in business process redesign.
   (c) Are not discussed by J. Harrington in his book *Business Process Improvement.*
   (d) Are often perceived as being among the hardest to generate, and certainly harder to generate than communication flow diagrams.

8. Which of the following symbols is not used in business process representations generated through functional flowcharting?
   (a) A rectangular shape.
   (b) An arrow.
   (c) A column containing one or more activities.
   (d) A drumlike shape.

9. The unified modeling language (UML):
   (a) Is a set of standard notations for object-oriented analysis and design that was developed with the goal of unifying the methodologies developed by Ivar Jacobson, Grady Booch, and Al Gore.
   (b) Is a set of standard notations for object-oriented analysis and design that was developed with the goal of unifying three existing methodologies.
   (c) Is a set of standard notations for object-oriented analysis and design that was developed with the goal of unifying data flow diagram notations developed by DeMarco and Yourdon.
   (d) Is a set of standard notations for systems analysis and design that was developed with the goal of unifying the diagramming techniques developed by Gane and Sarson.

10. Which of the following statements is not consistent with the interpretation of the holistic systems view discussed in this chapter?
   (a) It provides little in terms of details about the inner workings of a business process.
   (b) It contributes to one's understanding of business processes in terms of broad elements that characterize them.
   (c) It provides more in terms of details about the inner workings of a business process than most activity flow–oriented views.
   (d) It can be used in the redesign of business processes.

Discussion Questions

1. Develop a textual description of a business process like the one in the section describing the predictive car maintenance process of a rental company in this chapter. The business process example you will develop should be of a company outside the car rental industry and should be as realistic as possible.

2. Develop a communication flow–oriented representation of the business process example you developed in response to Discussion Question 1, using the related diagram symbols previously discussed in this chapter. Also, develop a data flow diagram of the business process example you developed in Discussion Question 1, using the data flow diagram symbols previously discussed in this chapter in connection with the traditional systems analysis and design approach to business process modeling. What are the differences between the two representations? How could those differences affect the outcomes of a business process redesign project targeting the business process example you developed?

3. Develop an activity flow–oriented representation of the business process example you developed in response to discussion Question 1, using the related diagram symbols previously discussed in this chapter. Compare it with the communication flow–oriented representation you developed in Discussion Question 2. What are the differences between the two representations? How could those differences affect the outcomes of a business process redesign project targeting the business process example you developed?

4. Develop an object-oriented representation of the business process example you developed in response to Discussion Question 1, using the use-case diagram symbols previously discussed in this chapter in connection with object-oriented approaches. Compare that representation with the communication flow–oriented representation you developed in Discussion Question 2. What are the differences between the two representations? How could those differences affect the outcomes of a business process redesign project targeting the business process example you developed?

5. Develop another textual description of a business process example like the one you generated in response to Discussion Question 1, but based on a different business process of your choice. Generate a representation of the new business process example using the object-oriented approach discussed in this chapter. Redesign the business process developed here and the one developed in response to Discussion Question 1. For the latter, use the communication flow–oriented representation. The goal of the redesign should be to reduce process costs. You don't have to use specific redesign guidelines—just use your common sense. Generate business process representations of the redesigned processes. In your opinion, did the difference in modeling approaches used affect the effectiveness of the business process redesign outcomes? Explain your answer.