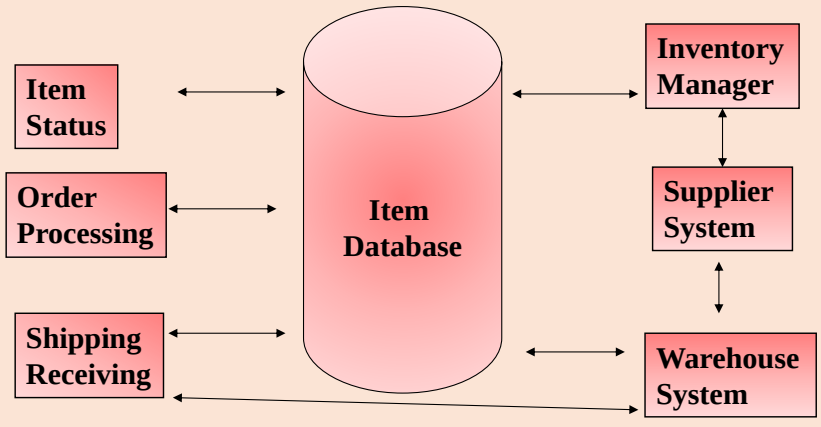
5 Enterprise Information Systems and Application Planning in the Digital Age

Openining Vignette: Walmart Automated Sales and Supply Chain Architecture

Walmart has become a major retail provider and gained significant competitive advantage over several established competitors such as Kmart. The main reason is that Walmart has one of the largest and most efficient sales and supply chain systems in the retail industry. The Walmart Sales and Supply Chain Application Architecture consists of several databases and applications that work with each other (see the diagram):

- An "Item Database" contains extensive information about each item sold by Walmart. The database shows item-id (barcode), price, items on hand, sales activity, etc.
- Handheld device reads barcode of an item on shelf and looks up item database for price, items on hand, and sale details including number of items sold today, this week and this month.
- Different applications monitor the item database and automatically generate a request to suppliers (over 3000 suppliers including many overseas locations).
- Suppliers are notified over an extensive network. They have to be able to receive and respond to purchases electronically.
- Items arrive in warehouse, will be scanned and added to the item database.
- When an item is purchased, the checkout counter automatically updates the item database.
- The database is mined/analyzed for trends (local, regional, national, international).
- The system uses a "pull model" with suppliers (i.e., pull whatever is needed at any time) instead of push (suppliers push the product).



Contents

5.1 Introduction to Enterprise Information Systems and Applications

Everyone agrees that information systems (IS) are the heart of the digital age. In addition, it is well known that IS are used in enterprises at all levels -- from shop floor to the executive suite -- to answer questions, make decisions, evaluate alternatives, predict possible outcomes, and make crucial

decisions. For example, the "Walmart Automated Sales and Supply Chain" system discussed in the Openining Vignette is a large scale information system that has given significant competitive advantage to Walmart over several established competitors such as Kmart. This system is one of the largest and most efficient sales and supply chain system in the retail industry. Similarly, Amazon has gone from a leader in online book sales to a leading digital enterprise that is now using drones, artificial intelligence, and IoTs to support homes of the future. This chapter describes enterprise information systems and the applications that are making all this happen.

Let us define some basic terms before proceeding:

- **Data:** raw facts and observations representing events occurring in the enterprise or the physical environment. For example, "55" is just data.
- **Information**: data that have been shaped into a form that is meaningful and useful to human beings. For example, "55 miles per hour" is information that is meaningful and useful.
- **Information Systems (IS):** a set of interrelated components that collect (or retrieve), process, store, and distribute information. Examples are MIS (Management Information Systems), GIS (Geographic Information Systems), and HIS (Hospital Information Systems). An IS can be manual, completely automated, or partially automated.
- **Enterprise Information Systems (EIS):** the information systems that support the entire enterprise at all levels and are not limited to MIS systems that are restricted to managers only. EIS subsume MIS and executive/decision support systems.
- **Information technology (IT):** automates and supports the IS and consists of all the computing hardware, software, databases, networks and devices that an Enterprise needs to use in order to achieve its business objectives. The IT systems are being called "digital technologies" or "digital infrastructures" because IT is almost all digital at present.

Figure 5-1 shows a simple purchasing system of an office supplies store (like Staples) that will illustrate the key points. This system is partially automated (order processing and inventory are automated, but payment and shipping are not). Thus, a customer places an online order to purchase a printer, let us say through web or a mobile application (app), the order processing app checks to see if the needed printer is available in the inventory. If so, it informs the customer to make a phone call or a trip to the store to pay for and pickup the printer. However, if the payment and the shipping systems were also automated, then the customer could also pay and have the printer shipped online.

This is quite appealing to the customers and gives the store a competitive edge. The completely automated purchasing system would also have a database that keeps track of the sales and provides feedback to the store manager about which items are selling better than others. Also, the customer support staff could look at the database to answer questions about shipping status. The following clarifications are worth noting in this simple example:

- Not all IS are automated.
- Not all information is for management consumption.
- In small organizations, critical business processes are typically automated first and others are automated later on an as needed basis.
- The automation could be carried further where a robot packs the product (printer in our example) and loads it to a drone. The main question is: what is the business value (e.g., increased revenues, better customer satisfaction, decreased cost of operation) of automation beyond a certain point.

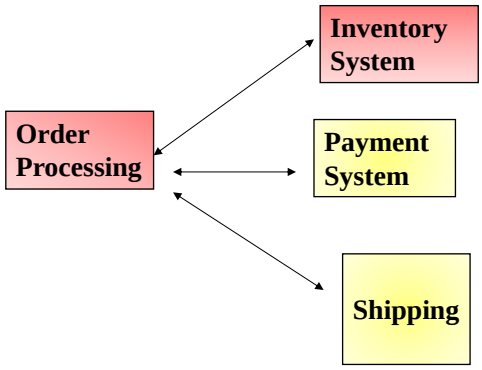


Figure 5-1: A Simple Purchasing System (Payment and Shipping are not Automated) -

Business applications automate the business processes and are the key enablers of business strategies. For example, the payment and shipping apps in the aforementioned purchasing system were added later for competitive advantage. Through these applications, businesses incorporate the Internet and mobile computing into every process, from sales and marketing to manufacturing and procurement to supply chain management and new product development. Significant activity is in B2B (business to business) trade that automates and streamlines communications, transactions, and collaboration with customers and suppliers. Thus, organizations increasingly serve as nodes on trading networks that rely on the Internet to exchange and process information between trading partners. This chapter introduces the concepts of business applications and attempts to answer the following key questions:

- What are Enterprise Applications and how are they related to Application Patterns?
- What are the different strategies to automate a Business process?
- What are categories of enterprise applications?
- What is Application Outsourcing and what are ASPs?
- What are the variations of Enterprise Applications such as Mobile, Location-based, etc?
- What are the examples of enterprise applications in retail, health, and other sectors ?

Chapter Highlights

- Enterprise applications are at the core of modern digital corporations because these applications automate business processes.
- An enterprise application architecture shows the main applications of an enterprise, what they do, and how they interact and interface with each other.
- An enterprise application pattern is a good first step towards an enterprise application architecture.
- Many enterprise applications span C2B as well as B2B operations. For example, many online purchasing systems support several suppliers who can handle backorders.
- Although the applications differ from each other, several common attributes and patterns can be found.
- Enterprise applications can be classified in terms of common applications (e.g., human resources, CRMs) versus industry specific (e.g., hospital information system).
- Most mobile applications are not fundamentally new applications; instead they are typical EB (ebusiness) applications with mobile interfaces -- called MEBAs (Mobile EB Applications).
- Increased number of enterprise applications can be rented from ASPs (application service providers). The ASPs are also becoming known as SaaS (Software as a Service) providers.

The following table, called the "**Application Matrix**" shows a high level view of an application plan. Basically , this matrix shows the business processes of an enterprise and then the application packages that will automate the given business processes. Simply stated, an application plan identifies the applications A_1, A_2… A_n that are needed to automate the business processes BP_1… BP_m of an enterprise. We will explain and expand on variations of this Matrix in this chapter.

	Application Package1	Application Package2	Application Package3	Application Package4	Manual Processes
Business Process1	X				
Business Process2				X	
Business Process 3					X
Business Process4			X		
Business Process 5		x			

5.2 XYZ Corp Develops an Application Plan

As a consultant for XYZ Corp, an imaginary company very similar to Dave's Digital Store (Case Study in Chapter 3), you have already developed a business strategy that drives the overall planning process. Now you need to develop an application plan that supports the business strategy. The main objective of application planning is to identify what business processes will be automated when, why, and how. This involves the following steps:

- Create a view that shows the main business processes (BPs) to be used by the company and the enterprise application packages (EAPs) that will automate the business processes. This should be done as an Application Matrix shown above in the "Chapter Highlights" sidebar.
- Use the Critical Success Factors (CSF) methodology as a basis for automation. In particular, identify five applications that are critical to the success of the company.
- For each application, also show the implementation strategy (buy, rent, outsource development, develop in-house, or extend -- BRODE).

The Agenda

- Information Systems & Applications
- Application Patterns and BRODE
- Web and Mobile Applications (Apps)
- Case Studies and Examples

5.3 Introduction to Applications – Automation of Business Processes

5.3.1 What is an Application?

Simply stated, an *enterprise application* is a computerized information system that automates a business process at enterprise level. For example, a payroll application automates a payroll process. As more businesses are becoming Web-enabled, enterprise applications are in fact the so called ebusiness applications. Through these applications, businesses are incorporating the Internet and mobility into every process, from sales and marketing to manufacturing and procurement to supply chain management and new product development. An *enterprise application architecture*, the focus of this chapter, shows the main applications of an enterprise, what do they do, and how they interact and interface with each other. For example, the Walmart application architecture shows how the sales and supply chain applications interact with each other to keep the Walmart stores operational.

Significant activity is in B2B trade that automates and streamlines communications, transactions, and collaboration with business partners and suppliers -- organizations increasingly serve as nodes on trading networks that rely on the Internet to exchange and process information between trading partners. At the core of B2B trade are the B2B enterprise applications and associated models. These models and applications offer the buyers and sellers a wealth of decision support tools for price and product comparisons, a wide range of channels to market products, and deliver enhanced services to customers. The focus of this chapter is not on technologies, but rather on the enterprise architectures that serve as the key enablers of business strategies.

According to Webster, an application "puts to use especially for some practical purpose". In this book, we are concentrating on computer applications that put to use computers for the practical purpose of supporting businesses. Specifically, we are only interested in a class of computer applications that are business aware, i.e., *we are interested in business applications*. Thus, Microsoft "applications" such as Word and Power Point are excluded from this class of applications, because they are not business aware (in fact, we consider them to be part of the IT infrastructure). Therefore, we define an application as follows:

Definition: An application system, commonly referred to as application in this book, is a business application that uses computers to support businesses, thus it is business aware and represents the business functionality and data.

Business in this context means any type of business such as manufacturing, aerospace, healthcare, finance, or telecom. Examples of such applications are airline reservation systems, inventory, control systems, financial planning systems, material handling systems and the likes. These systems are used by organizations to gain/retain competitive edge, reduce costs, and improve management decision making. From a business point of view, systems such as email, word processors, text editors, operating systems and Web browsers are not applications because they are not business aware.

An application consists of several "components" that are assembled to satisfy business needs (we will define these components formally in a later chapter). For the time being, let us assume that these components are of three types:

- **Application datasets** D = (d1,d2,...) which contain the information needed by the enterprise activities. Examples of this information are customer information, payroll information, design data, product information, and corporate plans. This data may be physically stored in flat files, relational databases, object oriented databases, or under any other database management system.

More and more applications are beginning to store enterprise "knowledge" in the form of rules in databases. In addition, some real-time databases may be stored in main memory for fast access.

- **Application programs** P = (p1, p2...) to perform business operations (e.g., bookkeeping, credit checking), engineering/scientific functions (solid modeling, simulations, animations, drawings), manufacturing operations (e.g., robotics), and/or expert systems inferences. The programs code the business rules, also known as business intelligence, that represent the functional logic that is unique to the user organization (not the data, not the user interface).
- **User presentation processors** U = (u1, u2...) to process the user access to the application data and programs. The user interfaces may be simple text command/response systems, pull-down menus, graphical user interfaces, speech recognition systems, and video systems with a pointing device (mouse). With the expected growth of multimedia applications, the user interfaces are beginning to include sophisticated combinations of voice, text, and video on the same screen.

