Information Systems: No Boundaries! A Concise Approach to Understanding Information Systems for All Disciplines

Shane M. Schartz
Fort Hays State, s_schartz@fhsu.edu

INFORMATION SYSTEMS: NO BOUNDARIES!

A Concise Approach to Understanding Information Systems for All Disciplines

SHANE M SCHARTZ

CONTENTS

This text is in a BETA version. It is a living document and will change and grow over the Fall 2021 semester. DO expect updates, rewording, and other items to appear.

Note From Author:

This book was created to provide a different experience for students beginning their studies in information systems. Instead of being bombarded with information from a business systems perspective, the goal of this book is to provide a baseline of material regarding information systems in all disciplines, not just business systems – hence the name No Boundaries!

Each chapter includes a homework assignment that is purposely designed to relate to the content area, however, is not remedial in nature. Instead, the assignment hopes to provoke some discovery learning, association, and fun!

1.

CHAPTER 1 - WHAT IS IS?

Learning Objectives

1.1 Understand the various definitions of information systems.

1.2 Explain the data-to-value process and its relation to the Input, Process, Output (IPO) model.

1.3 Understand the importance of information in decision making.

1.4 Differentiate between information technology (IT) and information systems (IS).

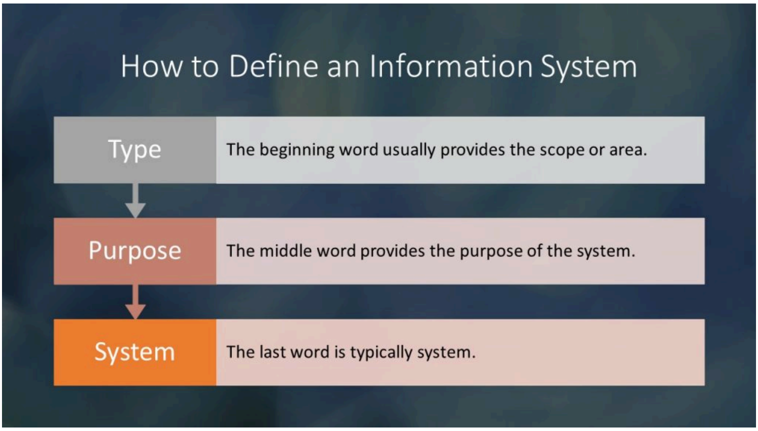
The ever-changing definition of information systems

A simple, beginning question such as "What is an information system?" will begin your journey down the complex, dynamic, and situational world that is information systems. Within the scope of information systems, the term 'IS' can refer to the field of information systems, a departmental unit within an organization, the overall information systems in use and even be used to describe specific components within an information system. The key to understanding which the focus is to also understand the context of the information being presented. For example, a discussion about issues related to a process or procedure most likely refers to a specific portion of the information systems in use. Discussing the difficulties in learning a new system in general, however, likely refers to the field of information systems.

While almost all information systems are unique in their own way, the do classify into common groupings. A person may be familiar with terms such as management information systems, geographic information systems, enterprise systems, social information systems, etc. These various categories of information systems can help further define the *purpose* of the information system. However, the question is what do all these systems have in common and how are information systems defined?

Information systems can be defined using the following: [Type] [Purpose] [System] (TPS). While there are variations of system 'naming' that go outside of these parameters, many systems will be named within this style. Let's start with management information systems. 'Management' has varying definitions as well, and for the sake of this text, we will use the Bateman & Snell (2013) definition of "the pursuit of organizational goals through organizational resources". 'Information', as a broad definition, is considered data presented in a context.

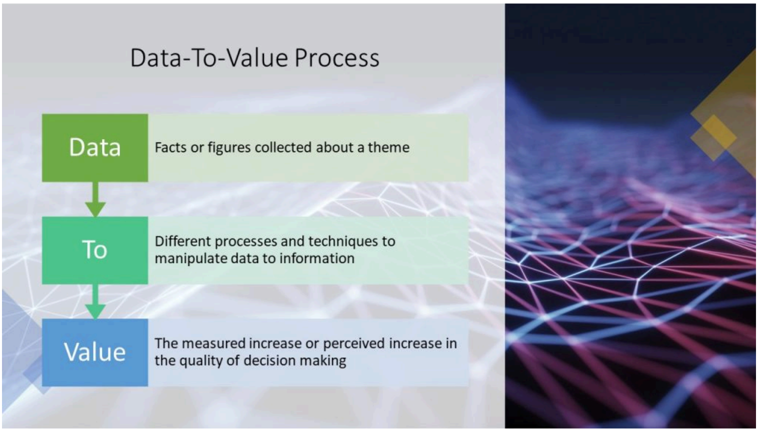
'System' ultimately is defined as a group of components working together. Now let's examine these terms through combinations.



