MODULE (THE BIG PICTURE)

This module introduces different aspects of digital enterprises and presents a simple framework, shown below, that covers the entire Learn-Plan-Do-Check cycle. This framework is used throughout this book and is the foundation of a computer aided planning environment that supports this book.

This module consists of the following chapters:

Chapter 1: Digital Enterprises and Digital Services– An Overview
Chapter 2: Information Systems Planning and Patterns– A Quick Overview
Chapter 3: Cases and Projects for Experimentation

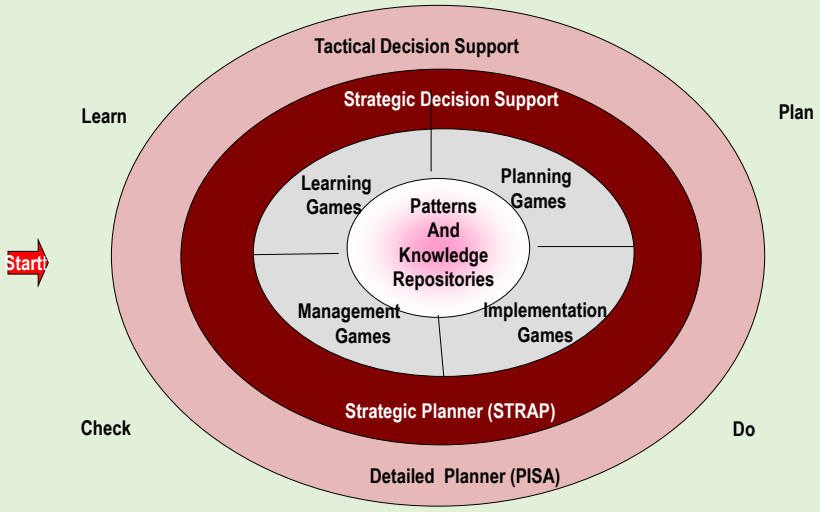

Figure A: The Learn-Plan-Do-Check Framework

1 Digital Enterprises and Digital Services: An Overview

Opening Vignette

A Barber's Shop can be a Digital Enterprise!

During a classroom discussion, we were trying to identify which organizations are ***not*** digital enterprises. A student said that a barber's shop is possibly not a digital enterprise. Very quickly, another student said that he makes his appointment on the Web to get a haircut. This led to an interesting discussion because a scissor can be Internet enabled by using Internet of Things technologies. So naturally, a program can be downloaded to a scissor for a different type of haircut. In addition, 3D printers could be used to "print" customized wigs in case the haircut goes wrong!

In other words, with Internet of Things, almost all enterprises can become digital enterprises and all services can be digital services. This is a profoundly interesting idea. In the early stages of computing, only payroll, inventory and billing were automated (i.e. were digital services). In the 1990s,Web technologies ushered in the era of ebusiness and ecommerce. Then in the early 2000s, mobile computing led to thousands of mobile apps. Around 2014, Big Data and Analytics shook up the computing industry and introduced more digital applications. Now, the combination of AI (Artificial Intelligence) with Big Data is leading to interesting applications of "Deep Learning" where the neural networks are being populated with Big Data to build extremely smart applications such as the IBM Watson. At the same time, Internet of Things and Web of Things are now making it possible for almost all mechanical and electronic devices to become Internet enabled and run Web apps.

A Video Clip: Basically, at the time of this writing, most companies use digital technology in some form or another. These technologies, as we will see in this chapter, offer many benefits to enterprises; however, they also present many challenges for executives. In this video interview, McKinsey director Paul Willmott, gives an executive overview of the opportunities and the threats posed by digital technology. Video URL: http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/the-digital-enterprise.

Contents

1.1 Introduction

We are in the middle of a digital revolution -- it is fundamentally affecting everyday life, restructuring business relationships and enabling new commerce activities, processes, and business models that were previously unimaginable. For example, a patient care system is designed in Germany, assembled in Spain by components that have been developed in Malaysia and India, and operated in a healthcare center in the US for patients in China and Nigeria and all of them under extreme time constraints. Use of Internet, mobile devices, machine learning, smart systems, blockchains and global partnerships keep growing at a dramatic rate as evidenced by Internet of Things, mobile apps, big data analytics, 3D printing, robotics and cloud computing, to name a few.

The digital revolution is bringing about fundamental shifts in how business is carried out by enterprises, how enterprises do business with each other, and how they interact with their customers, suppliers and regulators. In today's marketplace, businesses as well as consumers are adopting a digital lifestyle with high reliance on information technologies across all industry segments. Please see the sidebar "Digital Enterprises at a Glance" for additional information.

While our reliance on these technologies is increasing, so is the concern about the security and reliability of the technologies that are driving the modern digital environments. Imagine, for example, the impact of security attacks on firms such as Amazon, eBay, PayPal, GE, and several other civilian and military operations that rely more than 90% on IT. This chapter takes a broad look at the nature of organizations with special attention to digital organizations. This will help us to plan, engineer and manage such organizations. The objective of this chapter is to answer the following key questions:

- What is a digital enterprise and what are the typical examples of digital enterprises? (Section 1.2)
- What are the key building blocks of a digital enterprise? (Section 1.3)
- How are the digital enterprises evolving and what are different models of evolution? (Section 1.4)
- What are the different views on Next Generation Enterprises (NGEs) and Smart Enterprises? (Section 1.5)
- What are the promises and pitfalls of digital enterprises and what are the strategies to succeed? (Section 1.6)

The Agenda

- Digital Enterprise Concepts
- Evolution of Digital Enterprises
- Promises and Pitfalls of Digital Enterprises

Digital Enterprises and Technologies at a Glance

What are Digital Enterprises:
"Organizations where nearly all significant business processes and relationships with customers, suppliers, and employees are digitally enabled and key corporate assets are managed through digital means" [Laudon & Laudon 2015].

What are the key Digital Technologies being used by Digital Enterprises:

- Web and the Internet: Global digital networks and the Internet technologies that include IoTs (Internet of Things). Web technologies that range from the classical web to Web2.0+ and Social Media over the Web
- Mobile applications that include location based services, wireless sensor networks that support the IoTs
- Database technologies that include Big Data to store, retrieve, visualize, mine and analyze the massive amount of digital data accumulating in organizations
- Artificial Intelligence (AI) based smart systems that rely heavily on Big Data, Machine Learning, sensors, speech processing, pattern recognition and others for decision support
- Security technologies that include encryption techniques and blockchains to assure the privacy, accountability and integrity of corporate data
- Additional technologies such as 3D printing, nano technology, wireless mesh networks, biotechnology, and augmented/virtual reality (AR/VR) for yet to be fully exploited applications

How are enterprises leveraging these digital technologies:

- Reduce costs, sometime up to 90%, through digital marketing, online purchasing, and improved operations that integrate Web access and traditional IT systems
- Broaden their markets by extending their reach globally at minimal additional expense and enticing new prospects to become customers
- Enter new business areas through IoTs, collaborations, and expanded services made possible with Web and mobile apps
- Increase employee productivity by providing easier access to corporate information and services
- Achieve operating efficiencies by reducing the number of people making routine decisions, decreasing turnaround time, managing reduced inventories, etc.
- Enable business opportunities through mobile apps over fast wireless networks that could not be made profitable with manual implementations

What are the main digital challenges for the enterprises:

- How to understand the rapidly evolving digital technologies and decide which one to adopt and

which to defer
- Determine where the real values of digital technologies are (besides marketing and sales)
- Evaluate the automating decision support systems by using the latest developments in AI
- How to compete in this digital age where new digital startups can easily respond to customer needs compared to older companies with legacy systems
- Who should lead the digital strategies? Is it the CIO, CEO or a new "chief digital officer"
- How to build digital skills across the enterprise

Main Sources: [Sloan Management Reviews: 2015-now], [Forrestor 2016], [Willmott 2014], [Kane 2015], [Ruppa 2017], [Segars 2018].

1.2 The Digital Enterprises and the Digital Revolution

1.2.1 The Basic Definitions

Simply stated, an enterprise is a group of people with an overall and common goal or set of goals. An enterprise, also known as an organization or a firm, can be formed by at least two people but most enterprises consist of hundreds and even thousands of people. Our focus is on *digital enterprises* and *digital services* in public as well as private sectors.

- ***Digital Enterprise:*** An organization that heavily uses digital technology as a competitive advantage in its internal and external operations [Ruppa 2017, Streibich 2013]. Specifically, it is an "organization where nearly all significant business processes and relationships with customers, suppliers, and employees are digitally enabled and key corporate assets are managed through digital means" [Laudon & Laudon 2015].
- ***Digital Service:*** A business service that is delivered through digital technologies such as the Internet, world wide web, databases and mobile handsets. For example, online advertising and purchasing services over the web and mobile devices are digital services. Basically, a digital enterprise offers a set of digital services to its customers. The scope of digital services is being considerably expanded due to the advent of Internet of Things (IoTs) and Web of Things (WoTs); therefore, almost *everything* can be a digital service.
- ***Digital Technologies:*** These are the technologies that use digital information (0 and 1) only. The main power of the digital information is that it can be easily read, written and transferred by using computer programs. For example, a digital camera takes a picture where the images are represented in terms of bits (0 and 1). Thus, a program can make the picture bigger, smaller, change the colors, etc. Currently, the following technologies are of fundamental importance to digital enterprises and services (we will review these technologies in later chapters):
    - Global digital networks
    - Web technologies
    - Mobile applications
    - Database and Big Data technologies
    - Artificial Intelligence (AI) based smart systems
    - Security technologies such as encryption techniques
    - Additional technologies such as 3D printing, nano technology, wireless mesh networks, biotechnology, and augmented/virtual reality (AR/VR), etc

Instead of relying solely on their traditional core competencies, digital organizations are providing innovative services by clever combinations of outsourcing, partnerships, and assemblies of

components from multiple suppliers. Diverse enterprise models such as agile enterprises [Leybourn 2013], specialized enterprises [Pohle 2005], real-time corporations [Lindorff, 2002], mobile corps [Kalakotta and Robinson 2002], extended/virtual enterprises [Davis 2003], data-driven enterprises [Anderson 2015, Gallagher 2016], smart enterprises [Kale 2017] and the like are *variations* of digital enterprises that focus on certain aspects. Digital enterprises are in fact a combination of all of the above. In this book, we refer to the variants simply as digital enterprises, unless mentioned otherwise. The drivers for digital enterprises include:

- market differentiators that are pushing the companies to higher level services,
- continuous mergers and acquisitions that require frequent changes in business processes,
- pressures for quick deployments and quick time to market,
- need to respond to numerous schedule changes and change of plans,
- pressures to respond to new entrants and substitute technologies, and
- quick adjustments needed to cope with changing customer needs and market fluctuations.