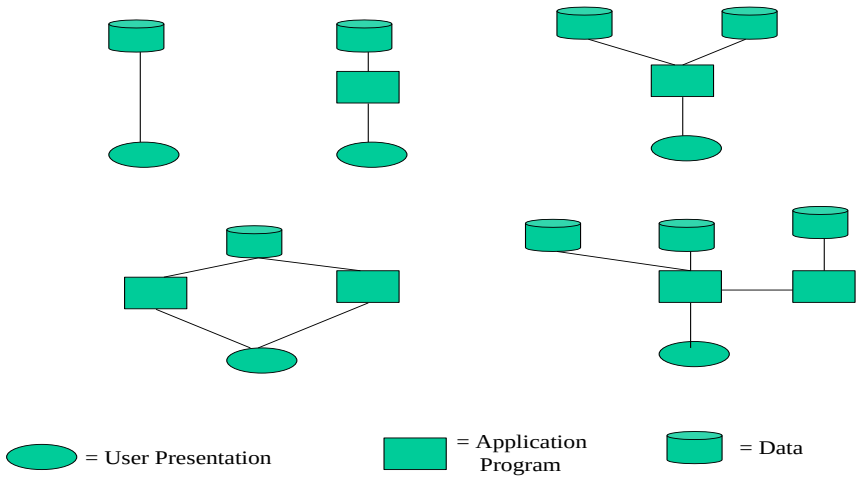


Figure 5-2: Five Sample Application Patterns (from simple to complex)

Figure 5-2 shows five different application "patterns" that illustrate how applications can be configured in terms of data, processing logic, and user interface components. The components of an application may be centralized or distributed. In a distributed application, the application components (user interface, user data, and programs) reside at different computers on a network. On the other hand, all application components of a centralized application are restricted to one computer. In web-based applications, the user interface processing typically resides on Web browsers and the user data typically resides on remote data servers (many of them belonging to trade partners). The application logic can reside on the data server, web browser site, web server site, another "middle tier" machine, or some combination thereof.

5.3.2 What are Enterprise Applications?

An enterprise application basically automates a business process. As defined in the previous chapter, a business process (BP) represents a business activity of an enterprise, for example, order processing, purchasing, paying creditors, creating financial statements, managing cash accounts, hiring employees, paying employees, or enrolling employees in benefits plans. Enterprise applications computerize these BPs. For example, a payroll application from Peoplesoft Corp automates the payroll BP. Similarly, an inventory management application automates an inventory management BP.

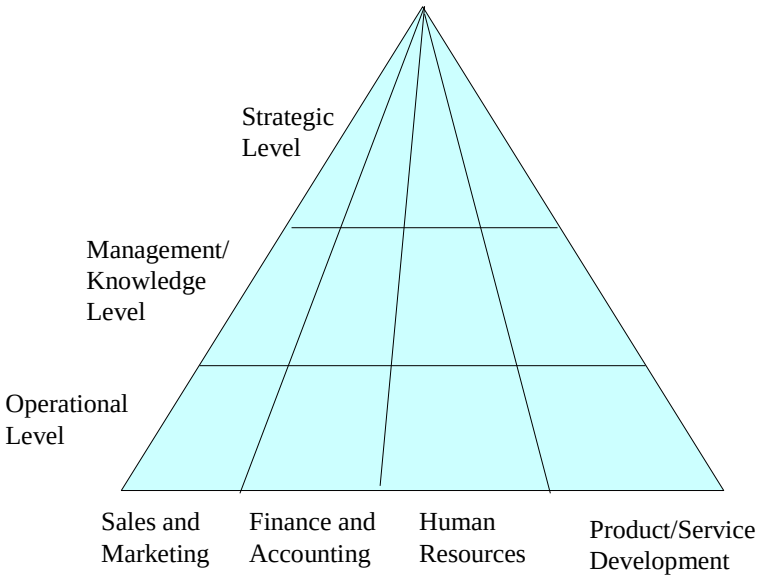


Figure 5-3: Different types of Business Processes and Application Systems at Different Levels

Figure 5-3 presents a common way to depict the different types of business processes (BPs) at different levels in an organization. This view, introduced in the previous chapter, shows that the organization is horizontally divided into strategic management, knowledge (middle) management, and operational levels. It is further divided into vertical functional areas such as sales and marketing, finance and accounting, human resources, and product-service development. For example, the sales function generally has a sales process at the operational level to record daily sales figures and to process orders. A knowledge/management-level process tracks monthly sales figures by sales territory and reports on territories where sales exceed or fall below anticipated levels. A process to forecast sales trends over a five-year period serves sales at the strategic management level.

Broadly speaking, three main types of business processes serve different organizational levels:

- **Operational-level** processes support day-to-day activities and transactions of the organization, such as sales, payrolls, and the flow of materials in a factory. Processes at this level answer routine questions such as the following: did Joe pay his bill, how many parts are in inventory, and how many chairs were sold today. Examples of operational-level processes include an inventory management system and a system that tracks the number of hours worked each day by hourly workers.
- **Management/knowledge-level** processes serve the middle managers and the specialists in a firm. Specifically they serve the monitoring, controlling, and decision-making needs of middle managers and attempt to make the specialists more productive. Management-level processes typically provide periodic reports, so that the managers understand how things are working, An example is a material requirement planning system that helps the managers decide how many materials will be needed to meet the production demand. Another example is a financial planning system for financial analysts.
- **Strategic-level** processes help senior management address strategic issues and long-term trends, with special focus on the external environment. The principal concern here is to understand the changes in the external environment and match them with the internal situation. Types of questions addressed by these processes are: what are the new trade regulations that could affect us, what will employment levels be in five years, what are the new products in the marketplace, and how will they affect us.

A business process can be naturally decomposed into several sub-processes, which have their own attributes, but also contribute to achieving the goal of the parent process. Business process analysis typically includes the mapping of processes and sub-processes to several levels of granularity.
Application Matrix: A High Level Application Plan

Table 5-1, known as the "**Application Matrix**", shows a high level view of an application plan. Basically , this matrix shows the business processes of an enterprise and then the application packages that could automate the given business processes. Simply stated, an application plan identifies the applications A_1, A_2… A_n that are needed to *automate* the business processes BP_1… BP_m of an enterprise. Thus, development of an application plan involves the following two steps:

- Identify the business processes that need to be supported
- Select the appropriate applications that will automate the business processes

The *business processes*, shown in different cells of Figure 5-3, capture an overall view of enterprise functional areas (e.g., sales, marketing, human resources), the major business processes in each functional area (e.g., purchasing and payment within procurement), and the key interactions between these processes. Such high level views of businesses are of great practical value to identify business scenarios, automation strategies, and enterprise applications.

The next step is to identify the applications A_1, A_2… A_n that are needed to automate the business processes BP_1… BP_n identified in this figure. In reality, one or many applications (apps, application packages, ERP systems) may be needed to support a given business process. and a given business process may need multiple applications. For example, a customer information system may support many business processes such as purchasing, marketing, and payment. Similarly, purchasing business process needs support of many applications such as order processing, inventory management, shipping/receiving, and payment packages. The result of this step is a table that may resemble Table 5-1. The Application Matrix shows which application packages (e.g., CRM from SAP) may be used to automate which business processes. The main challenge is to determine the most appropriate application packages that automate different business processes. The choices are indicated by X in the table cells. Note that BP2 is not automated at process. We will refine this application plan after we discuss different types of enterprise applications in some detail.

Table 5-1: Application Matrix – A High Level IT Applications Plan

	Application Package1	Application Package2	Application Package3	Application Package4	Manual Processes
Business Process1	X			X	
Business Process2					X
Business Process 3				X	
Business Process4			X		
Business Process 5			X		

5.3.3 Classification of Applications by Levels in Enterprise

Identifying applications for the Application Matrix is not trivial, because there is "no one size fits all" approach for enterprise applications. Some approaches and tools work well for decision support processes while the others work for operational support applications. In addition, some technologies work quite well for small departmental applications but not for large inter-enterprise applications of the same type. We will present a patterns-based methodology later that will allow us to systematically deal with the wide range of issues related to engineering/re-engineering of applications of different types at different spans. For now, let us take a closer look at applications at different levels of an enterprise -- operational, decision support and executive support applications. We will then look at other classifications such as user types and technologies.

Operational Support Applications support the day-to-day operational activities of an organization. A large number of operational support applications are categorized as OLTP (on-line transaction processing). As the name implies, these applications support on-line users and require robust transaction processing facilities such as logging, integrity control, and backup/recovery. OLTP applications are typically involved in the day-to-day operational activities such as order processing, purchasing, shipping, and inventory control. As a result, they tend to update data frequently and require immediate response. The major characteristics of these applications are:

- Operations are performed on current values of data
- Data is updated frequently by a large number of users
- Operations on data are predictable (non-discovery and not ad-hoc)
- Majority of users are line workers and clerical staff
- Data integrity and concurrency requirements are high (usually hundreds of concurrent users need to access the most current information)
- Stringent response time requirements (usually sub-second)
- Detailed, and usually small amount of data is accessed

Decision Support (Analytics) Applications are primarily intended for a class of users known as "knowledge" workers and managers. A large body of management literature on decision support systems has accumulated since the mid 1980s (see, for example, the textbook by [Turban 2010]. Decision support applications focus on informational data to drive the business and not on operational data to help in the day-to-day operation of a company. Examples of decision support applications are data warehouses, marketing information systems, executive information systems, and business planning systems. The characteristics of these applications are:

- Operations are performed on archival data and Big Data that is accumulating very rapidly in organizations. See the side bar on “Possible Use of Big Data, Analytics and Learning in Business Applications” for more details
- Data is not application captive, instead it is integrated across applications (enterprise data)
- Data is queried frequently and is updated very infrequently
- Queries are ad-hoc and used in a discovery and browsing mode
- Users are typically decision makers and knowledge workers
- Data integrity and concurrency requirements are low (for example, data can be slightly outdated for long range planning)
- Response time requirements are typically not stringent
- Large amounts of data (typically joins between very large relational tables) are processed

Executive Support and Real-time Applications are intended for top level managers. These applications focus on competitive analysis based on external data sources and Big Data. See the side bar on "Possible Use of Big Data, Analytics and Learning in Business Applications" for more details. Most executive support systems also possess real-time support because top level management decisions need to be in real-time. In real-time applications, time is the *only* requirement. These applications are embedded in real life activities such as monitoring and reacting to disasters and manufacturing processing. While the operational support and decision support applications provide information to users, the real-time applications are part of a real life process. Due to this, these applications impose stringent requirements for performance (sub-second response time), and availability (continuous and often fault tolerant). Examples of real-time applications are voice applications over the Internet, manufacturing control systems, real-time market data monitoring and analysis systems, command and control systems, and telecommunications network managers. The main characteristics of executive support and real-time applications are:

- Big Data about competitors and market situations for immediate decisions
- Application processes focus on monitoring for real life alerts that need immediate attention
- Response time and availability requirements are "hard" (must be met)
- Most data is kept in main storage to improve performance
- Data integrity requirements are low (data changes several times per second, so if you do not like the current value - wait for a second!)

Possible Use of Big Data, Analytics and Learning in Business Applications

Big Data and Data Analytics

- Big Data represents massive amount of data that can be used for improved decision making. Big Data is typically characterized by three parameters:
  - Volume (number of data items are extremely large),
  - Variance (the data format is highly variant – instead of highly structured data suitable for SQL queries, it may represent voice, images, and data captured through sensors),
  - Velocity (the data accumulates very quickly – for example, millions of images can be sent by a satellite in an hour).
- An example of Big Data is the World Bank Open Data Initiative that provides a very large repository of data from almost all countries in the world.
- Data analytics is the use of data, information technology, statistical analysis, quantitative methods, and mathematical models to help managers gain improved insights about their business operations and make better decisions.
- Data analytics of Big Data is a rapidly evolving area of work especially for business intelligence. For example, descriptive analytics uses Big Data to discover relationships between patient health and medication used, predictive analytics is used to predict the future based on past observations, and prescriptive analytics uses optimization techniques to find the least expensive solutions to a problem.
- Many data analytics projects at present are based on Big Data repositories in health, education, public safety, public welfare, and other vital sectors.

Deep Learning and Big Data

- Deep learning takes a model of human brain (called neural network) and populates it with Big Data on a subject matter (let us say skin cancer) to develop an expert system that is smarter than any skin cancer doctor. The basic premise of this work is that a human brain cannot store

and retake extensive knowledge but a computer brain can. The idea is to develop smart lawyers and smart doctors as expert systems based on deep learning that are far better than human experts.

- Smart systems based on deep learning are raising several issues. However, the main advantage of smart systems based on deep learning is that these systems, once built, can exchange information with all others. For example, if you are driving and learn about how to drive in heavy snow, then you are the only one who has this knowledge. But if an intelligent car learns the same lesson, then this knowledge can be replicated immediately to all other cars.