Using the TPS definition parameters and the definitions of each word, a 'management system' would be considered a collection of components working together to reach organizational goals while using organizational resources. 'Management information' would be considered presented data for the pursuit of organizational goals. Finally, 'information system' would be considered a collection of components that work together to present data in a context. A 'context', one should note, is presenting data in a perception that is meaningful to the end user or the person viewing the presented data. Altogether, a 'management information system' should be considered a collection of components working together to achieve organizational goals by presenting data in a meaningful context. Using the TPS parameters, this system would be limited in scope to management and its purpose is to produce information. It is also a system, which is discussed next. When comparing a geographic information system to a management information system, for example, both systems are systems that produce information, however, one is producing information for management and the other for geographic purposes. The type of system is critical to the purpose of the system as it drastically changes the functionality, appearance, and user interaction of the system.

The relationship between the data-to-value process and the input, process, output model

Referring to the definition above, the overall purpose of Information Systems is to produce information. To produce that information, data must be inputted into the system, analyzed (processed), and then outputted to the end user. So as an area of study, Information Systems is heavily involved in not only the creation of processing of data, but also providing value to users of the system. Value, in this context, is most defined as 'the perception of worth an end user assigns to the presented information'.



The conversion of 'meaningless' data into valued information follows a mature model of input, process, output (IPO). In one's quest to understand information systems and their impact, the relationship between IPO and data-to-value helps to define the goals of a particular system and find areas for improvement within existing systems.

The input, process, output model is a common model that has been in existence for decades. Used mostly within software programs or processes, the IPO model is a great tool when also considering the data-to-value approach to understanding information systems. Data is generally considered an 'input' to an information system, and as the old saying goes: "garbage in, garbage out". While mostly true, data can be manipulated within the processing stage to help improve the quality of the output. Within the IPO model, at any point 'value' can be added within the input phase, the processing phase, or the output phase. Increasing value in this case is increasing the quality of information *and* the quality of the perception by the user.

Input: In the information systems world data is almost always considered the input, so how can we improve the value? At the input stage improving the quality of the data will most likely provide the most value to the end user that only views the output stage. Specific strategies to improve data quality are dependent on the system design of the information systems in questions, however, there are some general tips.

1. Automate data collection. Unfortunately, humans make mistakes, and these mistakes can

be eliminated through automation.

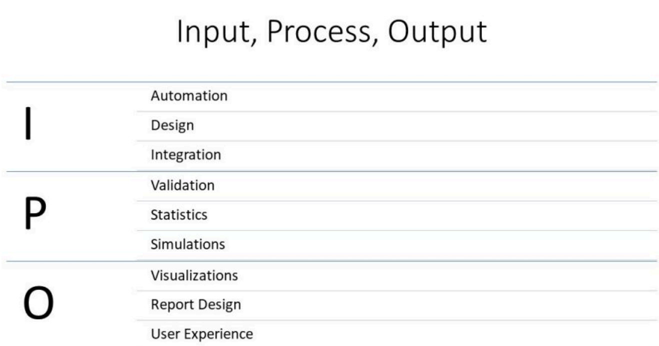
2. Database design will greatly impact your data quality. Revisit and revise the database and the data collection procedures often.
3. Consider integrations. Since information systems can be composed of many different pieces, many different types of software may be used. Consider the compatibility of the different software programs.

Process: In this application of the IPO model process is referring to the value-adding activities that occur to the data to transform it into information. This may include analyzing the data using various statistical techniques and data aggregating, cleaning, transformation, and manipulation. Value-adding tips for this phase:

1. Data validation – Checking and using techniques that ensure the integrity and accuracy of the data being processed.
2. Using the appropriate statistical techniques to create the information needed.
3. Applying analytical techniques such as trends and scenarios correctly to provide unbiased information.