Basically, the digital infrastructure becomes *the* primary source of company business. Large corporations such as GE adopted this model quite early and have prospered because of it (see the sidebar "Short Case Study: GE Becomes as a Digital Enterprise"). It is also well known that most current and future military operations are performed through sophisticated information systems that range from real-time embedded systems to chat groups. We will look at several examples of digital enterprises in the next sections.

It should be noted that digital technologies appear to drive digital enterprises. Not everyone agrees with this point of view though. For example, Kane (2015) argues that strategy, not technology, drives digital transformation. While the debate goes on, everyone seems to agree that digital technologies play a dominant role in the modern digital enterprises.

Short Case Study: GE as a Digital Enterprise

General Electric (GE) is one of the world's largest diversified manufacturers with more than 500,000 employees in more than 100 countries. Despite its size and old-economy businesses, GE was one of the first large companies that started purchasing and selling on the Internet in the mid 1990s with some early success. Much of the credit for GE's leadership goes to Jack Welch, GEs CEO for more than two decades. For example, GE Plastic's distribution arm (Polymerland) began distributing technical documentation over the Web in 1994 and put its product catalog on the Web in 1995. In 1996, GE Lighting reduced its purchasing cycle from 14 days to 7 days and also reduced its supply prices by 10 to 15 percent because of open bidding on the Internet. In 1997, seven other GE units began purchasing via the Internet. Jack Welch guided GE to a leading digital enterprise.

GE was also one of the first *Real-time Enterprises* that responded to changes and managed risks continuously instead of waiting for monthly or quarterly reports. As early as 2002, Gary Reiner, CIO of GE at that time, used a large keyboard and a huge screen display panel that showed the real-time status of software applications critical to GE's day-to-day operations. The screen displayed an array of green (indicates good), yellow (not as good as it could be) and red (trouble) icons that represented the status of GE's operations around the globe. For example, Reiner used the main screen for GE's plastics operation, which flashed a series of green lines and a few yellow lines. If red bars appeared on the screen, Reiner sent an email to the appropriate division manager asking for an immediate explanation.

Despite economy's ups and downs, GE has used digital technologies to compete and succeed in the ever changing marketplace. Due to its experience with digital technologies, GE launched a very

successful business unit on GE Information Services (GEIS) that was later sold in the marketplace.

At present (circa 2017), GE is a leader in the "*Industry 4.0"* wave, also known as Smart Manufacturing, that relies heavily on the convergence of industrial machines, Big Data, artificial intelligence and the Internet. GE is putting sensors on gas turbines, jet engines, and other machines; connecting them to the cloud; and analyzing the resulting flow of data by using Industrial Internet of Things (IoTs). The goal is to identify ways to improve machine productivity and reliability to new levels. GE is regularly using AI, analytics and Big Data in plant operations when many others are trying to understand these developments. Many articles, blogs and consulting reports (e.g., from Gartner) have highlighted the growth of GE as a digital enterprise leader and an Industry4.0 visionary.

Sources:

- The Connected Planet Articles: Industry 4.0, "General Electrics Industry 4.0 Vision", Link: http://www.theconnectedplanet.net/general-electrics-industry-4-0-vision/, October 2017.
- Winig, L., "GE's Big Bet on Data and Analytics", Sloan Management Review, February 18, 2016.
- Babcock, C., "GE Uses Machine Learning To Restore Italian Power Plant", Information Week, June 16, 2016; Link: http://www.informationweek.com/iot/ge-uses-machine-learning-to-restore-italian-power-plant/d/d-id/1325918?
- GE Case Study (Feb 6, 2013), Link: http://www.slideshare.net/LaurenDPerry/ge-case-study-16389395
- Dave Lindorff, "GE's Drive to Real-Time Measurement," *CIO Magazine*, November 11, 2002

1.2.2 Examples of Digital Enterprises: eBusiness, eCommerce and eGovernment

eBusiness, eCommerce, and eGovernment are legacy terms but still heavily used for digital enterprises. Let us start with a definition of *e-business*, also known as ebusiness and electronic business, and discuss how it is related to e-commerce, also known as ecommerce and electronic commerce. Simply stated, *e-commerce (EC)* is buying and selling over the network (mostly Internet) while *e-business (EB)* is conducting business, including buying/selling, over the network (mostly Internet). Thus EB subsumes EC (see Figure 1-1).

> EB = EC + other activities such as conducting meetings, developing software and managing customer relationships.

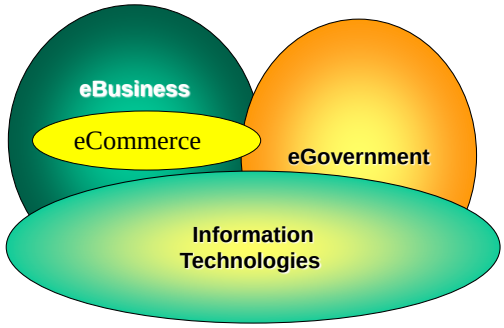

Figure 1-1: e-Business, e-Commerce and e-Government

Since e-business subsumes e-commerce, we will primarily discuss e-business (EB), unless e-commerce (EC) needs to be distinguished explicitly. Here are a few examples to illustrate the diversity of e-business:

- Companies such as Amazon, eBay, Google and Yahoo are heavily digitized firms that fully exploit ebusiness operations.
- Most banks at present provide ebanking services to a large user base. In addition, some banks are virtual and they only exist on the Internet.
- Dell Corporation uses virtual operations across multiple suppliers to exercise its well-known "build-to-order" model (the computers are assembled in plants that are in close proximity to the just-in-time parts suppliers).
- Many organizations (e.g., GM and Intel) have adopted real-time enterprise model where business activities are monitored and managed in real-time instead of relying on monthly and weekly reports.
- Amazon is using drones to deliver products to remote places and has formed partnerships with multiple suppliers (publishers, bookstores) that participate over the Internet to conduct business transactions (i.e., when you buy a book from Amazon, bookstores closest to the shipping address participate in fulfilling the order).
- Virtual Phone Companies (VPC) and Telecom trading hubs (e.g., www.telezoo.com) offer internet plus phone services, including spare bandwidth, without owning any physical assets.
- Many sites such as vertical.com, works.com, drugstore.com, and MSN.com tie multiple organizations transparently over the Internet to conduct business.
- National Industrial Information Infrastructure Products (www.NIIIP.org) supports product building across a large number of partners over the Internet.

eGovernment (also known as eGov, e-Government, electronic government, digital government, or online government) uses digital technologies between a government and its citizens, employees, other government agencies and related businesses. These digital interactions occur at all levels of government (city, state/province, national and international levels). As shown in Figure 1-1, there is some overlap between ebusiness, ecommerce and egovernment. This is mainly because many government operations (e.g., paying employees, advertising, and human resources) are similar to their counterparts in business. Here are some examples of egovernment:

- Smart Cities initiatives heavily use digital innovations to improve the lives of its citizens. There are more than 400 smart city projects at the time of this writing (2017).
- Digital Britain, eSingapore and eKorea are examples of ambitious use of digital technologies to automate most of the government services at country levels.
- eTokyo in Japan and iHetauda in Nepal are examples of ambitious automated services at city and county levels.

Many examples of egovernment services are published regularly in the Center for Digital Governments (www.**centerdigital**gov.com/) and the United Nations Public Administration Network (www.unpan.org). Please see the sidebar "Useful Sources of Information for Digital Governments and Cities" for additional information.

A very good source for digital enterprise information is the digital enterprise website (**www.digitalenterprise.org)** maintained by Mike Rappa. This site also has many case studies that include Amazon, eBay, Google, Yahoo, and many more. Please see the sidebar "A Good Source for Digital Enterprise Case Studies".

Useful Sources of Information for Digital Governments and Smart Cities

- Pelton, J.N. and Singh, I.B., (2019), "Smart Cities of Today and Tomorrow", Springer, 2019.
- United Nations Public Area Network: www.unpan.org
- World Bank Infodev: http://www.infodev.org/en/index.html
- World Economic Forum, Global Information Technology Report 2009–2010 (http://www.networkedreadiness.com/gitr/)
- International Telecommunications Union (ITU): www.itu..int
- World Health Organization (WHO): www.who.int
- Center for Digital Governments: http://www.centerdigitalgov.com/
- eGovernment for Development Information Exchange (http://www.egov4dev.org/index.shtml)
- Digital Britain Report (2010): http://interactive.bis.gov.uk/digitalbritain/report/
- Smart Cities Projects: General information (http://www.smartcities.info/)
- Obama Initiative on Smart Cities: http://www.triplepundit.com/2015/09/obama-administration-launches-smart-cities-initiative/
- Sustainable Smart Cities: http://www.mastersportal.eu/studies/131067/sustainable-smart-cities.html
- European Smart Cities: http://www.smart-cities.eu/

A Good Source for Digital Enterprise Case Studies: www.digitalenterprise.org/cases/

Note: This screenshot was taken on January 6, 2019.