5.3.4 Classification of Applications by Users

Applications in modern enterprises are multidimensional and complex. The traditional e-business applications view, shown in Figure 5-4, explains these applications in terms of:

- **Business to Customer (B2C) applications** that are used by the customers. Examples of these applications are online-purchasing and web advertising.
- Internal Business to Employee (B2E) applications that can be further decomposed into:
  - *Individual (departmental) applications* are intended for a small group or a department. These applications may support, for example, sales activities of a department.
  - *Enterprise applications* are designed to satisfy the needs of an entire enterprise and are used commonly throughout an enterprise. For example, a human resource (HR) application is an enterprise application. Most ERP (Enterprise Resource Planning) applications are also enterprise applications.
- **Business to Business (B2B) applications** that are used between businesses. These applications are used to exchange orders, products, and payments between companies in B2B trade. Examples of these applications, as expected, are B2B applications such as supply chain management and emarkets.

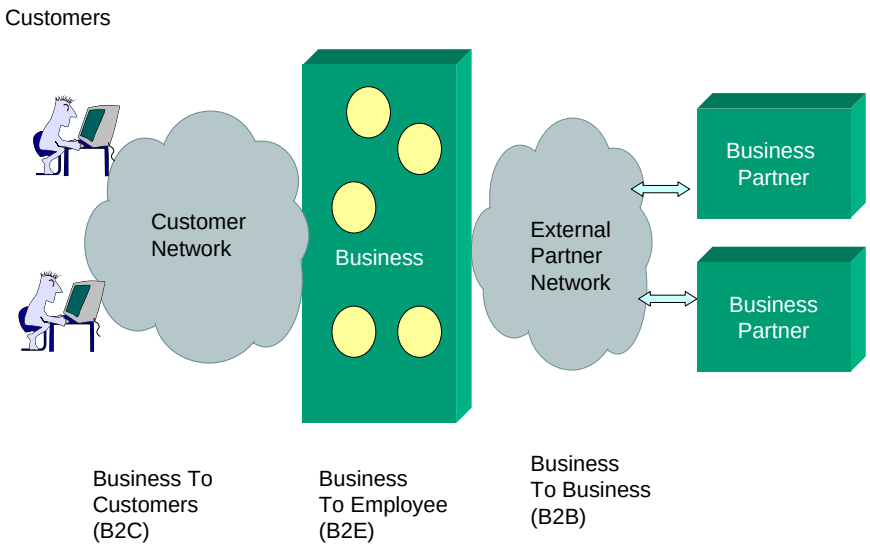


Figure 5-4: Enterprise Applications -- High Level View

5.3.5 Classification of Applications by Technologies

Enterprise applications (apps) can use different types of technologies such as Web, Wireless Networks, and Smart Systems. In particular, "smart" applications are gaining popularity in modern digital enterprises. In these companies, the entire enterprise is viewed as a collection of digital applications that monitor and configure themselves in real-time to respond to business activities. In a real-time system, time is the *only* performance indicator. In a real-time digital enterprise, all of a company's departments, channels, and partners are connected electronically, so that all communications in all direction throughout the supply and demand chains are instantaneous.

In general, Web and mobile applications continue to be areas of increased activity. We will take a closer look at these applications later in this chapter, but here is a quick overview:

- *Web applications* use a Web Browser to access remotely located applications anywhere on the Web. Broadly speaking, these applications are categorized as (see section 5.6 for additional information):
    - Basic web applications that use the classical web technologies (e.g., web browsers and web servers) to access remotely located programs and databases
    - Web 2.0 applications that use social media and semantic web technologies
    - Web of Things apps that utilize the Internet of Things technologies to access remotely located apps and data stored on sensors, coffee machines, dishwashers, and virtually all types of devices
- *Mobile applications* typically run on handsets and other mobile devices and are extremely popular at present (see the sidebar "The Mobile App Usage – Key Statistics & Facts by Statista"). Broadly speaking, these applications are categorized as (see section 5.6.2 for details):
    - Standalone mobile apps that are downloaded to the handsets and then operate in a "disconnected" mode
    - Mobile e-business applications (MEBAs) that provide access to back-end ebusiness applications such as customer relationship management and supply chain management
    - Location-sensitive applications that typically use GPS to provide location-sensitive information (e.g., the nearest gas station)
    - Wireless sensor and RFID applications that use sensors, RFIDs, and other small devices to collaborate and inform each other

- *Intelligent ("smart") applications* that utilize the AI capabilities of DAL (Detect, Adjust, Learn). Many of these applications use IoTs (Internet of Things) that use sensors and wireless networks for detection and can also learn and utilize the knowledge gained for improved future operations. Specifically, these devices use the following DAL capabilities:
    - *Detection (D)* through sensors that provide vision, speech recognition, sound, touch and other sensing capabilities. These devices are connected to other devices through wireless sensor networks such as Bluetooth and Zigbee.
    - *Adjustment (A)* through rules or other techniques. For example, a smart radiation detector can detect a dangerous level of radiation and automatically trigger an alarm.
    - *Learning (L)* by using the machine learning algorithms of data mining, fuzzy logic and case-based reasoning. For example, a smart university building can detect that there are evening classes on Mondays and adjust the energy controls accordingly.

For all practical purposes, web, mobile and smart applications are not fundamentally new applications. Instead, web, mobility and intelligence is another aspect (dimension) of the traditional applications that can be accessed over web and wireless networks.

Mobile App Usage – Key Statistics and Facts by Statista

According to reports released by Statista, the number of applications available in the Google Play Store reached 3.5 million in December 2017, while as of January 2017, 2.2 million apps were available on the Apple App Store. In addition, the following information is worth noting:

- 25% of all the apps that are installed on the mobile phones are never used
- An average Android application loses 90% of daily active users within the first month

Sources:

- https://www.statista.com/topics/1002/mobile-app-usage/
- https://dzone.com/articles/9-mobile-apps-marketing-case-studies-conjoining-ma

5.3.6 The Composite Apps: Web-based, Mobile and Smart Apps

Most modern apps are composites – they use web browsers, run on mobile devices and use AI. These composite apps use web, mobility and intelligence to provide business value that can be accessed over web and wireless networks. Large number of such apps are commercially available at the time of this writing in almost all sectors of our life e.g., health, education, public safety, public welfare, transportation, agriculture, travel, entertainment and many other sectors. For example, smartphones and smart watches have a wide range of sensors with many connectivity options (Cell, WiFi, Bluetooth, Zigbee, etc) and the capacity to learn so that these devices in our pockets can automatically monitor our movements, location, and workouts throughout the day and provide suggestions.

For example, a smart phone can capture our speech pattern over many years and detect when we are beginning to have dementia. Many interesting applications of smart devices actually are in the WoT (Web of Things) where the IoTs are Web enabled (see http://webofthings.org/). These apps run over a wireless network with links to GPS.

5.3.7 Example of a Modern Retail Store – Using Web, Mobile and Smart Apps

A conceptual view of a modern retail business, such as Amazon.com, is shown in Figure 5-5. Several web, mobile, smart and composite apps are used in such businesses regularly. For example:

- At the core of this business is a composite purchasing app that allows a smart phone user to order items through a speech recognition system. This app is also GPS enabled so that the location of the customer is automatically recorded. The customer wants the items to be delivered to a location closest to the caller (e.g., a rescue squad that wants some medication to be delivered to a disaster area).
- This app then makes selections from a list of items based on the current inventory and suggests items that could be purchased based on the customer's past purchases and user profile. The customer initiates the purchasing process for selected items and goes through the payment and inventory system.
- The Web-based payment and inventory application at the retail site is linked to a host of vendors that exist on the cloud and to the Big Data about available products on the Internet. The inventory

system invokes the supply chain management system to place orders with the suppliers who can deliver the needed products quickly.

- The shipping/receiving application notifies the appropriate distributors that new items have arrived. The receiving application may also notify an intelligent robot or a drone to physically receive the items when they arrive in the distributor warehouse and deliver them to the needed location.

Many more permutations of automated workflow in a retail store of the future can be envisioned with web, mobile and intelligent apps performing routine tasks. Also, similar scenarios can be imagined in health, manufacturing, and other sectors.

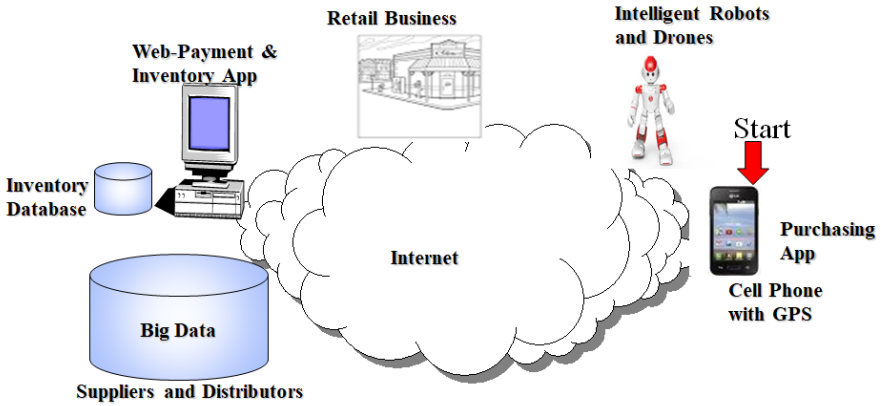


Figure 5-5: Digital Retail Store with Web, Mobile and Smart Apps

5.3.8 Enterprise Resource Planning (ERP) Systems: A Quick Overview

Traditionally, enterprise resources have been managed by a multitude of independent applications in human resources, payroll, order processing, inventory control, billing, and accounts payable/receivable systems. In some cases, companies have hundreds, even thousands, of applications that manage enterprise resources. The basic idea of ERP systems is that they provide an integrated approach to manage and operate enterprise resources such as employees, materials, and services. ERP systems provide a single application framework that integrates these applications together. Examples of ERP applications are SAP and Oracle Applications.

Before proceeding, we should emphasize that ERP is not one application. Instead, ERP is used to represent a family of applications that are used to support enterprise operations. These applications are integrated around commonly shared databases or a large database. Figure 5-6 shows a conceptual view of an ERP system that supports several enterprise applications through a common database such as a customer database. Since ERP systems cover most of the enterprise resources:

ERP Application = Enterprise Application.

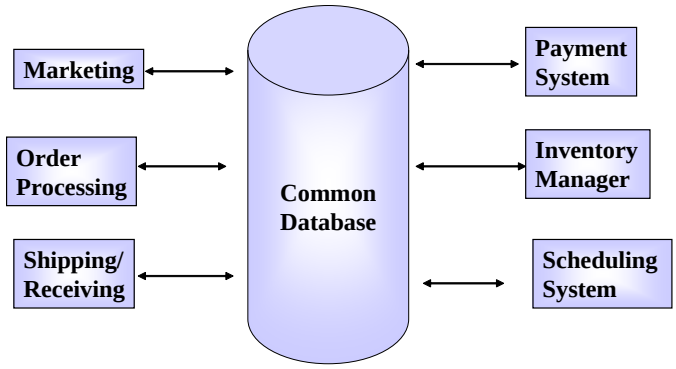


Figure 5-6: Modern Enterprise Applications

Although ERPs became popular in the 1990s, they have existed in principle since the 1970s. An example from manufacturing best illustrates the evolution of ERPs. The focus of manufacturing systems in the 1960s was on inventory control. Most of the software packages (usually customized) were designed to handle inventory based on traditional inventory concepts. In the 1970s, the focus shifted to MRP (Material Requirement Planning) systems which tied inventories to materials planning (i.e., the material suppliers were connected to the inventory systems to keep inventories at acceptable levels). In the 1980s, the concept of MRP-II (Manufacturing Resources Planning) evolved which extended MRP to shops' floors and distribution management activities (i.e., the inventories were also connected to shop floor systems and distribution channels to take advantage of quantity discounts and fulfill just-in-time inventories). In the early 1990s, MRP-II was further extended to cover areas like Engineering, Finance, Human Resources, Project Management, etc., i.e., the complete gamut of activities associated with all enterprise resources. Hence, the term ERP (Enterprise Resource Planning) was coined.

ERPs are playing an important role in the current enterprises, especially as players in a supply chain of trading partners. For example, the ERP of a manufacturer must interact, directly or indirectly, with the ERP systems of material suppliers and distributors in a supply chain. Extensive discussion of ERPs is beyond the scope of this book. However, a quick look at ERPs is presented in a later chapter.

5.3.9 Another Look at Application Matrix

The **Application Matrix** shown below has been enriched by using the knowledge about different types of applications. We have basically refined the application plan based on different types of enterprise applications that could be used to automate the various business processes. Please note that business process 2 is manual and is performed by two staff members.