Output: Output, or reporting, consists of activities that are designed to improve the visualization and usefulness of the information. In practice this is typically in the form of real-time dashboards and or static info graphics or more traditional reports. Some general tips for output are as follows:

1. Create meaningful and minimal information visualizations that provide the information needed.
2. Attempt to review and remove any bias that may be present in your visualizations.
3. Create a standard design format for information tools to provide consistent and intuitive user experiences.

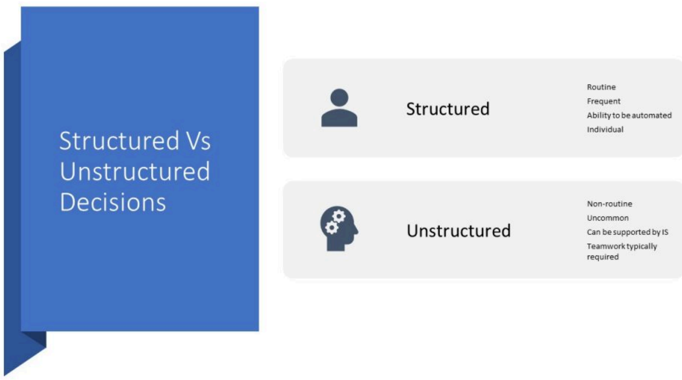


Decision-making and information

Perhaps one of the most common applications of information systems is decision-making. The information produced within an information system has the benefit of constantly being reproduced and updated – providing users with a common platform that can used individually or by many across the globe to be able to consistently use the same information to ideally make consistent decisions.

Information systems can also be used to automate decisions. Routine, or structured, decisions will typically follow a logical rule that allows the decision maker to use minimal or no effort to make the decision. For example, the decision to eat during the day should be a routine decision. However, it may become more complex to decide *what* you would like to eat! Information systems could be used to help you automate that decision, such as systems for dietary needs, wearables, etc.

While information systems and technology can help better automate routine decisions, the real power of information systems is in non-routine decision making. A non-routine decision is typically a complex decision that requires many facets of information to be considered simultaneously to help decrease the risk of making a bad decision. For example, purchasing a car would be considered a non-routine decision. There are many factors to consider, new versus used, type of car, etc. How does one decide which car to buy? Each factor provides its own wealth of information, of which can be of poor quality and biased. Even the fair price of a car can be a topic of debate. As people, in complex decisions such as this we tend to explore and utilize multiple resources simultaneously to help us ultimately make the decision. In information systems, one of the goals is to help unify and aggregate the information needed to help make the decision. Therefore, when you visit car buying sites you will see common items such as distance traveled (total miles), condition, year, and other common characteristics. Some sites will then provide you user ratings and reviews along with professional reviews from car experts.

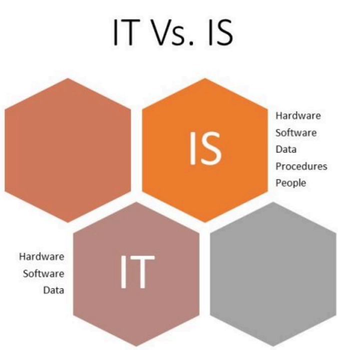


So how does a person know they are making the right decision, and can an information system tell them? The simple answer is no, however, information systems through artificial intelligence, data mining and machine learning are getting closer to helping users *predict* the likelihood of decision making as part of the process in aiding decision making.

IT vs. IS

Often Information Technology ‘IT’ and Information Systems ‘IS’ are used interchangeably, however, they are not equivalent. So, what’s the difference between technology and systems? The ‘technology’ is a subset of the systems world. This is related to the definition of the systems definition: a group of components working together. So, what are the components of an information system?

While various sources will list different numbers of components, most agree that systems are composed of hardware, software, data, procedures, and people. Dr. David Kroenke refers to this as the five-component framework. In the debate of information technology and information systems, hardware, software, and data can be grouped into 'technology' and data, procedures and people can be grouped into 'people'. One may ask why data is in the middle and included on both sides. The simple answer is the technology creates the data; however, the purpose of the system is to produce information from the data. People, therefore, wouldn't use the system without data and in many instances, people *also* create the data.



The rule of thumb to decide between whether a topic is an information technology or and information systems topic is to consider whether people are involved. If people are not highly involved, then it is likely an IT topic and if they are highly involved it is an IS topic. Organizations are beginning to reflect this difference by have a separate technology area and sometimes even department. This area would focus on improving the technology in the organization, while the information systems area would become more focused on how to migrate the new technologies into the organization. It is important to note that it is typically easy to change technologies, however, also getting the people in the organization can be very difficult due to the resistance to change.