1.3 Building Blocks of a Digital Enterprise

1.3.1 Classification of Digital Enterprise Services: C2B, B2B, and B2E

Services in modern digital enterprises are used by the customers, employees, and the business partners, as shown in Figure 1-2:

- **Business to Customer (B2C):** services that are used by the customers. Examples of these applications are online-purchasing and web advertising.
- **Inter-enterprise (B2B):** services that are used between businesses. These services are used to exchange orders, products, and payments between companies in B2B trade. Supply chain management and financial exchanges are examples of B2B services.
- **Internal (Business to Employee – B2E**): services that support the employees of the enterprise. Human resource applications such as payroll are good examples of B2E services.

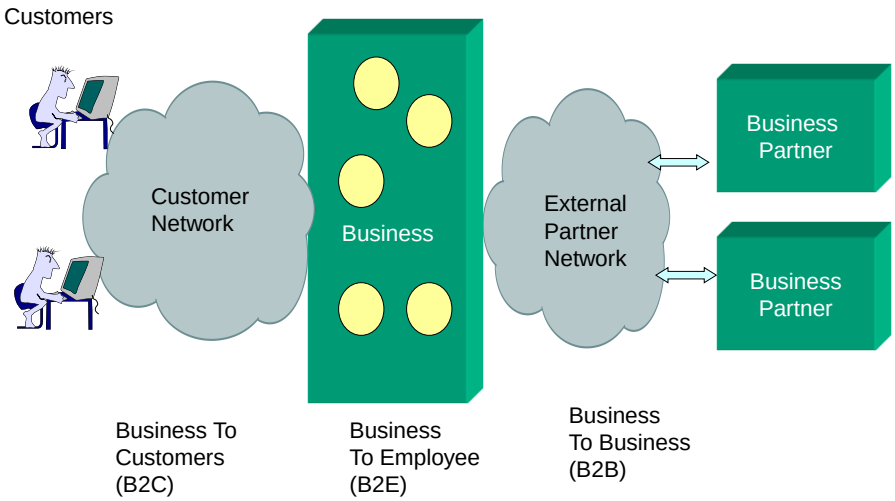

Figure 1-2: Digital Enterprise Services - High Level View

The view presented in Figure 1-2 can be easily mapped to egovernment view by simply changing the "Business" to "Government" and "Customer" to "Citizen". Thus the eGovernment services can be briefly summed up as:

- G2C (Government to Citizens)
- G2E (Government to Employees)
- G2G (Government to Governments)
- G2B (Government to Businesses)

We can also introduce the following refinements to capture different models:

- Big "B" to small "b" to capture the differences between large and small businesses. Interactions between large businesses (B2B) versus large to small business (B2b) differ greatly. For example, interactions between Walmart to Sears (B2B) are quite different than the interactions between Walmart to a small clothing manufacturer in Malaysia (B2b).
- Big "G" to small "g" to capture the differences between large to small government agencies. For example, interactions between US Homeland Security and Immigration Department (G2G) are

quite different than the interactions between the Homeland Security to a small city police department (G2g).

- We can, of course, go crazy by considering g2g, b2b, g2B, G2b and other such variations. However, each variation can be used to model different types of interactions.

1.3.2 Building Blocks of a Digital Enterprises: A Quick Glance

To better understand the complex interactions between business and IT and how IT supports the business, a very simple *"Enterprise Architecture"* view is presented in Figure 1-3. This view of an enterprise is presented in terms of three high level layers and their role as drivers and enablers of an enterprise:

- Business focused layer that concentrates on business strategies, services and business processes
- Business plus technology focused layer that deals with enterprise business applications
- Technology focused layer that provides the digital technology infrastructure to enable the applications

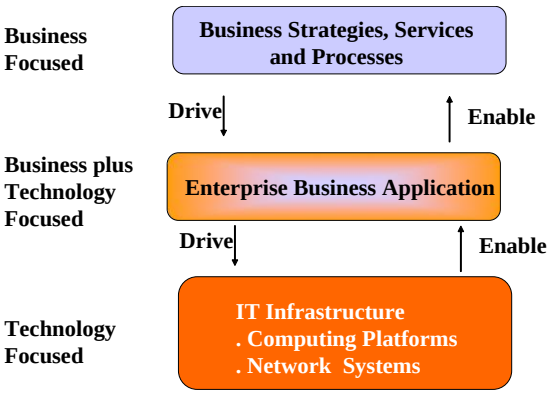

Figure 1-3: Key Building Blocks of a Digital Enterprise

The following discussion gives an overview of these three layers and defines some basic terms that are used throughout this book.

- **Business strategies** represent the long range game plan to win in the marketplace. Business strategies align the business products/services, processes, and several other activities to survive and succeed in the marketplace**.** The term business service and business process are frequently interchanged. For the purpose of this book, we will use the following definitions;
- **Business service** (BS) is something that is delivered to the customer. For example, dry cleaning service, house renovation service and online banking represent products that are delivered to the customer. A business service may be delivered to internal or external customers. For example, a payroll service is delivered to the employees of a company. Businesses usually deliver products, services or both to its customers.
- **Business process (BP)** is a collection of *activities* that are required to achieve a business goal – the goal may be a business service. At a basic level, a BP can be represented as a flowchart that specifies the orchestration of activities needed to complete the goal. For example, for a payroll *service*, several BPs have to be carried out (e.g., pay has to be computed, deductions have to be considered, overtime may need to be calculated, etc).

Thus a business service specifies what a user *receives* while a business process shows *how* the service is provided. In other words, a business service is an *external view*, while a business process defines

the *internal* set of activities and their flows needed to provide a service. In many cases, BPs and BSs can be interchanged. Unless needed, we will use BP or BS to signify the same thing. Business strategies, business services and business processes are an extensive area of business activity and are discussed widely in the traditional business and information systems management literature.

Enterprise business applications are the computer-based information systems that provide automated support to the business services/processes. These applications are also referred to as enterprise applications, business applications or just as applications in the literature. Whatever the name, these applications are "business aware". For example, an airline reservation system contains business logic and data related to airlines that is not the same as a hotel reservation system that contains business logic and data related to hotels. Business applications also provide business value to an enterprise. Obviously, an airline reservation system provides business value to the airline business. These applications use information technologies to support the enterprise and thus are enablers to the business processes.

The information technology (digital technology) infrastructure is used to build, deploy and operate the business applications. IT infrastructure, better known as digital technology infrastructure, consists of technologies such as computers, operating systems, networks, databases, and transaction managers. *This infrastructure enables the applications and is business unaware.* For example, the same type of networks and computers are used in airline reservation systems as well as hotel reservation systems. Here is a quick synopsis of the components of digital technologies infrastructure:

- The basic components are the digital devices and platforms such as computers, handsets laptops, servers, etc. with operating systems, utilities, and other business-unaware software
- The digital databases which store the information that can be manipulated and queried by programs
- The best known infrastructure is the network that interconnects remote applications, databases, and users. Internet, wireless, and broadband networks are examples of vital network technologies

An important player in modern enterprises is *middleware*, an increasingly crucial, yet bewildering component of the modern IT infrastructure. Middleware is needed to interconnect and support applications and users across a network. Web technologies are the most commonly known example of middleware services.

As we will see, the simple but elegant view presented in Figure 1-3 will lead us to the following initial definition of an Enterprise Architectures:

> **Enterprise architecture (EA)** = Business architecture + application architecture + technology architecture (computer platform architecture + network architecture)

We will revisit this definition and expand the discussion of EA in a later chapter.

Basic Terminology

- ***Information System (IS):*** A formal system that collects, stores, processes, updates, and displays information. An IS can be computer-based or manual.
- ***Computer-Based Information System (CBIS):*** An automated system that collects, stores, processes, updates, and displays information. A CBIS typically consists of a user database (a pool of data), a set of programs to access and manipulate the database, and user interfaces to invoke the programs.
- ***Digital Service:*** A business service that is delivered through digital technologies such as Internet.

For example, online advertising and purchasing services over the web and mobile devices are digital services.

- ***Application System:*** An automated information system. Thus an application system = CBIS. Our focus is on business application systems, also frequently referred to just as "applications", that support business functions. Business applications are business aware and represent the business aware functionality and data.
- ***Information Technology (IT):*** A collection of computer and communication technologies that are used to build, deploy and use the CBIS and other automated systems. These technologies consist of the networks, the computers, the operating systems, the middleware and many other components such as directories, programming languages, database managers, etc.
- **Strategy**: It is a game plan to win. There are different types of strategies. For example, a legal strategy is a game plan to win legal cases, a battlefield strategy is a game plan to win battles, a business strategy is a game plan to win in the marketplace, and an e-business strategy is a game plan to win in e-business.
- ***Working Solution***: A system (software + hardware) that satisfies the technical as well as organizational requirements (functional, security, performance, budgetary) and can be deployed, installed, operated and managed. In our case, a working solution consists of the application system plus the enabling IT infrastructure.
- **Enterprise architecture (EA)** = Business architecture + application architecture + technology architecture (computer platform architecture + network architecture)

Use of Emerging Technologies in Business

Internet of Things and Web of Things

- 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) provide 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 content 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.

Big Data and Data Analytics

- Big Data represents massive amount of data that can be used to improve 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), and Velocity (the data accumulates too 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 retrieve extensive knowledge while 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.

Quick Examples of Using these Emerging Technologies (Many More in Later Chapters):

- Smart Cities: The IoTs are transforming entire cities by solving real problems which citizens face each day. With the proper connections and Big Data access, the Internet of Things can address traffic congestion issues and reduce noise, crime, and pollution. Smart cities also use Big Data and Machine learning to detect the various problems, adjust accordingly and learn to do it better in the next round.
- Smart and Connected Vehicles: The connected cars are equipped with Internet access and can share it with others. The connected vehicles that may not be totally autonomous (e.g., driverless) are connected through a Vehicle Adhoc Network – a specialized wireless network designed specifically for fast moving objects. These cars also use Big Data and Machine Learning to detect possible accident situations, adjust to avoid them and learn to do it better in the next round.
- Smart Factories: The "*Industry 4.0"* wave, concentrates on "smart factories" that rely heavily on the convergence of industrial machines, Big Data, artificial intelligence, robotics, and the Internet. Industry 4.0 is also known as Smart Manufacturing, that includes cyber-physical systems, Industrial Internet of Things (IIoTs), cloud computing and artificial intelligence. Smart factories are putting sensors in factory machines; connecting them to the cloud; and analyzing the resulting flow of data by using IIoTs. The overall goal is to improve machine productivity and reliability to much higher levels.