Table 5-2: Application Matrix – A Revised High Level IT Applications Plan

	Application Package1	Application Package2	Application Package3	Application Package4	Manual Operations
Business Process1	Operational (ERP)			Operational (ERP)	
Business Process2					Performed by Sally and John

Business Process 3				Decision Support (web-based)	
Business Process4			Operational (Mobile)		
Business Process 5			Operational (Web-based)		

Time To Take a Break

- Information Systems & Applications
- Application Patterns and BRODE
- Web and Mobile Applications (Apps)
- Case Studies and Examples

Suggested Review Questions Before Proceeding

- What is an information system? Give 3 examples of your most favourite information sytsems
- What is an Application and how is it related to an information system? Give 3 examples of your most favourite applications
- What are Enterprise Applications? Is every application an enterprise application?
- What are the main entries of an Application Matrix at a high level?
- What is the difference between Applications at operational versus decision support levels?
- Give one example for each C2B, B2E and B2B application
- Can mobile apps also access web resources?
- An Enterprise Resource Planning (ERP) system is not one application but a collection of applications supported by a common database. Is this statement true?
- Can an Application Matrix be used to represent an Application Plan?

5.4 Enterprise Application Patterns to Support Application Plans

5.4.1 What are Enterprise Application Patterns?

A high level Application Plan, as discussed previously, can be displayed by using a two dimensional Application Matrix.

Figure 5-7 shows a more detailed view of the Application Plan by using a Business Process Pattern (BPP), introduced in the previous chapter. A BPP can be used to identify what BPs are automated by different types of enterprise applications and also the interrelationships between different players. As we will see shortly, a BPP can directly lead to a better understanding of what type of enterprise applications *(enterprise application patterns)* are needed for an enterprise.

Enterprise applications, as we will see later, automate the business processes by using different automation strategies such as commercial-off-the-shelf (COTS) packages, rentals through application service providers (ASPs), outsourcing of software development, and the increasing appeal of software re-use through service-oriented offerings based on Web-Services. These strategies translate a BPP to an *enterprise application pattern (EAP),* illustrated in Figure 5-8. This figure shows what BPs are commonly automated and how it is done (i.e., which automation strategy is used: buying, renting, outsourcing development, building in-house, or extension/re-engineering of existing applications).

The choice of applications and the automation strategies depends on several factors such as company size, web reliance, and mobility reliance. For example, small companies in some industry segments (e.g., restaurants and local stores) typically automate only a few essential services such as back-office processes and may rent many of these services from ASPs. However, companies relying heavily on Web will have a high degree of automation and will invest in web-based purchasing and enterprise portals. Also companies exploiting mobile services will support mobile applications such as M-commerce. Figure 5-8 shows the resulting EAP of a small to medium store with low reliance on Web and mobile services. It is a refinement of the BPP shown in Figure 5-7. . The EAP suggests a sketch (a pattern) that the user can customize to build an automation vision to drive the business process reengineering projects.

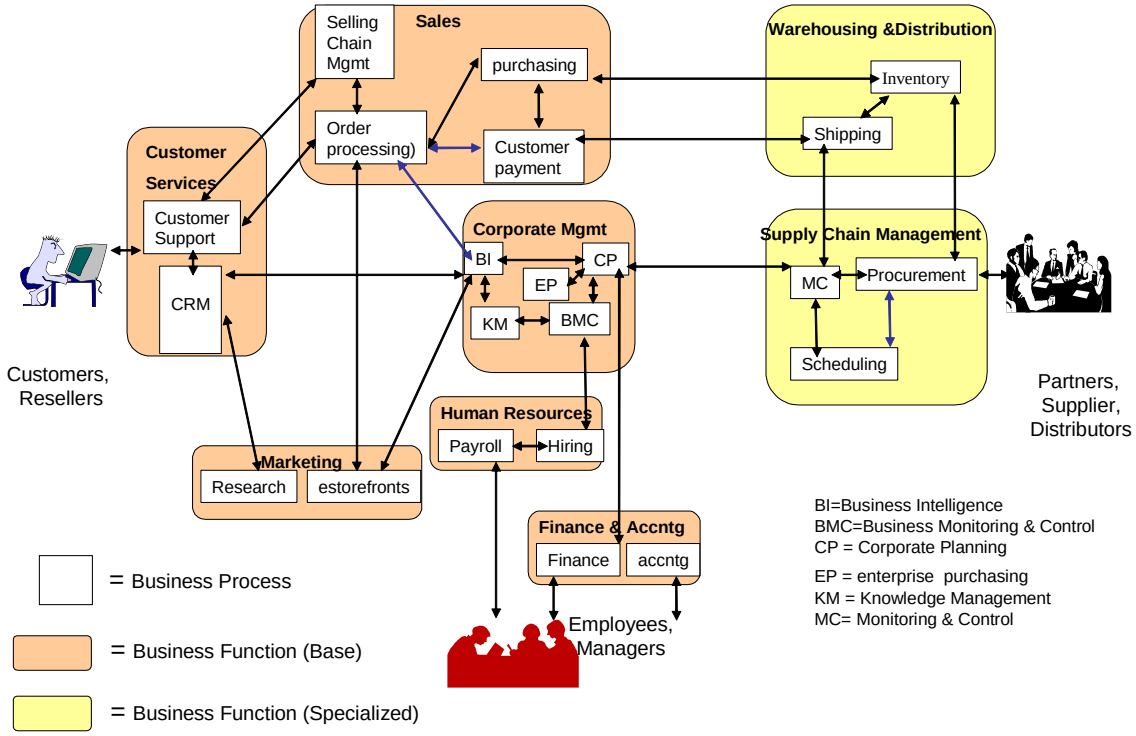


Figure 5-7: Sample Business Process Pattern (BPP) for a Retail Store

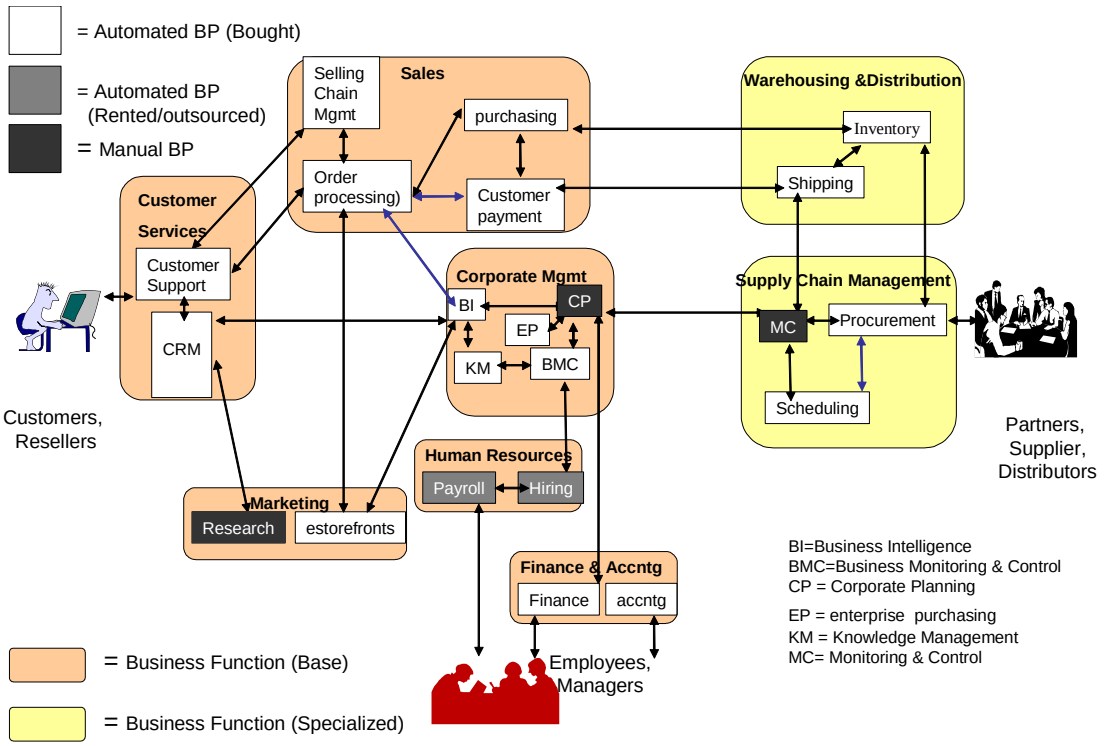


Figure 5-8: Enterprise Application Pattern (EAP) of a Retail Store

5.4.2 Common versus Industry Specific Enterprise Applications

Some enterprise applications are common to all industry sectors while others are specific to some industry sectors. Common enterprise applications, also known as *horizontal* enterprise applications, basically automate common business processes in different industry sectors. An example of common enterprise applications is PeopleSoft Human Resource (HR) application package that is being used by companies in retail, healthcare, manufacturing, and many other sectors. Similarly, industry specific applications, also known as *vertical* enterprise applications, automate industry specific business processes. Examples of such applications are patient care systems in healthcare and material requirement planning systems in manufacturing sectors.

5.4.2.1 Healthcare Specific Enterprise Applications

Figure 5-9 is a high level view of business processes and their interactions for the healthcare, i.e., hospitals industry. This pattern shows the common (darker rounded edges) and industry specific (lighter rounded edges) business processes. Chapter 4 discussed this topic and highlighted the differences between the clinical and administrative aspects of healthcare systems.

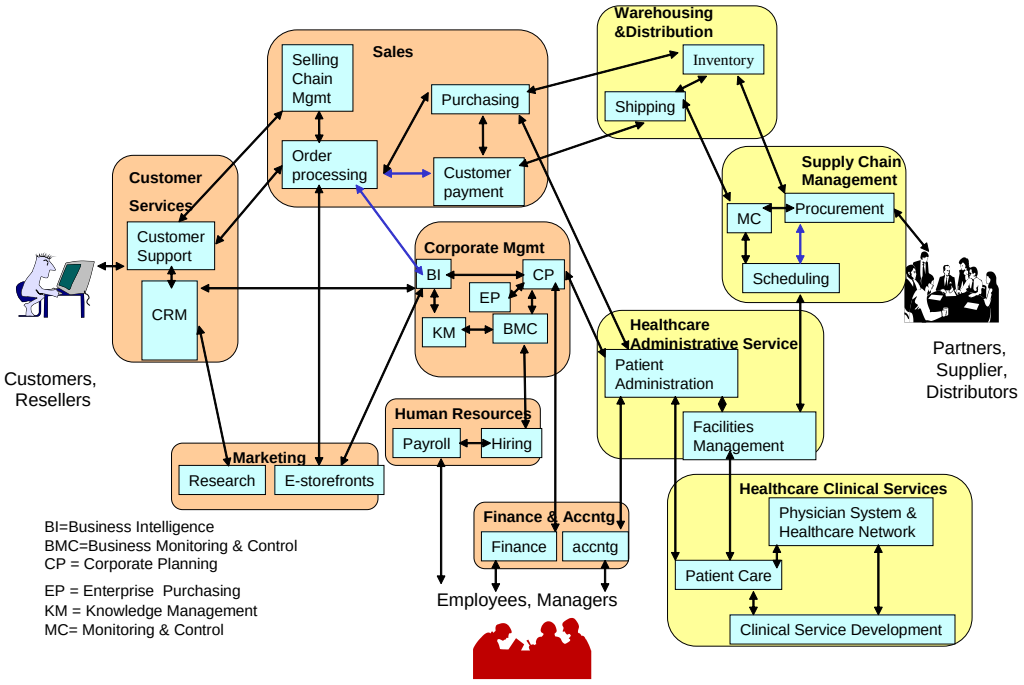


Figure 5-9: Enterprise Business Pattern for Healthcare Industries

The clinical services focus on patient health and primarily interact with:

- Patient administration services to assure that the admitted patients are provided proper care.
- Facilities management to assure that appropriate facilities are available for the admitted patients.

Healthcare administrative services are responsible for managing the administrative aspects of healthcare business. As shown in the figure, healthcare administrative services interface with:

- Patient care: the objective of these services is to facilitate the clinical services needed by the patient.
- Purchasing and accounting: customers have to agree to pay for the healthcare services to be offered.
- Corporate planning (CP): all healthcare services (clinical plus administrative) have to be approved by the company administration.