Chapter 1 Homework

Overview

This assignment is designed to help you understand the 'skills' gap that may or may not exist in your industry.

Assignment

In this assignment you will explore the skills gap (or lack of) within your future career industry. Complete/answer the following questions in a separate word document and submit it to blackboard for grading.

Questions/Statements

1. What industry do you plan to work in once you complete your academic career?
2. Using the following report: The Skills Gap (and other resources as appropriate), describe what is happening within your industry.
3. Finally, conclude with how you plan to address the skills gap with your current career path.

Grading

A satisfactory submission will address the questions/ statements above providing a description of the industry and the skills gap within the industry. An explanation comparing the gap to your current career path is also expected.

A beyond satisfactory submission may include detailed information about the skills gap within your industry and a detailed description of how the industry is addressing the skills gap. Further analysis will show the strengths or weaknesses your current career path may be providing and provide solutions for fulfilling those gaps or strengthening current plans.

2.

CHAPTER 2 - IT TECHNOLOGY

Learning Objectives

2.1 Describe the evolution and role of information technology hardware.

2.2 Describe the evolution and role of information technology software.

Information technology hardware

Hardware, or information technology hardware, truly began in the early 1900s as mechanical devices and theoretical frameworks. These devices and frameworks, with electricity and technological advances slowly morphed into the recognizable computer hardware that we use today. As hardware has evolved, it has mostly followed one main ‘law’ referred to Moore’s law. Moore’s law states that the number of transistors in a dense integrated circuit doubles in size about every two years. This doubling of transistors in the same space directly and indirectly has brought about a few consistent changes:

1. Hardware size has greatly decreased over time.
2. Data transfer between devices has become more powerful over time.
3. Hardware costs have greatly decreased over time.

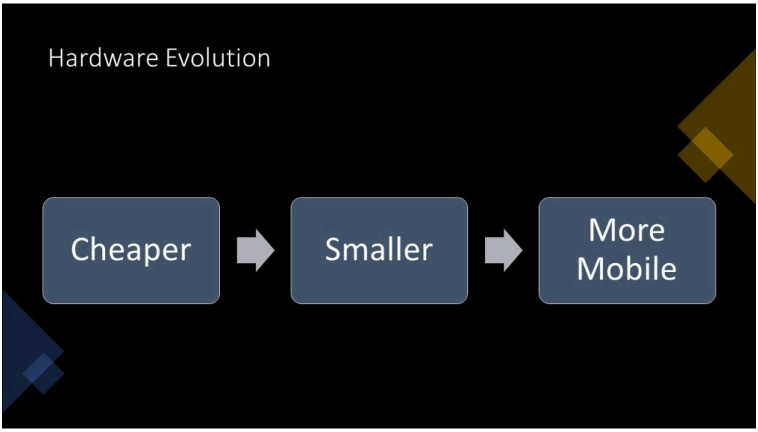
These increases and decreases have caused data storage to become affordable, allowing organizations and individuals to store tremendous amounts of data while also allowing that data to be processed in almost real-time. For data, the rule was the data should be worth its cost, however, the data now costs very little to store, and the value of that data may be high in the future. Organizations and individuals can now store almost all data they want to store; however, the costs have shifted from the hardware being prohibitive to the management and security of that data.

The physical parts of computing devices – those that you can actually touch – are referred to as hardware. The opposite of hardware is software, which you cannot physically touch. The difficulty with classifying hardware is that most hardware *contains* software. Hardware typical users interact with also input and output information – meaning not only are they hardware they are also ‘mini’ information systems as well! These mini systems are commonly referred to as digital devices or devices.

This includes devices such as the following:

- desktop computers
- laptop computers
- mobile phones
- tablet computers
- e-readers
- storage devices, such as flash drives
- input devices, such as keyboards, mice, and scanners
- output devices such as printers and speakers.

Besides these more traditional computer hardware devices, many items that were once not considered digital devices are now becoming computerized themselves. Digital technologies are now being integrated into many everyday objects, so the days of a device being labeled categorically as computer hardware may be ending. Examples of these types of digital devices include automobiles, refrigerators, and even soft-drink dispensers.