The Agenda

- Digital Enterprise Concepts
- Evolution of Digital Enterprises
- Promises and Pitfalls of Digital Enterprises

Time to Take a Break

Suggested Review Questions Before Proceeding

- Given the current and future trends, what company exactly *cannot* be a digital enterprise and what business service *cannot* be digital?
- What exactly are digital enterprises? Please name three enterprises that you feel are digital
- What exactly are digital services? Please name three services that you feel are digital
- Show a simple Enterprise Architecture to Support Digital Enterprises

1.4 Evolution of Digital Enterprises

1.4.1 Quick Overview: The Internet Stage Model of Evolution

Simply stated, the use of digital technologies in business and government has gone through several stages of evolution. Figure 1-4 shows an Internet centric view that casts this evolution into the following four broad stages.

- **Stage 1: Simple Web sites for Advertising.** This stage became popular in the mid 1990s and is still the foundation of many corporate Web sites. The basic idea is to use the Web sites to display /advertise company products. All other company operations are largely unaffected. For example, a restaurant can just display its menu on a website for advertisement.
- **Stage 2: Basic e-Commerce for Online Purchasing.** In this stage, the consumers could select the products through the Internet and then also buy them from a single organization. In this case the service is not only advertised but also delivered over the Internet. In addition, the Web is used as an interface to corporate applications (i.e., new applications are developed and existing applications are given "face lifts" by using the Web). This stage became popular in the late 1990s.
- **Stage 3: Extended/Virtual Enterprises.** EEs (Extended Enterprises) go beyond basic e-commerce sites by tying services from multiple businesses through a single Web interface. In this stage, Web technologies take a central role in gluing services across multiple organizational units spanning different organizations. It adds B2B interactions to C2B as encountered in the previous two stages. The B2B interactions, although hidden from the users, take place directly between business partners. This stage, became popular at the turn of the 21st century, is at the core of e-business activities like online shopping, trading between business partners and integration of business processes across organizational boundaries. An example of extended enterprises, also known as virtual enterprises, is Amazon.com (when you order a book from Amazon.com, many other suppliers may be involved in this transaction).
- **Stage 4: Next Generation Enterprises (NGEs).** This stage goes beyond stage 3 to add wireless web, intermediaries (trading hubs, emarkets), real-time business monitoring and control, mobile devices, self-serve customers, and many other features such as Big Data, Internet of Things and

Smart AI-based Services. In this stage, the interactions between business activities within an enterprise are conducted, monitored and controlled electronically. In addition, external communications with business partners are conducted through trading networks that support B2N (business to network) interactions. The digital infrastructure becomes the primary source of company business in this model. In fact, NGEs rely almost exclusively on the digital infrastructure to conduct business and often result in restructuring and transforming of the industry.

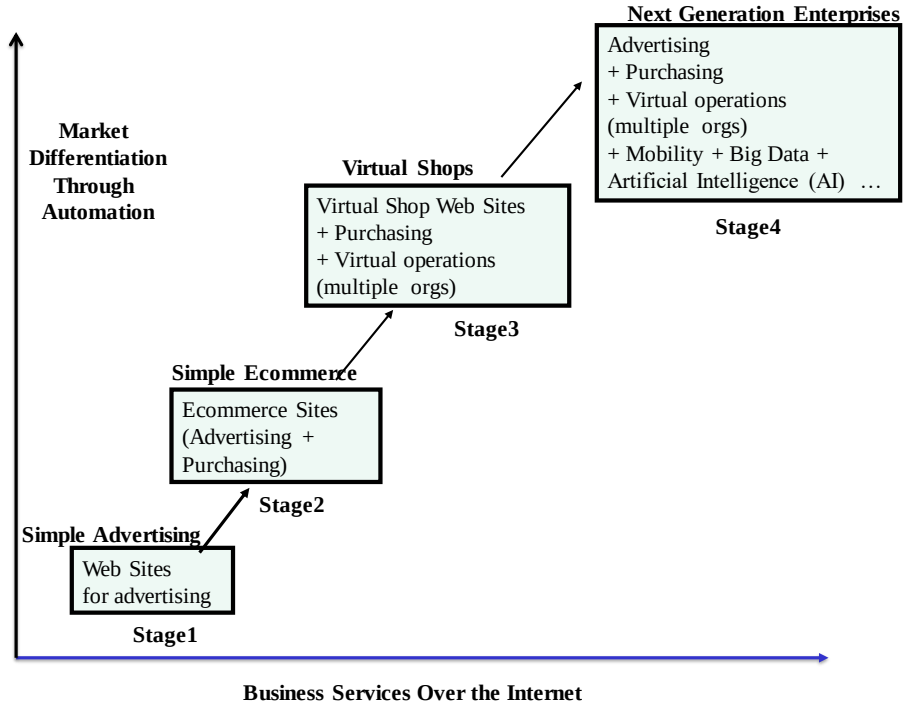

Figure 1-4: Evolution of Digital Enterprises

NGEs are very interesting because NGEs employ innovative business models and rely on the emerging "next generation" technologies" (e.g., Next Generation Networks, Next Generation Web, Next Generation Databases, Next Generation Software Infrastructure, etc). However, NGEs raise several issues that span businesses and technical domains. Specifically:

- Strategic and application issues such as the business risks and pitfalls that need to be avoided
- Architecture and integration issues that address how NGEs can be architected, developed and integrated
- Digital infrastructure issues that are concerned with enabling technologies such as networks and databases for NGEs
- Management and support issues that address the planning, organizing, staffing and security issues concerned with NGEs

We will develop a more extensive list of these issues in the next section and will attempt to answer them in this book.

1.4.2 The Mega Trends (Web, Mobility, Data and Smartness) – A Multidimensional View

The stage model discussed above is simple but is mostly one dimensional – it relies on the Internet as the primary player. There are other dimensions that can be considered to represent how the enterprises are evolving to become next generation of digital enterprises. After experimenting with several conceptual models to capture the essence of NGEs in a simple but elegant manner, we have selected four basic attributes that define our reference multidimensional space shown in Figure 1-5. This analysis proceeds by mapping various configurations of enterprises to regions in this space. With each attribute, we associate a set of discrete values, {Low, Medium, High, Very High}, based on an informal, qualitative estimation shown in Table 1-1. In this model, NGEs conduct business by fully exploiting the following four 'mega trends" displayed in Figure 1-5:

- *Web (W)* technologies for internal as well as external business activities on the Internet and Web technologies. Internet of Things and Web of Things show the high values of this dimension.
- *Mobility* (M) support for the mobile customers, workforce and operations over wireless networks that range from short range wireless sensor networks through Deep Space Communications.
- *Data* (D) for internal as well as external business decisions and analytics. Low values indicate use of Excel spreadsheets on small files but high values represent heavy use of Big Data to make business decisions.
- *Smartness (*S) to quickly detect and respond to changing business conditions and learn from them to do a better job in the next round. Extensive use of Artificial Intelligence and Deep Learning represent the high values of this dimension.

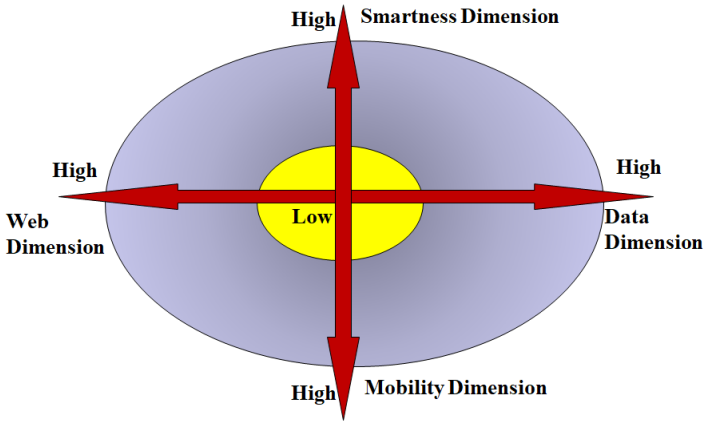

Figure 1-5: Four Dimensional View of Digital Enterprises -- The Mega Trends

These four dimensions (WMDS) provide a simple yet powerful mechanism to represent a wide range of enterprise models, including the stage model discussed previously. Different enterprises cover a region in this diagram and are represented as circles/ellipses. For example, the inner circle shown in Figure 1-5 indicates a local bakery store with low reliance on any of these four capabilities while the outermost circle represents a global digital enterprise such as Google or Amazon. For each dimension, the {Low,Medium,High} ordering is defined by locating the "easy case" at the center, in such a way that outer regions naturally come to represent more challenging cases.

The main idea is that NGEs lie at the outer edges of this model. As the NGEs push *simultaneously* towards these four dimensions, they dramatically increase their reliance on a complex array of digital technology services that include mature technologies such as Web Services, Semantic Web, wireless middleware services, wireless networks, application servers and systems management platforms. They can also represent emerging technologies such as Internet of Things and Deep Learning.

Basically, NGEs are not one dimensional entities that can be characterized as "e-corporations", "mobile corporations" or "agile enterprises" but are multidimensional entities that are *simultaneously* using mobility, Big Data, smart services and other capabilities to conduct businesses (see Figure 1-5).

As the enterprises push towards these four dimensions, they not only dramatically increase their reliance on digital services but also change the situation where the digital infrastructure starts driving the business strategies. In addition, new issues in planning, integration, security and administration arise which this book is focused on. In particular, NGEs need to plan and integrate their digital services quickly and correctly to compete and survive.