5.4.2.2 Manufacturing Specific Enterprise Applications

Figure 5-10 is a high level view of business processes and their interactions for the manufacturing industry. This pattern also shows the common (darker rounded edges) and industry specific (lighter rounded edges) business processes. Chapter 4 discussed this topic and identified two manufacturing specific business functional areas: manufacturing logistics and manufacturing production services. Manufacturing logistics is responsible for maintaining the quality of products manufactured, minimizing risks to the company that may be incurred due to the manufactured products, and managing the product life cycle and data resources. As shown, logistic services interact with:

- Monitoring and Control (MC) activities of supply chain management. In particular, the quality assurance (QA) deals directly with MC to assure that supply chain pressures do not decrease quality of products.

- Materials planning of manufacturing production. In particular, product life cycle management (PLM) activities feed directly into materials planning because different stages of a product ("finished goods") need different types of materials.

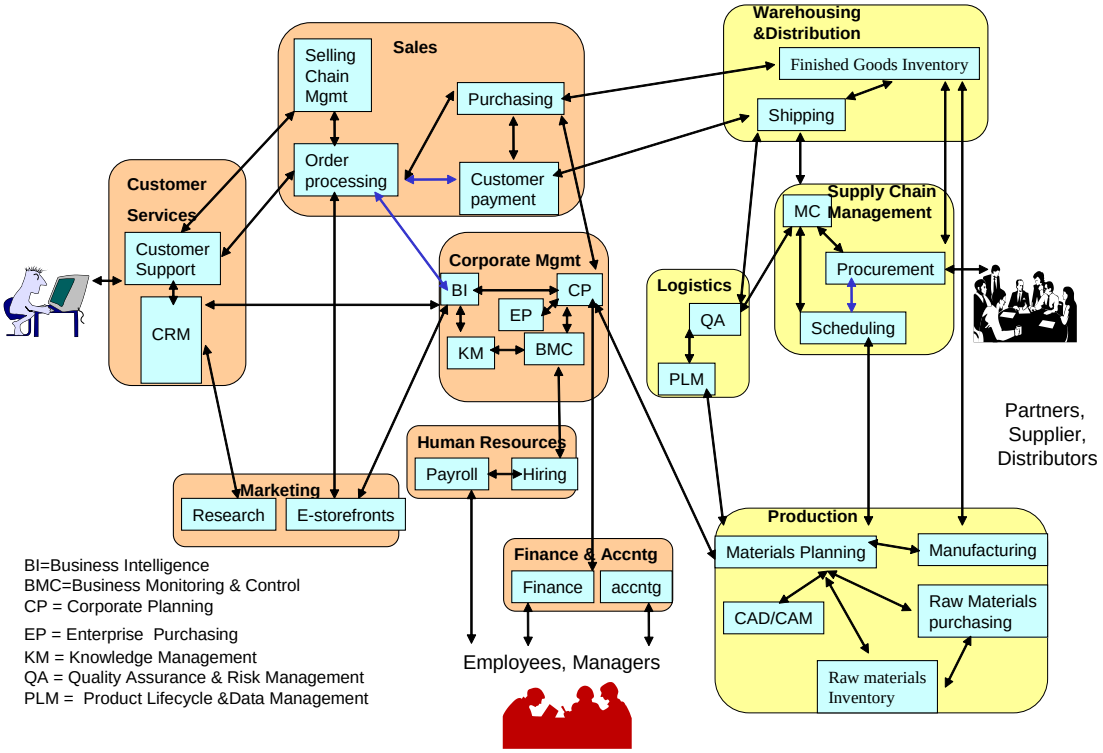


Figure 5-10: Enterprise Business Pattern for Manufacturing

Manufacturing production is the core manufacturing activity that converts raw materials into finished goods -- it is responsible for the actual process of producing the firm's goods and services. Manufacturing and production systems deal with materials requirement planning, CAD, CAM, raw materials inventory, and raw materials purchasing (see figure). As shown in the figure, manufacturing production processes interact with:

- Supply chain management to assure that the suppliers provide the products needed for purchasing
- Warehousing and inventory to update the finished goods inventory whenever new goods are produced
- Logistics for quality assurance and PLM activities
- Corporate planning (CP) to make sure that the corporate management is aware of long range needs of manufacturing activities

5.4.3 A Closer Look at Enterprise Applications

Figure 5-11 shows a more detailed view of the C2B, B2B, B2E, C2C patterns. Let us revisit the main ideas before discussing the applications that support these patterns:

Customer to Business (C2B): In this case, the customers (consumers) buy, sell, and receive other business services from the businesses. Examples include several DOTCOM companies such as amazon.com (for buying practically anything online), ebay.com (a popular site for buying numerous

products), shop.com (for buying groceries), and Flowers.com (for buying flowers). This pattern covers two parts:

- *Consumer information services* that concentrate mainly on providing information to the customers. This includes Web advertising and customer support.
- *Consumer online purchasing* that allows customers to buy goods and services online. This is at the core of C2B e-commerce.

Business to Business/Government (B2B or B2G): In this case, businesses interact with each other for activities such as order processing, purchase systems, inventory management, billing/payment, shipping/receiving, and supply chain management. Examples of B2B activities can be found in companies that use traditional EDI (Electronic Data Interchange) systems for order processing and invoices, such as Amazon and Dell Computers that rely heavily on information technologies to conduct business between partners. One of the businesses may be Government, thus the term B2G is used in this context. B2B/B2G activities fall into two broad categories:

- *B2B direct* where the business activities are conducted directly between trading partners. This includes the typical supply chains and exchanges between businesses and their partners where the parties know each other and have already established business relationships.
- *B2B indirect* in which the trade partners use emarkets as intermediaries. This is also known as *Business to Network (B2N)* interactions where you interact with a trading network. In real life, it is similar to going to a shopping center where the actual shops may change. Emarkets are examples of B2N trading, because suppliers and buyers can form a trading network to buy and sell from each other.

Business to Employee (B2E): This represents the internal business services of an organization and involves applications that have been known as "back-end" applications such as payrolls, material requirement plannings, marketing information systems, etc. Enterprise Resource Planning (ERP) is part of B2E.

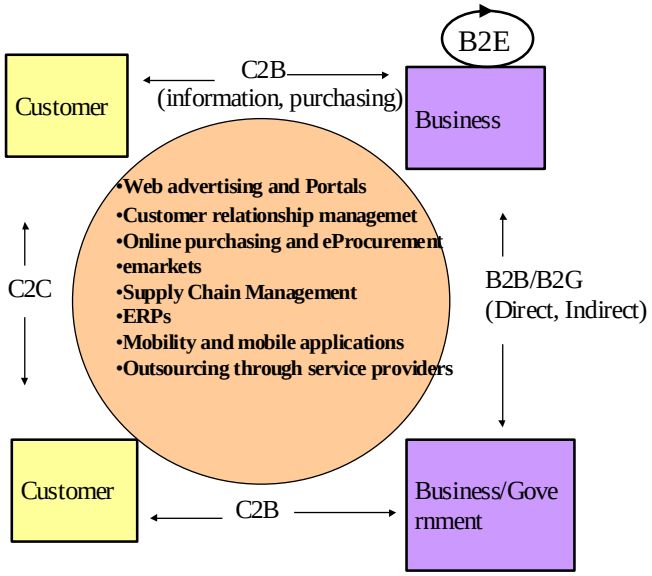


Figure 5-11: Modern Enterprise Applications

Customer to Customer (C2C): In this case, the customers (consumers) conduct business with each other directly or through intermediaries. Examples are auction sites such as E-bay and trading hubs

such as COW.com. As compared to B2B and C2B activities, C2C activities in E-business are relatively new, but expected to grow in the marketplace.

The exchanges between the players (consumers and businesses) can be two tiered (C2B, B2B, C2C) or three tiered (C2B2C, for example). In some cases, such as supply chains and trading networks, there can be n-tiered exchanges where n>2. The portals, customer relationship management (CRM), online purchasing, supply chain management, and other enterprise resource planning (ERP) systems and other business patterns are shown in table 5-3. The top row of this table shows the various business patterns. These business patterns are a good way to introduce the EB applications. In reality, most common EB applications are "composite patterns" that comprise the basic patterns. This table shows, for example, that Web advertising can be described in terms of C2B-Information, B2B-Direct, and B2E. This table also illustrates many applications that contain almost all functionality on one website. For example, many websites provide composite functionality where you can look at informational articles, browse product specific information, add your customer profile, order some product, get a billing/shipping confirmation, and then link to a shipping website to track your order. We will explain the entries in this table within the contents of this chapter.

Table 5-3: Business Applications in Terms of Business Patterns

Business Patterns / Business Applications	C2B-Information	C2B-Purchasing	B2B – Direct	B2B-Indirect	B2E	C2C
Web advertising and Portals	X		X		X	
Customer Relationship Management (CRM)	X		X	X	X	
Online Purchasing and EProcurement	X	X	X	X	X	
Electronic marketplaces and trading hubs	X	X		X	X	
Supply Chain Management			X	X	X	
Enterprise Resource Planning (ERP) systems					X	
Data Warehouses and Data Mining	X	X	X	X	X	X
Outsourced applications	X	X	X	X	X	X
Mobility and mobile applications	X	X	X	X	X	X

Note: Many real life applications span the C2B, B2B and B2E patterns.

Enterprise Applications for Real-Time Enterprises

Real-time is an important dimension of next generation enterprises. The interest in real-time corporations is stimulating diverse technical sectors such as CRM, ERP, business intelligence, and supply-chain solutions. For instance, enterprises are becoming far less interested in historical and transactional data from just one portion of their business. Thus, vendors are attempting to spread solutions across applications. Analytics -- the field of providing business analysis tools -- is not limited to one department; instead it focuses on digesting data extracted from real-time applications across the enterprise.

Business partnerships have been formed to provide enterprise-wide views. For example, Alphablox has formed a partnership with IBM to integrate Alphablox's infrastructure software into IBM's WebSphere application server for enterprise wide functionality. Similarly, application vendors are amending offerings to align themselves to real-time enterprises. Yantra Corp., for example, unveiled a new version of its Multi-Enterprise Commerce Management Suite -- an order and inventory management package that combines data in real time across enterprise divisions and external channels. As another example, supply-chain company CommerceEvents is offering its AdaptLink integration platform which is built in response to real-time events such as shipment cancellations or incomplete orders, while providing support for Web services, wireless, and AIDC (Automatic Identification and Data Capture) technologies.

Two applications are getting the most attention for real-time enterprises: supply chain and CRM. For example, APL Direct Logistics, a Jacksonville, Florida-based fulfillment company that ships merchandise to consumers, has installed a real-time enterprise software package for real-time supply chain tracking. APL uses a real-time system from Yantra, Inc. to move data across payment processing, authorization, and settlement systems and trigger alerts if packages do not arrive at their destination as promised. The company has eliminated batch feeds to its suppliers. CRM systems are already offering functionality to link companies, customers, and suppliers together to form the basis for achieving the real-time enterprise. Companies such as General Electric are using real-time wireless solutions that are linked to their technical service reps to meet customer support-level agreements. These reps report savings of one hour per day as needed information gets delivered to them wirelessly in real time.

Sources:

- "The Economics Of The Real-Time Enterprise", Forbes Report, Sep 23, 2014, link = http://www.forbes.com/sites/oracle/2014/09/23/the-economics-of-the-real-time-enterprise/#3fae1793153c
- Peter Fingar, P. and Bellini, J., "The Real-Time Enterprise:", Wiley, 2004
- Jones, J., "Real Time's Trickle-Down Effect", Infoworld, January 17, 2002

5.5 Business Process Automation Strategies through BRODE (Buy, Rent, Outsource, Develop, Extend)

Business process automation (BPA) is the process of using packaged software to automate business processes. These packages may be the well known ERP (enterprise resource planning) systems, a BPM system, or a combination. For example, payrolls can be automated by using a payroll package from PeopleSoft. However, to automate a supply chain system between multiple suppliers, it may be necessary to use a BPM or a business rule management system. The most common strategies used in BPA are (see Figure 5-12):

- buy software package (whatever is needed),
- rent the needed package from an application service provider (ASP),
- outsource software development for the chosen BP,
- develop software in-house, and
- extend/re-engineer existing systems.

The various BRODE (buy, rent, outsource, develop, develop, extend) strategies are briefly discussed here, and more details will be provided later.