Personal computers

A personal computer is designed to be a general-purpose device. That is, it can be used to solve many different types of problems. As the technologies of the personal computer have become more commonplace, many of the components have been integrated into other devices that previously were purely mechanical. We have also seen an evolution in what defines a computer. Ever since the invention of the personal computer, users have clamored for a way to carry them around. Here we will examine several types of devices that represent the latest trends in personal computing.

Portable computers

In 1983, Compaq Computer Corporation developed the first commercially successful portable personal computer. By today's standards, the Compaq PC was not very portable: weighing in at 28 pounds, this computer was portable only in the most literal sense – it could be carried around. But this was no laptop; the computer was designed like a suitcase, to be lugged around and laid on its side to be used. Besides portability, the Compaq was successful because it was fully compatible with the software being run by the IBM PC, which was the standard for business.

In the years that followed, portable computing continued to improve, giving us laptop and notebook computers. The “luggable” computer has given way to a much lighter clamshell computer that weighs from 4 to 6 pounds and runs on batteries. In fact, the most recent advances in technology give us a new class of laptop that is quickly becoming the standard: these laptops are extremely light and portable and use less power than their larger counterparts. The MacBook Air is a good example of this: it weighs less than three pounds and is only 0.68 inches thick!

Finally, as more and more organizations and individuals are moving much of their computing to the Internet, laptops are being developed that use “the cloud” for all of their data and application storage. These laptops are also extremely light because they have no need of a hard disk at all! A good example of this type of laptop (sometimes called a netbook) is Samsung’s Chromebook.

Smartphones

The first modern-day mobile phone was invented in 1973. Resembling a brick and weighing in at two pounds, it was priced out of reach for most consumers at nearly four thousand dollars. Since then, mobile phones have become smaller and less expensive; today mobile phones are a modern convenience available to all levels of society. As mobile phones evolved, they became more like small computers. These smartphones have many of the same characteristics as a personal computer, such as an operating system and memory. The first smartphone was the IBM Simon, introduced in 1994.

In January of 2007, Apple introduced the iPhone. Its ease of use and intuitive interface made it an immediate success and solidified the future of smartphones. Running on an operating system called iOS, the iPhone was really a small computer with a touch-screen interface. In 2008, the first Android phone was released, with similar functionality.

Tablet computers

A tablet computer is one that uses a touch screen as its primary input and is small enough and light enough to be carried around easily. They generally have no keyboard and are self-contained inside a rectangular case. The first tablet computers appeared in the early 2000s and used an attached pen as a writing device for input. These tablets ranged in size from small personal digital assistants (PDAs), which were handheld, to full-sized, 14-inch devices. Most early tablets used a version of an existing computer operating system, such as Windows or Linux.

These early tablet devices were, for the most part, commercial failures. In January 2010, Apple introduced the iPad, which ushered in a new era of tablet computing. Instead of a pen, the iPad used the finger as the primary input device. Instead of using the operating system of their desktop and laptop computers, Apple chose to use iOS, the operating system of the iPhone. Because the iPad had a user interface that was the same as the iPhone, consumers felt comfortable, and sales took off. The iPad has set the standard for tablet computing. After the success of the iPad, computer manufacturers began to develop new tablets that utilized operating systems that were designed for mobile devices, such as Android.

The commoditization of the personal computer

Over the past thirty years, as the personal computer has gone from technical marvel to part of our everyday lives, it has also become a commodity. The PC has become a commodity in the sense that there is very little differentiation between computers, and the primary factor that controls their sale is their price. Hundreds of manufacturers all over the world now create parts for personal computers. Dozens of companies buy these parts and assemble the computers. As commodities, there are essentially no differences between computers made by these different companies. Profit margins for personal computers are razor-thin, leading hardware developers to find the lowest-cost manufacturing.

There is one brand of computer for which this is not the case – Apple. Because Apple does not make computers that run on the same open standards as other manufacturers, they can make a unique product that no one can easily copy. By creating what many consider to be a superior product, Apple can charge more for their computers than other manufacturers. Just as with the iPad and iPhone, Apple has chosen a strategy of differentiation, which, at least at this time, seems to be paying off.

Information technology software

The second component of an information system is software. Simply put: Software is the set of instructions that tell the hardware what to do. Software is created through the process of programming. Without software, the hardware would not be functional.

Types of software

Software can be broadly divided into two categories: operating systems and application software. *Operating systems* manage the hardware and create the interface between the hardware and the user. *Application software* is the category of programs that do something useful for the user.