The simple model presented in Figure 1-5: can be used to characterize an overall profile of a digital enterprise and can also display how a given enterprise can evolve over time from an initial inner circle to the outermost in 3 years. We can also represent agile enterprises, mobile enterprises and other popular enterprises by using this model (see Section 1.4.4). However, it is just a starting point. Additional attributes (dimensions) can be easily added to further refine this model. Examples of additional dimensions are Analytics, BiG Data and others. In fact, consulting groups such as Gartner publish top 10 strategic technologies yearly. This list of technologies can be used in this model.

Table 1-1: The Key Dimension Parameters (WMDS)

	Web Reliance (W)	**Mobility Reliance (M)**	**Data (D)**	**Smartness (S)**
None	No use of Web	No use of Mobile Services	Small text files and spreadsheets	No Detection, Adjustment, Learning (DAL)
Low	Information only	SMS	Small databases	Detection Only
Medium	Simple transactions (eCommerce)	Mobile eBusiness Applications (MEBAs)	Relational databases for Shared Corporate Data	Detection and Agility
High	B2B and eCollaboration	Location-based Services (LBS)	Big Data from some external sources to conduct business	Detection, Agility and Learning
Very High	Enterprise 2.0+, Internet of Things and Web of Things	Extensive use of Wireless Sensor Networks and IoTs	Very Big Data from internal as well as external sources to conduct business	DAL with emphasis on Deep Learning and Big Data

1.4.3 A Closer Look at the Four Dimensions

Web Dimension -- the Electronic Enterprises

- **None (No use of Web):** This represents a really low-tech firm that may use email services, but nothing else.
- **Low (Basic Websites):** This represents the use of websites to display/advertise company products. All other company operations are largely unaffected. For example, the customers have to separately order the products that they select by browsing through company websites.
- **Medium (Basic e-Commerce).** This allows the consumers select the products through the Internet and then buy them over the Internet from a seller. This option mainly concentrates on C2B (consumer-to-business) operations where the service is not only advertised but can also be purchased over the Internet by the consumers.

- **High (e-Business).** This option adds B2B (business-to-business) interactions to C2B as discussed in the previous two stages. The B2B interactions, although hidden from the users, take place directly between business partners. For example, when you order a shirt from Kohls, many other suppliers may be involved in this transaction.
- **Very High (Digital Enterprises, Enterprise 2.0+, Internet and Web of Things):** This option goes beyond ebusiness to a completely digital enterprise where almost all business activities are conducted over the Web. An example is Enterprise 2.0, proposed by [McAfee 2006], that exploits a new wave of business communication tools including blogs, wikis and group messaging software for collaboration within organizations. The result is highly productive and collaborative work environments that are needed in the digital age.

Mobility Dimension – The Mobile Enterprises

- **None (No use of mobile computing).** This represents a firm that may use cellular phones for talking but there is no other use of mobile computing applications
- **Low (Wireless Messaging and Wireless Web).** This option uses wireless messaging services (SMS, MMS , Blackberry) and Wireless Web (doing web surfing from mobile devices)
- **Medium (Mobile eBusiness Applications -- MEBAs).** This means that the company goes beyond stage 1 and supports access to EB applications through mobile devices. Specific applications are mobile portals, mobile commerce, mobile customer relationship management systems (m- CRM) , mobile supply chain management systems (m- SCM), etc
- **High (Location Based -- Positional and Voice-- Services).** This means that the company is going beyond stage 2 and exploiting positional applications (Location Based Services - LBS) and voice applications (typically based on VoiceXML). LBSs support geographic position (location) for some applications. An example is positional-commerce that provides support to customers based on their geographic position (e.g., to give you information about deals in the Chicago area when you are in Chicago). The systems use a GPS (Geographical Positioning System) to locate the position of the customers. In many cases, a positional attribute (P) is added to mobility. For example, M-commerce becomes MP-commerce or MPV (mobile-positional-voice) commerce.
- **Very High (Mobile Enterprises).** This means that the company is going beyond stage 3 and adopting additional sophisticated mobile apps [Umar 2013, Kalakota2002]. These may include specialized applications involving mobile agents and sensor networks. Mobile agents are programs capable of being transferred to remote hosts in order to carry out different tasks on behalf of their users. Wireless sensor networks (WSNs) are formed by extremely small sensors or nano computers. For example, many sensors are installed or sprayed in an area to detect vehicle movements, collect temperature fluctuations and gather a variety of useful information.

Data Dimension - The Big Data Driven Enterprises

- **None (Small text files and spreadsheets):** This represents a small enterprise where almost all operations are performed manually.
- **Low (Small databases).** The enterprise uses a small database (e.g., Microsoft Access) for simple database queries.
- **Medium (Relational databases):** The enterprise uses multiple relational databases and may also have Shared Corporate Data (e.g., a Data Warehouse).
- **High (Big Data):** The enterprise has large number of diverse internal and external data sources with at least one data source that is "Big Data" (e.g., the World Bank Data Source). Many data mining, analytics, business intelligence and visualization applications are supported through the Big Data.
- **Very High (Very Big Data):** The enterprise conducts business by using very large number of data sources that span sensor data and video clips to satellite images. This large volume of data, in diverse formats, is dispersed across multiple sites that may be located in different countries and

continents. The data dimension plays a crucial role in the enterprise. Big Data supports extensive data mining, analytics, business intelligence, and visualization applications for key decisions.

Smartness Dimension - The Smart Enterprises

Simply stated, smart services and enterprises exploit a mixture of agility, detection and learning capabilities to satisfy the end user needs. For the purpose of this book, we have adopted the following definition suggested by IBM:

A smart system has three basic features:

- Knowledge (K) of the system
- Detect (D) a problem/opportunity
- Adjust (A) quickly as needed
- Learn (L) to improve the future operations

This helps us to nicely define the smartness dimension in terms of the following levels:

- **None (No Smartness):** This represents an enterprise that does not use any of the DAL (detection, adjustment, learning) capabilities
- **Low (only Detection):** The enterprise may have the ability to detect problems and opportunities, but is not agile enough to adjust itself accordingly.
- **Medium (Detection Plus Agility):** The enterprise can detect problems and opportunities quickly and also have the agility to adjust accordingly in a timely manner.
- **High (Detection, Agility and Learning):** The enterprise has all the necessary DAL capabilities to be a Smart Enterprise
- **Very High (All of the Above):** The smart enterprise may use the detection, agility and learning at the highest levels thus creating extremely powerful applications in health, education, public safety, public welfare and many other sectors.

These levels of the smartness dimension illustrate how a "dumb" system with almost no capabilities for detection, adjustment or learning can gradually reach the smartest stage with 100% DAL capabilities. An assessment of existing systems can be represented as different points on this dimension and strategies to move towards smarter systems as different paths . Thus smartness can be introduced gradually. A wide range of technologies such as sensors, speech recognition, computer vision, pattern recognition, self healing networks, mobile apps, data analytics and intelligent workflow systems can be used to move existing systems to smarter points. However, technologies alone cannot make a system smart. In fact, smartness can be achieved through a combination of people, processes and technologies. We will discuss this more in the next sections.

1.4.4 Examples and Sample Representations of Digital Enterprises

Table 1-2 illustrates how some well known enterprises can be represented in terms of the four parameters (WMDS) shown in Figure 1-5. The following observations can be made from this table:

- Small local restaurants have very small reliance on technologies but restaurant chains such as Domino's and McDonald rely very highly on the Web and Data technologies. However, the reliance on mobile applications and wireless networks is moderate. The reliance on Smart technologies such as Artificial Intelligence (AI) has not been exploited by these industries at the time of this writing.
- Large banks such as the World Bank and Wells Fargo do not use mobile apps and wireless communications extensively because of security risks associated with wireless systems. However, they fully exploit the web technologies for web banking and electronic fund transfers.

- Logistics and distribution companies such as UPS, Federal Express and US Postal Services rely very highly on mobile computing and wireless networks due to the need for tracking parcel routing and tracking. Web and Data dimensions are being used heavily but AI technologies are yet to be explored fully.
- Smart cities such as London and Brussels and Next Generation enterprises such as General Electric are pushing the technology envelop in all possible directions.

This simple table can be used to represent a very large number of enterprises such as mobile corps, data-driven corps, agile corps and the like. For example, real-time enterprises require high to very high web reliance and mobility reliance to capture information from mobile users, and very high agility reliance to adapt to real-time demands. We will extend this model in the next section.

Table 1-2: Sample Enterprises Represented in Terms of Core Parameters

	Web Reliance	Mobility Reliance	Data Reliance	Smartness Reliance
A Neighborhood Pizza Shop	Small	Nothing	Small	None
Domino Pizza Chain of Restaurants	Very high	Medium	Medium to High	Low
The World Bank	Very high	Medium	Very High	Medium to High
UPS and Federal Express	Very High	Very high	Medium to High	Low to Medium
Smart Cities Such as London	Very High	Medium to High	Very High	High
Next Generation Enterprises such as General Electric	High to Very High	High to Very High	Very High	Very High

1.5 Extended Models and Next Generation Enterprises (NGEs)

1.5.1 Extended Model – Eight Dimensional View of Digital Enterprises

Although the four dimensional view of digital enterprises based on the megatrends of Web, Mobility, Data and Smartness is a good starting point, we can easily add several other major digital technology trends to this model. Figure 1-6 displays an extended model that adds the following four digital technologies to capture the more realistic view of modern digital enterprises:

- *Analytics (A*) dimension represents the use of statistical and optimization techniques to analyze, forecast and optimize business operations. Extensive reliance on analytics techniques represent the high values of this dimension.
- *Outsourcing* (O) of operations to widely dispersed sites and partners is a common business practice at present. Cloud providers offer extensive capabilities for very high levels of outsourcing.
- *Security* (S) technologies are essential for most modern digital enterprises. Extremely high levels of security measures are needed for financial institutions, government agencies and defense organizations.