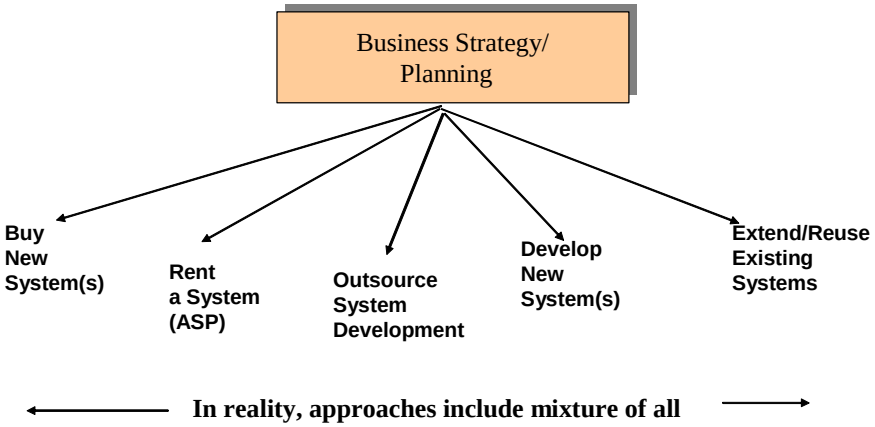


Figure 5-12: Options to Translate Strategies to Working Solutions- BRODE (Buy, Rent, Outsource, Develop, Extend)

5.5.1 Buy Software

A great deal of prewritten software is commercially available for sale in the marketplace. It is a good idea to buy software packages, when such software is readily available at a reasonable cost from reputable suppliers and meets a majority or all of the business needs. Most such software is geared towards common requirements – customization and modification of software to meet an organization's needs may be necessary. The costs and benefits of bought software must be weighed. It is common to send a request for proposal (RFP) -- detailed questions – to vendors before purchasing packaged software.

The movement of "open software" should be mentioned here. It is a good idea to investigate open source software, because it is theoretically free. However, the cost of maintenance (from companies such as Red Hat) must be kept in mind. In addition, some open source software may not be robust and may require extensive debugging to operate.

Additional guidelines to be considered for purchasing software packages are:

- It is a good idea to download a demo copy of the software, if available, and test it before purchasing.
- It is a good idea to allow a pilot phase for critical applications before deploying a purchased application for production use.
- Before buying a software package, it is a good idea to make sure that the software has proper documentation and technical support.

5.5.2 Rent Software through ASP

It is a good idea to rent software from an ASP (application service provider) for a cheap and a quick way of automating business activities. In general, renting software is one of the quickest ways of supporting 'on-demand' computing. In addition, renting software eliminates the need for in-house hardware, software, and technical support staff; hence, reducing costs. However, it is generally not a good idea to rent software services that are crucial to your company's success and/or require high level of security. Renting software makes sense if a company:

- Needs software very quickly
- Needs software for a short time

- Does not want to spend a great deal of money to buy a software package
- Will not distinguish itself by automating this process
- Serious security and intellectual property issues are not raised

Once a decision to outsource has been made, it is a good idea to develop detailed service level agreements (SLA) with the ASP that specify the level of support, the name of the contact, clauses for discontinuation and cancellation, etc. On the other hand, ASPs should provide configurable applications, secure Internet access to applications, online training courses, use of "failover" backup servers to provide 24x7 continuous application uptime, disaster recovery, load balancing, hotline support, and software upgrades/maintenance.

In practice, after renting an application from an ASP, many companies choose to buy the software based on experience. Thus, renting can be used to test software before purchasing. Software packages can be rented from:

- ASPs such as Corio (www.corio.com), now owned by IBM.
- Software providers such as SAP, Oracle, etc. Most software providers are now allowing rentals by using 'software as a service (SaaS)' model.
- Websites and rental locations commonly advertised on Google.

5.5.3 Outsource Software Development

This approach is useful when a company cannot buy or rent software and does not have the expertise to build software internally. Outsourcing software development allows a highly customized version built for your company. However, outsourcing software does not reduce the time for development. Thus, this approach should not be used if software is needed quickly.

The software development houses should be chosen after background checks of development houses and development contracts. After the application has been developed, the firm should test the application at its site and allow a pilot phase for critical applications. In particular, acceptance testing, phased development, and phased payment are important considerations.

5.5.4 Develop Software Yourself

Developing software in-house should be used if customized and specialized software can be developed by in-house technical staff. To develop software in-house, you need to assign software development tasks to developers, hire new staff and/or train the existing one. In addition, a software development and testing environment is needed. It is important to allow a pilot phase for critical applications.

Several special cases for developing in-house exist. In some cases, for example, end-users can develop applications with little help from technical specialists using 4th generation tools. In addition, specialized tools, environments, and skills are needed for developing web sites, portals, social networking sites or wireless applications.

5.5.5 Extend/Re-engineer Existing Software

This approach should be used if existing software can be customized and enhanced by in-house technical staff. To re-engineer software in-house, you need to assign software re-engineering tasks to

developers, hire new staff and/or train the existing staff. The re-engineered application should be allowed a pilot phase for critical applications.
Re-engineering of legacy applications is a major undertaking that requires a great deal of time and effort. Approaches based on business components and service oriented architectures (SOA) attempt to minimize this effort. As we will see, the basic idea is that both current and future IT systems will provide standard interfaces, thus allowing them to be linked more easily and flexibly. We will review this topic later in this book.

5.5.6 Application Matrix: A Final Look

The Application Matrix shown below has now been enriched by using the knowledge about different types of BRODE (Buy, Rent, Outsource, Develop, Extend) strategies. Basically, we have added more intelligence to different cells of the Matrix. This approach can be used to keep enriching this matrix with more information that results in a very powerful plan.

Table 5-4: Application Matrix – A High Level IT Applications Plan

	Application Package1	Application Package2	Application Package3	Application Package4	Manual Operations[
Business Process1	Operational (ERP, Rented)			Operational (ERP, Extended)	
Business Process2					Performed by Sally and John
Business Process 3				Decision Support (Web-based, Developed)	
Business Process4			Operational (Mobile, Bought)		
Business Process 5			Operational (Web-based)		

Time To Take a Break

- Information Systems & Applications
- Application Patterns and BRODE
- Web and Mobile Applications (Apps)
- Case Studies and Examples

Suggested Review Questions Before Proceeding

- What are Enterprise Application Patterns and how can they be used in Application Planning?

- Give one example of a common and one example of an industry specific enterprise application.
- What exactly is BRODE, explain through an example?
- What is the main advantage and disadvantage of buying software for automation?
- What is the main plus and main minus of renting software through ASP?
- What is the main plus and main minus of outsourcing software development?
- What is the main plus and main minus of developing software yourself?
- What is the main plus and main minus of extending existing software?

5.6 Composite Applications for Enterprises – A Closer Look

Most modern apps, as stated previously, are composites that use web browsers, mobile devices and AI capabilities. In fact, web, mobility and intelligence are different aspects (dimension) of the modern applications that can be accessed over web and wireless networks. Very large number of composite apps are commercially available at the time of this writing in almost all sectors of our life e.g., health, education, public safety, public welfare, transportation, agriculture, travel, entertainment and the like. Specific examples of such applications are:

- Smartphones and smart watches have a wide range of sensors with many connectivity options (Cell, WiFi, Bluetooth, Zigbee, etc) and the capacity to learn -- these devices can automatically monitor our movements, location, and workouts throughout the day and provide suggestions.
- All web applications use web browsers to access remotely located enterprise applications anywhere on the Net. These applications use the classical web technologies (e.g., web browsers, web servers, HTML and HTTP) to access remotely located programs and databases. These applications may also use Web2.0 capabilities to invoke social media and web services.
- Millions of mobile apps can be downloaded from Google Play and Apple Store to Androids and I-phones. These apps may utilize the Internet of Things technologies to access remotely located apps and data stored on sensors, coffee machines, dishwashers, and virtually all types of devices.
- A large number of clerical applications at present are being converted to smart applications that are very knowledgeable about the subject matter and also have the ability to detect any special situations, adjust accordingly and do a better job in the next round. These applications are being used to support smart cities, smart towns, smart tourism, and many other smart enterprises.

The following discussions provide additional information about the web, mobility, and smartness dimensions of composite applications.

5.6.1 Web-based Applications – An e-Commerce Example

Figure 5-13 illustrates a typical Web-based online purchasing system. This example of "Clothes.com" shows how the HTML documents on the server are used by the browser to display the content and then invoke a purchasing system through a gateway. Once HTML documents have been created on the Web server, an Internet user can browse through them as if he/she is flipping through a catalog. As shown in Figure 5-13, the URL consists of three components: the protocol (http), the Web server name (clothes.com), and the needed document (overview.html). HTTP provides the transfer of information between the Web users (the clients) and the Web Servers. A "Purchasing Gateway" software is developed and installed at the Web site to get into action when a user clicks on the

"purchase" button. It prompts the user with a form (HTML supports forms) to fill out. The gateway program uses this form information to interact with a purchasing system that processes the purchase. The role of the gateway is to provide a Web interface to the purchasing system.

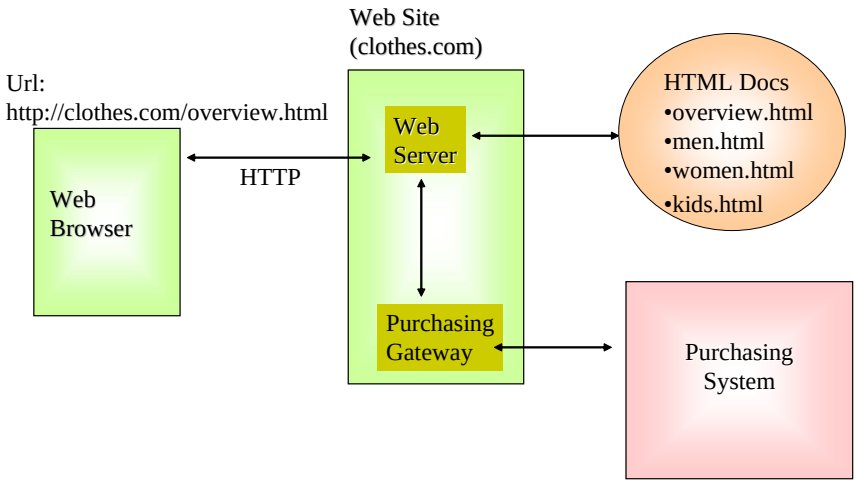


Figure 5-13: Conceptual View of Web-based Purchasing System

5.6.1.1 From eCommerce to K(Knowledge) Commerce – An Example

Traditional ERP systems focus on physical resources. Knowledge systems concentrate on knowledge as an enterprise resource. In particular, there is a growth in the "'Knowledge Market" where companies can advertise, sell, and buy knowledge over the Web. For example, consider a manufacturing company that wants to setup a plant in China. To accomplish this, the company needs the answers to many questions that span legal, management, technical, and marketing issues such as what are the legal restrictions, are the needed materials available, what type of workforce is available in that region, and how to best market the products.

To answer questions like these, information needs to be exchanged between the suppliers and the consumers. This leads to "knowledge (K) commerce", where knowledge is bought and sold over the net. Technically, K-commerce would need an extensive ontology (vocabulary) and semantic web agents that could engage in K-trade.

Source: Mentzas, G., et al, "Knowledge Services on the Semantic Web", CACM, October 2007, pp. 53-58

5.6.1.2 Internet of Things and Web of Things Applications – Home of the Future

Internet of Things (IoTs) and Web of Things (WoTs) provides Internet and web services on sensors, RFID tagged devices, refrigerators, vehicles, machines, appliances, and practically anything that stays still, moves or flies. Basically:

- Internet of Things (IOTs) is concerned with interconnecting "things" – mostly real world objects such as wrist watches, refrigerators, TVs, heaters, and sensors. These things basically have an Internet Protocol (IP) address, so that they can be discovered and interconnected through the Internet routers.
- Web of Things (WOTs) provides an Application Layer for the IOTs, so that they can use the web apps. Simply stated, the things can now have browsers and can upload and download

web contents from web servers. Instead of re-inventing completely new standards, the Web of Things reuses existing and well-known Web standards such as HTTP and HTML.

An example of using IoTs and WoTs is the "Home of the Future" with the following possible scenario:

- An alarm clock is Web enabled and has a browser that can connect to different Websites to show flight times, weather, and other information sources. The alarm clock can also send a signal to your shower, so that it gets warm by the time you step into the shower.
- The shower itself is web enabled and can send a command to your coffee machine to prepare the coffee ahead of time.
- The refrigerator is also web enabled and can detect when you are running out of milk and can automatically place an order to the nearby grocery store.

5.6.2 Mobile Applications for Enterprises – A Brief Overview

Mobile apps typically run on handsets and other mobile devices. In general, these applications are categorized as the following:

- Standalone mobile apps that are downloaded to the handset and then operate in a "disconnected" mode
- Mobile e-business applications (MEBAs) that provide access to back-end ebusiness applications such as customer relationship management and supply chain management
- Location-sensitive applications that typically use GPS to provide location-sensitive information (e.g., the nearest gas station)

5.6.2.1 Mobile Enterprise Business Applications (MEBAs)

An EBA (Enterprise Business Application) is a set of business software applications that provides functionality and services for the key-front and back-office initiatives of modern enterprise. EBAs include enterprise resource planning, customer relationship management, and supply chain management applications, among others.

Mobile Enterprise Business Applications (MEBAs) add the mobility dimension to EBAs. MEBAs enable the core enterprise applications (ERPs, SCMs, CRMs, etc.) for availability to employees, partners, and customers who could be roaming around the globe. This idea may seem potentially threatening to some, but MEBAs are becoming a reality very quickly. Use of mobile devices such as laptop computers, personal digital assistants (PDAs), and digital telephones with Internet and wireless data access is widespread. The ability to support these highly mobile devices as part of an extended enterprise application strategy is critical. The mobile e-Business applications enable mobile customers to conduct transactions with their financial services, telecommunications, or product suppliers of choice.

MEBAs create many opportunities such as business and revenue growth, support for new types of customers, and conformance to different social models of how and where business is conducted. But MEBAs also introduce several risks. Security and unauthorized access is a natural issue. In addition, highly mobile organizations need to manage the scores of laptops, as well as the data held on mobile devices. In particular, these organizations need to handle data synchronization, file distribution, software distribution, and systems management tools needed for mobile applications. This problem will only grow as new types of devices become part of the extended enterprise. Some companies such as Synchrologic Inc., provide tools to manage the synchronization, distribution, and data control to mobile users on a variety of devices.

The Internet infrastructure of the mobile enterprise needs to deliver access to corporate information, data, and services to users regardless of location or device type. The architecture must also handle data transfer, file access and distribution, and synchronization throughout the system. This architecture should accommodate all device types used to manage data remotely, and should also be designed to provide an access point - ideally a portal - that serves as an entry point for users.

5.6.2.2 Mobile Commerce (M-Commerce)

M-Commerce describes the growing phenomenon of using wireless mobile devices such as digital phones and PDAs to search the Internet, access data and information, and conduct purchasing or business transactions. M-Commerce is fueled by the extreme popularity of mobile devices such as laptop computers and cellular phones.

Here are some examples of m-commerce:

- You never have to wrestle with cables to connect to e-commerce sites. You can connect your mobile devices to any e-commerce site.
- You can connect to your corporate network or surf the net for bargains while waiting in the doctor's office, having your car serviced, or even traveling around the globe.
- Your docked mobile PC and PDA can automatically synchronize your purchasing information as soon as you walk through your office door.

5.6.2.3 Location-Sensitive Applications

Many location-sensitive applications, also known as location-based services (LBSs), are available at present. Examples of these applications in m-business and m-government are:

- E911 services that provide location of a user who calls 911 emergency phone number from his/her cellular phone. Regulatory agencies are also requiring mobile operators to provide accurate locations for emergency purposes and public safety to support E911.
- Search for the most relevant information according to your location – e.g., "I am looking for a shop within 5 miles of my home", "what movies can I see in my neighborhood and how far will I have to travel", and "find the nearest hotel, or check what else is in the neighborhood".
- Display maps and calculate routes based on where you are located. In addition, you can improve transportation of goods by locating the nearest pick-up point and planning routes based on real-time traffic situations; or by reporting alerts in case of changing traffic patterns, and adjusting the route.
- Some limousine companies are tracking their cars and can detect unauthorized off-route vehicle stops or off-route activities – for example, if a limo driver calls and says that he is at the airport, the LBS can show if he is at home (technology is not good for everyone and every situation !).
- Advertising and notification services relevant to the user's location. For example, if a particular area has been declared hazardous, SMS messages can be sent to the citizens in the area.
- City Guides can be shown with location of nearby historical structures/buildings, government offices, and interactive commercial services if you are in certain part of the city.
- Permit requirements can be obtained based on location. For example, permits for digging an area with underground pipes or cables can be obtained easily. LBS makes it easier to obtain a drilling permit in a rural area and to register the associated filings with ground water districts and natural resources/environmental entities.
- Insurance risk analysis can be conducted based on locations. Tools such as Where@Risk, for example, provide a location match to the appropriate risk criteria that can be used by insurance adjusters to develop policies.

There are numerous applications that are driving the developments of LBS. The mobile operators are expecting significant revenues by offering a number of location-based services such as positional commerce. Location-sensitive information can be bundled into mobile commerce and other applications as a value-added service.

To meet these demands, a wide range of techniques for location management have been introduced. The oldest and by far the most commonly used technique is based on cell ID (i.e., a cellular user is located by the cell he/she is in). Other techniques include Assisted Global Positioning System (AGPS), Angle of Arrival (AOA), and variants of time taken (these techniques estimate distance by determining the time it takes for the signal to reach the user). These techniques yield different location accuracy (typical ranges are 50 meters to several kilometers).

While LBSs can provide valuable capabilities to support mobile applications for business as well as government initiatives, they also raise additional privacy concerns for general public use. In essence, an LBS database can have a complete log of what locations you visited in a day and how long you stayed at each location. Naturally, the benefits need to be balanced against the privacy concerns.

5.6.2.4 Wireless Sensor Network (WSN) Applications and Internet of Things

Sensors are small devices that can be used to measure temperature, humidity, motion, color changes in a painting, or any other measurable thing. Most of the current and future applications of sensors are in the area of Internet of Things and Web of Things. The sensors in IOTs and WOTs, also called motes, are installed in particular locations or can be "sprayed" in a particular area to gather information. Sensors by themselves are not very powerful -- they just sit around and collect information. The real power of sensors comes from wireless sensor networks (WSNs) which are formed when these tiny sensors start communicating with each other through wireless. WSNs can shuffle the information collected through thousands of sensors and transfer it to the public Internet or a corporate LAN. The information can finally be collected at a control point where it can be analyzed (Figure 5-14). Although most WSNs consist of very small processors communicating over slow and cheap wireless networks, WSNs can be used in several situations.

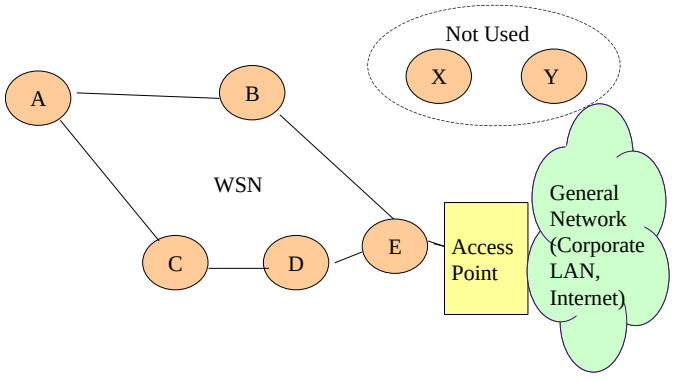


Figure 5-14: A Sample Wireless Sensor Network

Thousands of tiny low-power sensor devices are typically spread over large areas to form WSNs in many practical applications. The sensors of WSNs collaborate with each other to monitor the environment, guide vehicles, and detect faults in buildings and bridges. Some of the examples are:

- In many military situations, sensors are "sprayed" in a battlefield or an enemy area to detect and record certain activities and send information back to control centers for analysis and appropriate action.
- WSNs are being considered as an alternate to landmines where the sensors can detect enemy vehicles. This is much safer than landmines, which stay long after the conflict is over and are hazardous to the people living in that area. In contrast, sensors are harmless after conflict, because they simply sit around collecting useless data until their batteries die.
- WSNs are also being used in medical situations for patient monitoring. For example, patient heart rate and blood oxygen levels are monitored by sensors. This information is gathered from different patients and sent to the PDA of an attending physician [Jovanov 2001].
- WSNs can be used in supply chain management systems. For example, Sears Canada has completed an experiment that uses WSNs to detect if an item is damaged on transit before the customer gets it.
- WSNs are also used to detect temperature fluctuations, earthquakes, automobile speeds, and cattle activities in fields. Many civilian applications of WSNs have been developed and deployed.

5.6.2.5 RFID Applications

RFID (Radio Frequency Identification) systems have been used in a variety of applications. An RFID system typically consists of the following components:

- A tag or label that is embedded with a single chip computer and an antenna. The antenna is so small that it can be printed on the tag with carbon-based inks. RFID tags (chip plus antenna) are also called "transponders". The tag is somewhat similar to the commonly used bar code labels. However, an RFID tag has more intelligence. There are two typesof tags. "Passive" tags, the type of tags commonly used in retail stores and supply chain systems, which pick up enough energy from the radio to operate and communicate back to the radio. "Active" tags have an embedded battery and offer the advantage of longer-range communications and can communicate with other tags. In this case, a WSN can be formed between the RFID tags.
- A short range radio (e.g., a wireless LAN such as Bluetooth) that communicates with the tag. The radio receiver is usually an RFID reader, or detector/interrogator, that gets the information from the RFID tag and then sends it to a back-end system for processing. An RFID system's "read range" — the distance a tag must be from the detector/reader — varies from a few centimeters to tens of meters, depending on frequency used, whether a tag is active or passive, and the type of antenna used on the reader.

In many practical applications, an RFID reader transmits a wireless signal to the RFID transponder, which responds in milliseconds with a unique identification code sent to the reader. The reader sends this code to the host system for processing. RFID is being used increasingly instead of the old bar-code systems, because unlike bar code-based tracking systems, an RFID system can read the information on a tag without requiring line of sight and without the need for a particular orientation. That means RFID systems can be largely automated, reducing the need for manual scanning. In addition, RFID tags hold much more data than the bar code labels.

Additional information about RFID can be found at www.rf-id.com.

5.6.3 The Intelligent ("Smart") Applications

Intelligent (Smart) systems and applications exploit a mixture of agility, detection, and learning capabilities to satisfy the end user needs. For the purpose of this book, we will use the basic idea that smart systems (smart people, smart applications, smart cars, smart cities, smart enterprises, etc) must

have the following key features of human intelligence displayed in Figure 5-15 (this concept is roughly based on the IBM Smarter Planet Initiative):

- Knowledge (K): familiarity and awareness or understanding of someone or something
- Detection (D): ability to discover, sense or feel a situation such as a problem or opportunity
- Adjustment (A): ability to change and act accordingly, e.g., stop and choose a different strategy
- Learn (L): the capability to gain more knowledge and to use the knowledge to do a better job in the future.

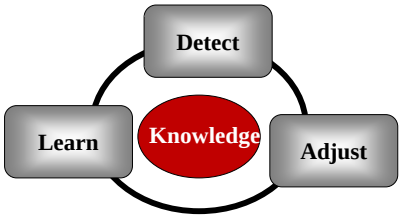


Figure 5-15: Key Features of an Intelligent System

Although additional capabilities can be added, we will use this simple Know-Detect-Adjust-Learn (KDAL) cycle to characterize smart applications. For example, a Smart Environmental Protection Application will have the following capabilities:

- Know about the pollution levels that are dangerous to human beings
- Detect pollution concentration in city streets (sensors and automatic alarms when the radiation level rises to a dangerous level).
- Adjust the system to shut down some sources
- Learn what caused the pollution to prevent it in future

Let us consider an example that illustrates how a clerical inventory application can be converted into a smart inventory application. Suppose that you have a simple clerical inventory system that has a database of items and the ability to display and update the inventory. Your boss wants you to convert it to a smart (intelligent) inventory management system. The following table shows how it could be done by first just adding knowledge capabilities about the suppliers, and then adding the DAL capabilities to detect any problems with the suppliers, adjusting accordingly, and then learning to do it better in the next round. Obviously, the intelligent inventory system is of much higher value to the company. The system can be made smarter by adding more knowledge, detection, adjustment, and learning capabilities.

Clerical Inventory System	*Knowledge-based Inventory Systems*	*Intelligent Inventory System*
• A Database of Items • Ability to display and update the inventory	Clerical system capabilities plus • Knowledge about the suppliers and schedule of the delivery system	Knowledge plus DAL Capabilities • Detect any problems based on past performance of suppliers • Adjust suppliers based on rules about when to change the suppliers • Learn about the best and worst suppliers and put this knowledge back into the system

Time to Take a Break

- ✓ • Information Systems & Applications
- ✓ • Application Patterns and BRODE
- ✓ • Web and Mobile Applications (Apps)
- • Case Studies and Examples

Suggested Review Questions Before Proceeding

- What is the basic difference between e-Business and e-Commerce?
- What is the difference between eCommerce and K(Knowledge) Commerce?
- Find one Web of Things Application besides Home of the Future.
- Give one example of a Location-Sensitive Application.
- What is the relationship between Wireless Sensor Network (WSN) and Internet of Things?
- What are MEBAs and why are they important?
- Is the following statement true: more fundamentally new mobile applications will be developed in the future instead of mobility as another feature of existing applications? Explain your reasons.