- Globalization (G) of operations to widely dispersed sites by using the broadband digital networks supported by satellite communication systems. Global enterprises conduct business operations that are dispersed across multiple locations in different countries and continents.

The eight dimensional model seems to capture a very large number of digital enterprises. For example, IBM has a CAMSS (Cloud. Analytics, Mobile, Social Media, and Security) model for modern smart enterprises. Our 8 dimensional model captures the CAMSS model very well (the social media is represented by the Web Dimension in our model). While more dimensions can be always added, it seems that 6 to 8 dimensions are good enough for our purpose: to represent a large number of digital enterprises in a simple yet elegant manner.

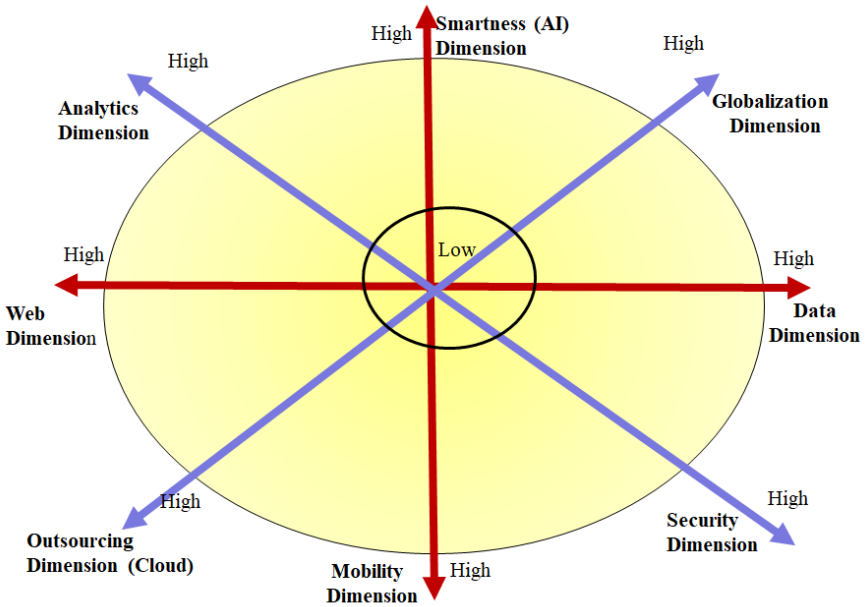

Figure 1-6: Extended View - Eight Dimensional View of Digital Enterprises

1.5.2 Highlights of Different Views on NGEs and Smart Enterprises

NGEs, as stated previously, represent the outermost circle in Figure 1-6 and thus push the envelope in using the next generation of digital technologies and business models to conduct business. Basically, a smart enterprise is an NGE that fully exploits the smartness dimension of knowledge, detection, adjustment and learning. Thus a smart enterprise is a special case of NGEs. Let us review the different views of NGEs presented in the literature and then take a closer look at smart enterprises (see the sidebar "Smart Services and Smart Enterprises").

An early view is to describe NGEs as the final stage of evolutions starting from an ebusiness point of view [Umar 1999, Kalakotta 2002]. These evolutions start from simple Web sites that only advertise business services to simple ecommerce (EC) sites where the users can buy items online and to B2B trade over the web and beyond. Some vertical market segments have explicitly used the notion of "Next Generation" to indicate forward thinking. For example, telecom sector has aggressively used the notion of Next Generation Telcos (NGT) to compete in the marketplace. NGTs are supposed to provide on-demand telecom services, support next generation operation support systems and Next Generation Networks (NGNs).

Another view, presented by consultants such as [Kidd 2000], emphasizes that Next Generation Enterprises (NGEs) are concerned with looking beyond current best practice in manufacturing and services. Corporate architecture of NGEs is viewed as a network capable of reconfiguring itself and self adapting as the business environment changes and the core competencies are spread across corporations. After the world wide adoption of Web technologies in 1990s by enterprises, many different aspects (dimensions) of enterprises have emerged due to the adoption of a wide range of digital technologies. For example, in the early 2000s, mobile computing led to "Mobile Enterprises" and around 2014, Big Data and Analytics shook up the computing industry and introduced the concept of "Data Driven Enterprises". Now, the combination of AI (Artificial Intelligence) with Big Data is leading to the concept of "Smart Enterprises" or "Intelligent Digital Enterprises". As more digital technologies are adopted by the digital enterprises, the concept of NGEs will evolve.

As the NGEs evolve, the questions about the tradeoffs and the interrelationships between different technologies (the dimensions) are becoming important. For example, being smart by ignoring mobility and data dimensions is virtually impossible. In addition, speed centric management decisions to bring products to market quickly can be dangerous due to the underlying complexities and interdependencies of technologies. [Mukherjee 2017] builds an interesting case against agility by arguing that thoughtfulness is much more important than being the first in the marketplace. According to Mukherjee, the following three ideas must go: "i) Agility, which prizes the ability to rapidly change established strategies, assets, or processes; ii) First-mover advantage, which decrees that whoever introduces a new product or service or technology first will almost inevitably win; and iii) Minimum viable product, which encourages the release of early versions of products or services, letting the market decide whether to give these early versions further support."

Smart Services and Smart Enterprises

The basic idea is that smart systems (smart people, smart cars, smart cities, etc) must exhibit four key features of human intelligence shown in Figure A (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 problem or opportunity
- Adjustment (A): ability to change 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.

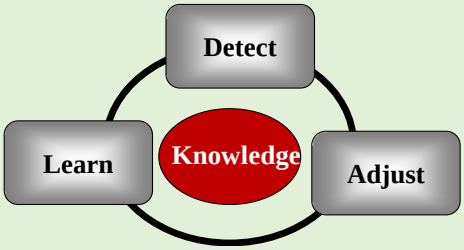

Figure A: Key Features of a Smart System

Let us use the example of a driverless car (smart car) to illustrate this concept. Specifically, a smart car must have the following capabilities:

- *Know* about driving, i.e. possess the knowledge and familiarity, awareness and understanding of driving a car at the level of a licensed driver.
- *Detect* a situation, i.e., an event, an opportunity, or a threat. For example, the car must be able to

detect rain, snow, a pedestrian, a downhill slope, or a blocked road.

- *Adjust* according to the situation, i.e., stop on a red light and for a crossing pedestrian. Adjustment involves developing plans of action based on alternative analysis and requires reasoning (i.e., inferences) based on rules. For example, if it is raining and the car is on a downhill slope, then slow down.
- *Learn* to do it better in the next round when a similar situation arises. Basically, the smart car should be able to *automatically* acquire knowledge (new things, new relationships between things, and new rules), retain knowledge and remember (through short term memory, long term memory, persistent memory), and update knowledge (revise things, revise relationships between things, and revise rules).

Although additional capabilities can be added, we will use this Know-Detect-Adjust-Learn cycle to characterize smart services and enterprises. For example, a Smart Environmental Protection Service will have the following capabilities:

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

In the same vein, Smart Enterprises and Smart Cities should know about the needs of their populations, detect when the needs are not being met, adjust to meet the needs and also learn to do it better in the next round. An interesting example is how machine learning and data-driven smart marketing is revolutionizing the travel industry [Schrage 2018].

The Agenda

- ✓ Digital Enterprise Concepts
- ✓ Evolution of Digital Enterprises
- Promises and Pitfalls of Digital Enterprises

Time to Take a Break

Suggested Review Questions Before Proceeding

- How many stages are in the Internet Stage Model of Evolution.
- How many dimensions are in the Mega Trends Model. Please list them.
- Can the stage model be represented by the four dimensional model.
- Extend Table 1-2 to represent eight dimensions and represent Amazon.com by using the eight dimensional model.
- Select a smart city and 2 other organizations of your choice and represent them by using the

eight dimensional model.

1.6 Wrapup - The Promises and Pitfalls of Digital Enterprises

1.6.1 The Promises

The digital enterprise activity is fueled by several business factors such as the following:

- **Economic reasons.** These are naturally the main drivers. For example, labor costs traditionally keep going up and more staff is needed to support products in the market. However, digital services lower cost of labor due to the replacement of labor with web-based advertising and purchasing. In particular, Web-based advertising allows companies to reach a much wider customer-base without expensive marketing personnel. In addition, online-purchasing can provide 24X7 purchasing of goods without any sales personnel. For example, by using the Internet to interact with customers, Proctor and Gamble has cut its marketing research costs by 50 to 75 percent. Most companies and government agencies effectively use Web-based advertising and purchasing to reach more customers around the clock at more sites but with lower costs.
- **Possible improvements in business processes.** Significant improvements in procurement and order fulfillment are driving several companies to digital services. For example, IBM found that the time to fill orders dropped from 30 days to 1 day and the contract negotiation time dropped from 6 months to one month by using digital technologies (see
- Figure 1-1). Survival is pushing many companies to move to digital services, because if they do not, they could be annihilated by the competition.
- **Facilitate quick adaptation.** Businesses need to adapt quickly (i.e., enter new markets, redefine focus), reduce cycle time (i.e., setup a new large scale business in 6 months), improve responsiveness, give better financial and operational flexibility, and improve utilization of resources. This is becoming increasingly possible with digital technologies.
- **Significant reduction of paperwork.** For example, Staples has gotten out of the paperwork business by using digital technologies since 2000. According to an August 26, 2002, Wall street Journal advertisement, 3.3 million corporate end-users of Staples used real-time order information for over 80,000 items. This has significantly reduced paperwork over the years with huge savings. The items are made available at the Staples Web site (www.staples.com) that displays on-hand inventory instantly and handles customer orders.
- **New and improved organizational structures.** Digital services impact organizational structures by changing hierarchy of decision making and reducing need for middle management and clerical support. Different levels of managers can interact directly through a corporate Intranet. In addition, firms can exist entirely or partially on the Web leading to ***virtual enterprises.*** These enterprises tie suppliers to consumers and eliminate a complete organizational structure. For example, Corolla is a virtual flower shop that gets online orders for flowers from customers and routes the orders directly to the farmers. This "flower shop without any flowers" eliminates the need for a flower store where the farmers used to bring their flowers to be sold.
- **Market Differentiation**. Digital services provide market differentiation to many companies. For example, Amazon.com provided a market differentiation by offering around 1.5 million book titles while average bookstores offered about 50,000 book titles. Keep in mind that these market differentiations can also quickly disappear.
- **Increased outsourcing options through cloud computing.** Outsourcing through the Internet (i.e., utilizing the Internet to move business services and functions outside the corporation) saves

operational and support costs in installation, repair, shipping, and inventory management. Numerous Service Providers (SPs) provide application and network services over the cloud. For example, IBM, SAP, Microsoft, and Corio host a complete set of business applications to facilitate partial or complete outsourcing of business information systems.

- **New business partnerships.** Business partnerships are being formed at function level because competition has moved to business function (service) within a company instead of company business. For example, if company A provides a better call center but company B builds better software quickly, then partnering with A for call centers and B for software development makes better business sense.
- **Potential of eMarkets.** Electronic marketplaces and trading hubs (i.e., virtual internet "stores" offering products and/or services from many vendors) became popular to provide improved services for the buyers. Examples exist in business-to-consumer (e.g., Amazon, MSN), consumer-to-consumer (e.g., eBay), and business-to-business (e.g., FastParts, COW). Interesting examples of emarkets can be found in the Telecom eMarkets such as Arbinet and Band-x. Although not fully realized, emarkets have a great deal of potential, especially if systems supporting business functions such as inventory, supply chain, network design, etc. are integrated with electronic markets in the cloud.

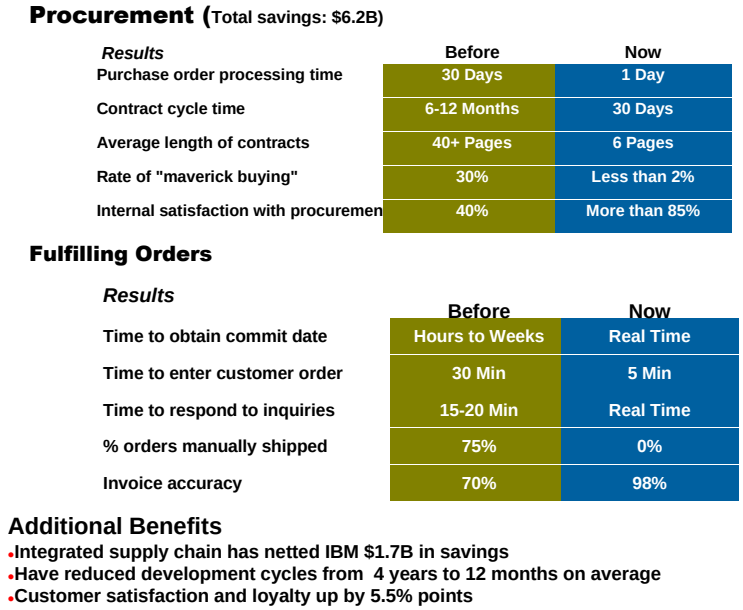

Figure 1-7: Impact of Digital Services (source: IBM)

1.6.2 What Can and Does Go Wrong – The Pitfalls and the Risks

Although digital services offer organizations a wealth of new opportunities, they also present several risks, pitfalls, and challenges. The potential pitfalls span business as well as technology issues. Examples of the key business pitfalls are:

- **Unproven and unclear business models.** Simply stated, a business model is how you make money. In the zeal of becoming another dot-com, many companies forgot who will be willing to buy all the things become available online. For example, just how many people want to buy live lobster and Purina Dog Chow online anyway -- even if these and other items were sold online by using the most appealing technology. Many companies have assumed that the Web has unlimited

potential, thus it is good to over-invest in online operations. This thinking is quite unrealistic and can lead to large investments with no returns.

- **Misunderstanding of customer behavior.** For example, many companies assumed that once customers use their Web site, they will be so captivated that they will always return, thus ensuring profitability. It is well known in the traditional brick-and-mortar sales that repeat business is never assured and organizations must continuously strive to retain existing customers. Repeat business is especially difficult in Web-based purchasing because if it is easy for the customers to do business with you over the Web, it is equally easy for them to shop somewhere else. To build customer loyalty, the businesses have to provide increased customer contact (e.g., happy birthday e-mails) and/or allow personalization at their Web sites.
- **Lack of understanding of technology costs.** Doing business over the Internet can be expensive and the costs need to be managed with the traditional business methods. While virtual retailers may not need costly storefronts and retail workers, they still have to pay for Web site development and marketing. Businesses with unclear on-line strategies can waste thousands and even millions of dollars building and maintaining a Web site or a mobile app that does not deliver the desired results.
- **The myth of Web's unlimited potential.** Based on this myth, organizations may over-invest in online operations. This practice is quite unrealistic, and often leads to disappointment and/or failures. Some companies also felt that Web sites can eliminate the need for call center staff. While the Web sites can minimize post-use assistance, they cannot eliminate all levels of support. In several cases, human contact is the best way to satisfy customer needs.
- **No attention to business process changes due to the Web and Mobile Apps.** Online purchases over the Web and handsets require careful orchestration of the firm's divisions, production sites, and sales offices with customers, suppliers, and business partners. Several business processes need to be redesigned and traditional boundaries between departments and divisions need to be re-defined. Use of online-business activities forces companies to act rapidly (customers will typically not wait for 3 months for an item to be shipped if they used the Internet to place their order quickly).
- **Possible channel conflicts.** On-line sales and marketing through the Web may create channel conflicts because the firm's sales force and distributors may fear that their revenues will drop as customers make purchases directly over the Web. Using alternative channels created by the Internet requires very careful planning and management. Different companies deal with channel conflicts differently (see [Laudon 2015] for details).
- **Legal and privacy issues.** Several legal and privacy issues are raised by digital services because the laws governing digital technologies are still being written, especially at the international level. For example, how to settle the legality of e-mail contracts and enforce restrictions when items are sold in the US via a Web site located in Italy with suppliers in Singapore and Hong Kong, whose law would apply? Security and privacy in such a global environment is a serious issue because all information, including credit cards and e-mail, passes through many computer systems on the Internet where it can be monitored, captured, and stored.

In addition to business and management challenges, there are also numerous technical challenges. The main technical challenge is that digital enterprises are large and complex distributed systems that are not easy to build, deploy, and manage. Specifically:

- **There is more "behind the scene" complexity** of most digital systems**.** This is due to multiple applications, databases, computing platforms and networks of different vintages and types that need to work together. For example, a medium scale online purchasing system requires inter-working between more than a dozen systems that may range from Web-based new catalog systems to legacy inventory and payment systems.

- **Many infrastructure components (e.g., middleware and application servers)** are becoming available from a wide range of suppliers. This leads to many interfaces, standards and protocols. It is difficult to build systems in these environments without sound architectural principles.
- **Increased interdependencies and points of failures** between numerous components arise because distributed applications are more complex. In addition, several disciplines need more coordination (databases, networks, middleware, applications, operating systems) for an e-business system to operate. This makes the task of security, performance and interoperability nontrivial.
- **Many difficult management and support challenges** arise due to the underlying complexity of the e-business systems. For example, there are many hidden costs such as software and staffing costs that can be higher due to multiple licenses and environments, especially for middleware. In addition, how to plan, organize, staff, and monitor these complex systems is not well understood.

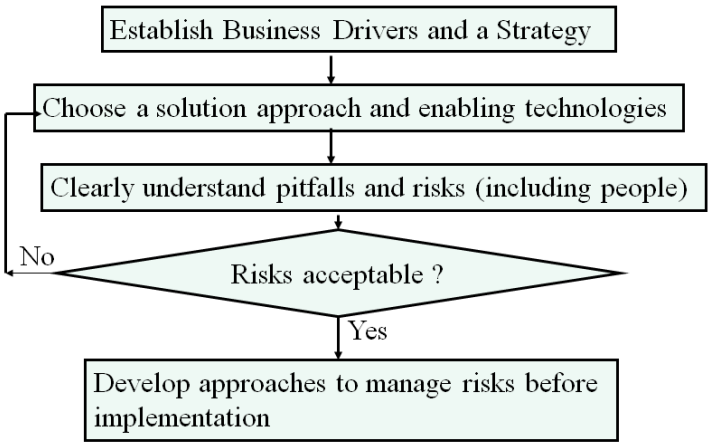

Figure 1-8: Recipe for Success

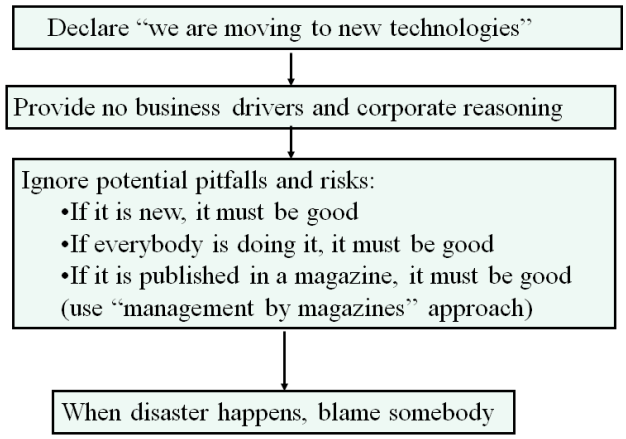

Figure 1-9: Recipe for Failure

In their zeal for glory, many companies ignore these issues and warnings. Before investing, organizations should establish realistic objectives and develop a solid plan to meet the objectives. Successful solutions exploit the promises of new technologies but carefully understand the business drivers and manage the risks while the others do not (see Figure 1-8 and Figure 1-9). The sidebar "What Went Wrong – Two Classic Examples " illustrate this point. We will visit these issues in more details in the next section.