5.7 Case Studies and Examples

5.7.1 Enterprise Applications for Smart Cities

The smart city industry is projected to be a $400 billion market by 2020, with 600 cities worldwide. These cities are highly interconnected entities where many automated activities (applications) have to interact with each other. Viewing smart city as an enterprise, a large number of enterprise applications support different features of a smart city such as smart energy management, smart healthcare, smart transportation, smart citizen services, and others. These applications heavily rely on IoTs, sensors, data analytics, machine learning and the like. To explore the role of these applications and also to understand better how the technologies are supporting smart cities, let us use the KDAL (Knowledge, Detection, Adjustment, Learning) features of smart systems, defined above, to describe smart energy and smart health.

Example1: Smart Energy Applications.

- Knowledge (K) is accumulated through data collection from IoTs and sensors, analysis of the data and conversion to information (e.g., which areas of the city are consuming more energy than others), and then to knowledge by adding rules (e.g., if the energy consumption continues at this rate, the city will run out of it in 3 years)
- Detection of energy spikes through sensors located in different parts of the city
- Adjustment and containment of energy spikes through appropriate procedures and regulations

- Learning, through machine learning techniques, to better understand where the energy spikes usually occur and under which circumstances --- this information can be used for better management of the power grid

Example2: Smart Public Healthcare Applications

- Knowledge (K) is accumulated through data collection from electronic health records that show how many patients are being treated by which healthcare providers, analysis of the data and conversion to information (e.g., which population is underserved), and then to knowledge by adding rules (i.e., if this population keeps being ignored, it will have major socio-economic impact on the city)
- Detection of spikes through sensors (e.g., sudden increase in cholera or opiod cases)
- Adjustment through quick actions (e.g., outbreaks in small islands need immediate attention because health issues seriously impact tourism business)
- Learning to understand why the spikes happened (e.g., lack of controls on medications) and improving procedures so that it can be handled better in the next round

Similar KDAL-based approaches can be envisioned to better understand and implement smart transportation, smart citizen and government services, and smart tourism.

Blockchains for Smart Cities. Blockchains are being used in smart cities for secure exchanges and especially as a protection against cyberattacks [Pelton & Singh 2019]. In particular, blockchain apps are being used for secure collaborations between different smart city units to enforce accountability. A blockchain basically maintains a secure and accountable *ledger* of activities between different participants (e.g., transportation of medications between different healthcare agencies). Integration of blockchains into smart cities could better connect all city services while boosting security against cyberattacks. *Smart contracts*, based on blockchain can help with billing, processing transactions and managing B2B collaborations. In a smart contract, the terms of the agreement between buyer and seller are directly written into lines of code. Thus, a smart contract *executes* the agreement automatically (e.g., the sales commission of the seller is automatically calculated and deducted by each transaction). Smart contracts permit trusted transactions and agreements to be carried out among different parties without the need for a mediating third party, making the process safer, cheaper and faster. Blockchain can also be used in smart grids to facilitate secure energy sharing between multiple units of a smart city.

To summarize, the smart city industry is projected to be a $400 billion market by 2020 with many opportunities for using IoTs, sensors, AI technologies, and data analytics. Smart cities are expensive undertakings but initiatives such as smart streetlights are a good starting point for many cities since the LED lights pay for themselves within a few years. It should also be noted that most smart city projects at present are focusing on large metropolitan areas in developed countries. Many smart town projects are needed in the developing countries at the time of this writing.

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5.7.2 Some RFID Applications

In many areas, RFID-based passes are used in highway toll booths for automobiles. For example, in New Jersey, an EZPass system is being used heavily on the NJ Turnpike. An EZPass is bought and is pasted on the front windshield of a car. When the car approaches a toll booth, it slows down so that the RFID reader on the toll booth can read the EZPass number. In some stations, overhead readers can detect the code with the vehicle traveling at full speed (55-65mph). If the user tag is missing or unreadable, a friendly trooper may stop the vehicle for investigation. A trooper is always nearby to help ☺. As soon as this is done, the reader posts this transaction to a database and then gives a signal to the toll booth that gives the green light to the automobile. The auto owner gets a monthly bill from EZPass for all transactions. This whole process takes less than a minute – usually the car just slows down. In the older manual system, an auto driver gets a toll ticket when she gets on the NJ Turnpike, then before exiting, the driver stops, takes out her ticket, gives it to the toll booth attendant, pays the attendant, and then leaves. This may take several minutes. Similar systems are operating around the globe at present.

Many airlines are using RFID for airline baggage tracking. For example, British Airways has trialed a paper label-based RFID transponder. Each luggage has an RFID tag that is read by the RFID readers as the luggage moves on the belts. By using this system, more than 225,000 pieces of luggage are transferred successfully between airport hubs from Manchester and Munich to London's Heathrow airport with 100% accuracy. RFIDs are also used in tracking valuable assets. Unique RFID tags are installed on the asset and can be detected by RFID readers. If stolen, law enforcement agencies can be informed of the RFID serial numbers. For highly valuable assets, this information can be used for random checks at ports and other exit points within a country, thus preventing the asset from leaving the country.

A large number of case studies and examples of RFID have been published. The following are good sources:

- "RFID Technology Applications: Study RFID case studies, url: https://bin95.com/case_studies/RFID_Technology_Applications.htm (last viewed January 12, 2018)
- "25 RFID Case Studies Ebook", URLl: industrial-ebooks.com/Free-Downloads/25-RFID-Case-Studies-Ebook38.php

5.7.3 Case Study of Outsourcing through an Application Service Provider

Sunburst Hotels International Inc. owned and operated 87 hotels in 27 states, including some Comfort Inns and EconoLodges. The company could not perform all the complex functions required without the support of application software packages. The company needed an enterprise resource planning (ERP) system, but the cost to acquire and operate an ERP system from companies such as PeopleSoft was around $1.5 million. Most of the cost (around $1 million) was on computer hardware and software, because the Hotels had virtually no IT infrastructure. In addition, Oracle data management software for $500,000 was needed to support the PeopleSoft ERP system. There were also several other costs. For example, highly skilled staff would be needed to run and maintain these systems with a price tag of about $500,000. Even worse, how to locate and hire skilled staff in a competitive

marketplace across a large geographic area? To complicate the situation further, Sunburst was facing a minimum implementation period of six to eight months. Sunburst management was also familiar with the disasters, cost overruns, and long learning curves associated with the ERP systems.

With all this information and experience, the management opted to outsource the ERP system by using the USi application service provider (ASP). The main advantage was that Sunburst did not have to purchase and own its computers (except for PCs or network computers). The company also did not have to buy the PeopleSoft and Oracle software. In addition, the costs of building and maintaining a network were eliminated, because Sunburst accesses its ERP by using the Web browsers. Thus, the only Sunburst costs, in addition to the monthly rental, are for PCs, Web browsers, and telephone lines to connect to the Web. This eliminated most of Sunburst's infrastructure start-up costs. The monthly fees of ASPs vary (they can be from $30 to $500 per user per month or flat fees of $50K to $100K per month). This fee structure enables small companies to pay less, with their costs growing only as their companies grow. Staff costs were virtually eliminated by going to an ASP, because PeopleSoft software is owned and supported by USi. However, a few persons are typically assigned at the ASP customer sites to supervise the use of the outsourced system. The system was also up and running in only three months. In addition, the company was able to move slowly into using the ASP's software, trying out one function of the software package at a time.

But there are risks associated with using an ASP. Besides the relative trendiness of the ASPs, security and privacy are major concerns. Companies do not want to give their sensitive data to ASPs, and are concerned about access to sensitive data via the Public Internet. Some companies use private lines or use encryption over VPNs (Virtual Private Networks). Another concern about outsourcing is that the companies can be locked into the ASP vendor, placing them at the ASP's mercy. However, since the ASPs house commonly use software (PeopleSoft, Oracle Financials, and SAP), you can change ASPs as long as you are using common software. In the case of Sunburst, it is using PeopleSoft that does not belong exclusively to USi. Thus, Sunburst can leave USi and take their business to another ASP that is running PeopleSoft's ERP. And ultimately, if Sunburst cannot make it work with any ASP, it can purchase the software and hardware itself, the initial choice.

Key Points. Complex systems such as ERP are expensive to install and maintain. ASPs are a reasonable choice based on a thorough analysis of management, organizational, and technical issues.

Source*:*

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5.7.4 e-Business Applications for Lollipops

Chupa Chups Group, formed in 1958 by Enric Bernat is a popular Spanish brand of lollipop and other confectionery sold in over 150 countries around the world. With its central headquarters in Barcelona, the Chupa Chups Group is one of the largest lollipop manufacturer in the world. The Chupa Chups Group has constantly developed strong alliances with other food and beverage companies around the world in order to expand Chupa Chup’s commercial presence and market penetration in most world markets. It is also partnering with M&M/Mars to market and distribute the Chupa Chups line in the U.S. The group currently maintains over a dozen factories in Spain, France, Russia, China, Mexico, Brazil and many other countries.

The Chupa Chups Group has grown steadily since 1992 (the consolidated average growth rate was as high as 27.3%). With its subsidiaries in so many different countries, which are responsible for sales and distribution of the Chupa Chups products to the key markets, and representative offices in 30+

countries, the group has realized its vision of becoming a global company. Chupa Chups is selling its products in 180 countries (there are only 193 countries in the World), and achieved brand status worldwide in the early 2000s.

Chupa Chups wants to ensure the availability of sufficient stock to meet the worldwide demand (make-to-stock system) while reducing inventory cost, synchronizing their worldwide planning, taking possible bottlenecks into account, and integrating all their suppliers. Such an improved planning can help them to decrease their cost, which would ultimately result in higher returns. This can help the group produce the needed amount of the right product at the right time and get it to the consumers, making them satisfied and loyal to the brand. This is essential to remain competitive in the sugar confectionary world of business.

To face the challenges of expansion and brand loyalty while maintaining customer satisfaction and smooth operation, Chupa Chups needed an appropriate information system that could integrate all business functions (from production to marketing and sales) with their business processes worldwide. In addition, the system needed to coordinate all activities and information flows involved in buying raw materials, making the product, and moving it to its final destination. Therefore, Chupa Chups chose SAP Supply Chain Management (SCM) and Sales Support Systems creating a network of the group's suppliers, consumers, and the company itself.

This system, acquired around 2005 and expanded significantly since then, allows them to make flexible decisions, instantly see where problems occur, track shipments, and plan production according to the demand. This SCM was based on an Enterprise Resource Planning (ERP) System (SAP R/3), integrating all business functions, and thus enabling information to flow freely between all parts of the firm at all times.

In order to achieve its goal to expand the distribution of the Chupa Chups brand around the world, the group saw the need to reorient its manufacturing process – from make-to-order to make-to-stock. They used SAP's mySAP™ SCM, which helped them address their business requirements in a variety of ways:

Supply Chain Management

1. Enhanced Chupa Chup Group's entire planning cycle as it was enabled to predict and reduce cycle times.
2. The internal and external supply chain partners are now able to forecast and plan according to real demand by taking buying and selling behavior, market intelligence, and sales objectives into account.

Sales and Marketing

1. Enabled the company to gather and process information countrywide, which made sales forecasting more reliable.
2. Assisted the marketing department to implement more effective strategies and more efficient and reliable introduction of new products and promotions.
3. The company is now able to react to changing market conditions and customer requirements more quickly and efficiently.
4. Achieved greater customer satisfaction.

Finance

1. The company gained access to crucial information to help it better manage its budget portfolio.
2. Demand is profitably matched to supply, this allowed for the maximization of the company's return on investment.

The ERP implementation helped Chupa Chupa to enhance its sales, marketing, and other activities. By efficiently matching the supply of products to customers' demand for them, Chupa Chaps can easily react to changing market conditions and introduce new products with accuracy. It has considerably invested in digital technologies, especially social media, to create and maintain international brand.

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5.8 Chapter Summary

This chapter has quickly reviewed the enterprise applications and models that are at the core of modern enterprises. These enterprises rely heavily on the Internet-based infrastructure to conduct business. Basically, the partners in these enterprises are consumers and businesses that support C2B, B2B, C2C, and C2N interactions. Examples of these applications are:

- Portals
- Customer Relationship Management (CRM), and Self Serve Customers
- Online purchasing
- Intermediaries such as electronic marketplaces and trading hubs
- Supply Chain Management
- Enterprise Resource Planning (ERP) systems
- Service Providers (e.g. ASPs)
- Mobility

We have briefly scanned these topics in this chapter and have shown an architectural framework consisting of two integration layers (back-end, front-end), and a middle business layer that can be used to represent several enterprise applications and models.

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