What Went Wrong – Two Classic Examples

1) Furniture.com Goes Out of Business

Furniture.com was reviewed by CIO Magazine in the article "Furniture.com," Jan. 15, 2000. The company was selling furniture over the Web and promised Web shoppers 24-hour browsing and six- to eight-week delivery times on everything from table lamps to 10-piece bedroom ensembles. The company reported $22 million in net revenues for nine months ending September 2000 and attracted one million users a month. But the increase in usage also increased customer dissatisfaction. Customer complaints filed with the Better Business Bureau (BBB) in Worcester, Mass., jumped from one in 1999 to 149 in 2000 (most brick-and-mortar companies get three to four complaints a year). The most common complaints had to do with delivery problems, product quality and bill disputes.

The main problem was that the company management built the Furniture.com brand very well but they did not create the infrastructure needed to support it. The company under-estimated the logistics and costs involved in shipping such a bulky commodity cross-country and did not build a good way to track orders -- the company ended up tracking orders manually. Furniture.com also created a cancellation policy that was too expensive. The customers could, for example, cancel orders right until delivery day, but when six-week delivery turned into six-month delays, many orders were cancelled. Furniture.com closed down and filed for bankruptcy in November 2000.

Source: Stephanie Overby "The Changing Landscape of e-Business -- The Survivors", May. 1, 2001, CIO Magazine.

2) Boo.com Gets Booted Out

Boo.com promised its investors and on-line shoppers a Web site for online purchasing of high-quality, stylish, designer sportswear. Despite the widespread publicity, Boo.com declared bankruptcy only six months after its Web site had been launched, causing investors to loose an estimated $185 million. What went wrong? Here is the brief story.

The idea for Boo.com came from two 28-year-old Swedish friends who had already established and later sold Bokus.com, which is the world's third-largest on-line bookstore after Amazon.com and Barnes&Noble.com. The idea was to sell trendy fashion products over the Web at full retail price rather than at a discount. The Web site enabled shoppers to view every product in full-color, three-dimensional images with zooming and rotation capabilities to view them from any angle. To further entice buyers, the Boo.com customers earned "loyalty points," which they could use to obtain discounts on future purchases. Boo.com Web site was fluent in seven languages, accepted local currencies from 18 countries, and also offered free delivery within one week and also free returns for dissatisfied customers. In essence, this was to be the dream Web site for “time poor, cash rich” people.

Boo decided to develop both its Internet platform and customer-fulfillment systems from scratch. The overall plan was to launch the Website in 18 countries and handle 100 million Web visitors at once. The management also decided to open satellite offices in Munich, Paris, New York, and Amsterdam and hired hundreds of people to take orders from these offices once the site went live. However, the launch date had to be postponed a few times because of incomplete Web site development, and so many of the staff sat idle for months. By September the company had spent $70 million, and Boo undertook more fund-raising.

The Web site was finally launched in early November, 1999. The promised mass marketing blitz never happened. Basically, raising people's interest through pre-launch advertising while delaying the opening resulted in many disappointed and alienated potential customers. In addition, the site reviews were not good. Many (40 percent) of the site's visitors could not even gain access, the site was full of errors, and even caused visitors' computers to freeze. The site was slow and very difficult to use, far from revolutionary.

Only 25% of the customers were able to purchase from the website and users of Macintosh computers could not even log on because Boo.com was incompatible with them. The flashy graphics and interactive features took too long for users with slow Internet access. Angry customers jammed Boo.com's customer support lines and sales fell short of expenses. Things started going down hill quickly. Boo lost support from J.P. Morgan and Boo started selling its clothing at a 40 percent discount and laying off staff. Finally, in May 2000, the firm was liquidated with many outstanding bills it could not pay.

So what went wrong? Naturally, one problem was lack of planning and control. No matter what, all businesses need the fundamental activities of budgeting, planning, execution, and control. The company promised too much (e.g., 18 countries simultaneously), spent too much money on advertising and marketing hype (e.g., advertising in expensive magazines and renting offices in high-priced areas in London, Paris, and New York), and just wasted money without return on investment (employees reportedly flew first class and stayed in five-star hotels).

In addition, there were serious technical problems. Developing everything from scratch proved slow and expensive. The developers had to develop a complex virtual inventory system, because Boo maintained very little inventory of its own. Boo's multimedia presentation was complex and even the shopping cart was intricate because one customer might have a shopping cart with items from four or five different sources. The support for seven languages and 18 different currencies with calculations for taxes from 18 different countries is also an extremely complex task. Finally, many homes in the US and Europe lack the high-capacity Internet connections required to easily access the graphics and animation on the Boo.com site. In summary, a multitude of management and technical problems killed Boo.com.

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1.6.3 How to Succeed – From Strategies to Working Solutions

Unfortunately, many digital services (also known as IT services) fail, i.e., they are never used by the intended users. The well known Standish Group Chaos reports indicate failures to range from 50% to 70%. Failures in developing countries are much higher – in the range of 85%. To succeed in the digital age, the following things are needed at a very high level:

- A clear goal must be defined

- A solid strategy that is well thought out and is aligned with the goal
- Translation of the strategy into a working solution
- Expansion of the solution approach to handle the failures and address the pitfalls

Simply stated, strategy is a game plan to win. For example, lawyers develop strategies to win cases. In the same vein, army commanders develop strategies to win battles. In the turbulent and highly competitive of todays'marketplaces , IS managers have to develop strategies to win or to help their companies to win. Developing an effective strategy is essential but not enough. As evidenced by the above case studies, the strategic vision must be doable within the technical and business constraints. As noted by a Chief Executive Officer [Charan 1991]:

"There is a fine line between vision and hallucination".

To avoid "hallucination", the strategy must be translated into a working solution that executes the strategy. A working solution is a system (software + hardware) that satisfies the technical as well as organizational requirements (functional, security, performance, budgetary) and can be deployed, installed, operated, and managed. Without a good working solution and the strategies stay as visions or dreams that do not go anywhere.

Failure of IT projects as popularized by the yearly Standish Group Chaos Reports has been analyzed heavily. Most failures occur due to re-invention of the wheel throughout the system life cycle -- the unnecessary trial and error is not limited to one phase but to the entire Lean-Plan-Do-Check (LPDC) cycle, shown in Figure 1-10.

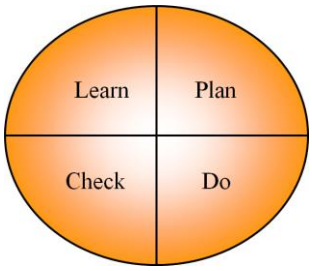

Figure 1-10: Show the Book Outline

The LPDC cycle, based on the idea by Peter Demming for continuous quality improvement, has been used for several years to successfully develop new systems and improve the existing ones. It consists of the following basic activities:

- **Lear**n what needs to be done (i.e., set a clear goal)
- **Plan** how to do it right (i.e., convert your knowledge into a working solution)
- **Do** whatever needs to be done to implement the working solution, and
- **Check** to see if the solution is actually working and adjust accordingly

Individuals involved in launching a digital service (e.g., a mobile health clinic) face many Learn-Plan-Do-Check challenges: "how do I understand the basic issues, policies, and approaches", "how do I develop a customized plan that is specific to my situation", "how do I successfully execute the developed plan", "how do I monitor and evaluate the progress being made", and "how do I do everything without re-inventing the wheel - what tools and solutions are available that I could use?" We will answer these questions in the next chapter by developing a systematic methodology and also suggesting a computer aided planning environment that supports the methodology.

The Agenda

- Digital Enterprise Concepts
- Evolution of Digital Enterprises
- Promises and Pitfalls of Digital Enterprises

Time to Take a Break

Suggested Review Questions

- List 3 promises and 3 possible pitfalls associated with using digital technologies
- Give an example of an company that has really benefitted because of the digital technologies
- Give an example of a company that failed too early because of too much technology
- How can you translate the strategies to working solutions. Give one example
- Can the Learn-Plan-Do-Check model be used to translate the strategies to working solutions

1.7 Why This Book?

The main goal of this book is to help the readers *successfully* plan, engineer and manage digital services by using the Learn-Plan-Do-Check cycle. To accomplish this goal, enough details are provided so that the translation can happen successfully and without failures. The sidebar "Book Outline" shows the overall structure and the topics discussed in this book. Module 1 introduces the basic concepts, Module 2 concentrates on business strategy and applications, Module 3 covers the digital infrastructure needed to support the strategy, and Module4 introduces a computer aided environment that supports the entire Learn-Plan-Do-Check cycle.

Each chapter is written as a self-contained tutorial on the subject matter. Different levels of discussion are included in each chapter (conceptual overviews, management summaries, trends and technical details) to support different audiences. Numerous references for additional study are provided. To illustrate the key points, a single case study about a company that is moving through the e-business maze is used throughout the book.

A powerful computer aided planning environment, called SPACE (Strategic Planning, Architectures, Controls, and Education) is unique feature of this book. SPACE augments this book through hands-on-experiments and systematically guides the users through all phases of the Learn-Plan-Do-Check cycle to clarify the concepts. The core capabilities of SPACE are covered in Module4.

Book Outline

Module 1 – The Big Picture

Chapter 1: Digital Enterprises and Services – An Overview

Chapter 2: Information Systems Planning and Patterns– A Quick Overview
Chapter 3: Cases and Projects for Experimentation

Module 2: Enterprise Business and Applications Planning
Chapter 4: Business Strategy, Organizations and Management
Chapter 5: Enterprise Information Systems and Enterprise Applications
Chapter 6: Enterprise Systems and ERPs

Module 3: Digital Infrastructure
Chapter 7: Enterprise Architectures and Digital Infrastructure Overview
Chapter 8: Data Bases, Big Data, Micro Data and Business Intelligence
Chapter 9: Networks, the Internet and the Web (IOT and WoT)

Module 4: Computer Aided Planning, Engineering and Management
Chapter 10: Artificial Intelligence and Intelligent Systems
Chapter 11: Computer Aided Planning, Engineering and Management
Chapter 12: Security and Governance
Chapter 13: Synthesis: Managing the Next Generation Enterprises

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