Operating systems

The operating system provides several essential functions, including:

1. managing the hardware resources of the computer,
2. providing the user-interface components,
3. providing a platform for software developers to write applications.

All computing devices run an operating system. For personal computers, the most popular operating systems are Microsoft's Windows, Apple's OS X, and different versions of Linux. Smartphones and tablets run operating systems as well, such as Apple’s iOS, Google’s Android, Microsoft’s Windows Mobile, and Blackberry.

Early personal-computer operating systems were simple by today’s standards; they did not provide multitasking and required the user to type commands to initiate an action. The amount of memory that early operating systems could handle was limited as well, making large programs impractical to run. The most popular of the early operating systems was IBM’s Disk Operating System, or DOS, which was developed for them by Microsoft.

In 1984, Apple introduced the Macintosh computer, featuring an operating system with a graphical user interface. Though not the first graphical operating system, it was the first one to find commercial success. In 1985, Microsoft released the first version of Windows. This version of Windows was not an operating system, but instead was an application that ran on top of the DOS operating system, providing a graphical environment. It was quite limited and had little commercial success. It was not until the 1990 release of Windows 3.0 that Microsoft found success with a graphical user interface. Because of the hold of IBM and IBM-compatible personal computers on business, it was not until Windows 3.0 was released that business users began using a graphical user interface, ushering us into the graphical-computing era. Since 1990, both Apple and Microsoft have released many new versions of their operating systems, with each release adding the ability to process more data at once and access more memory. Features such as multitasking, virtual memory, and voice input have become standard features of both operating systems.

A third personal-computer operating system family that is gaining in popularity is Linux (pronounced “linn-ex”). Linux is a version of the Unix operating system that runs on the personal computer. Unix is an operating system used primarily by scientists and engineers on larger minicomputers. These are very expensive computers, and software developer Linus Torvalds wanted to find a way to make Unix run on less expensive personal computers. Linux was the result. Linux has many variations and now powers a large percentage of web servers in the world. It is also an example of *open-source software*, a topic we will cover later in this chapter.

Application software

The second major category of software is application software. Application software is, essentially, software that allows the user to accomplish some goal or purpose. For example, if you must write a paper, you might use the application-software program Microsoft Word. If you want to listen to music, you might use iTunes. To surf the web, you might use Internet Explorer or Firefox. Even a computer game could be considered application software.

Productivity software

When a new type of digital device is invented, there are generally a small group of technology enthusiasts who will purchase it just for the joy of figuring out how it works. However, for most of us, until a device can actually do something useful, we are not going to spend our hard-earned money on it. A “killer” application is one that becomes so essential that large numbers of people will buy a device just to run that application. For the personal computer, the killer application was the spreadsheet. In 1979, VisiCalc, the first personal-computer spreadsheet package, was introduced. It was an immediate hit and drove sales of the Apple II. It also solidified the value of the personal computer beyond the relatively small circle of technology geeks. When the IBM PC was released, another spreadsheet program, Lotus 1-2-3, was the killer app for business.

Along with the spreadsheet, several other software applications have become standard tools for the workplace. These applications, called productivity software, allow office employees to complete their daily work. Many times, these applications come packaged together, such as in Microsoft’s Office suite. Here is a list of these applications and their basic functions:

- Word processing: This class of software provides for the creation of written documents. Functions include the ability to type and edit text, format fonts and paragraphs, and add, move, and delete text throughout the document. Most modern word-processing programs also have the ability to add tables, images, and various layout and formatting features to the document. Word processors save their documents as electronic files in a variety of formats. By far, the most popular word- processing package is Microsoft Word, which saves its files in the

DOCX format. This format can be read/written by many other word-processor packages.

- Spreadsheet: This class of software provides a way to do numeric calculations and analysis. The working area is divided into rows and columns, where users can enter numbers, text, or formulas. It is the formulas that make a spreadsheet powerful, allowing the user to develop complex calculations that can change based on the numbers entered. Most spreadsheets also include the ability to create charts based on the data entered. The most popular spreadsheet package is Microsoft Excel, which saves its files in the XLSX format. Just as with word processors, many other spreadsheet packages can read and write to this file format.
- Presentation: This class of software provides for the creation of slideshow presentations.

Harkening back to the days of overhead projectors and transparencies, presentation software allows its users to create a set of slides that can be printed or projected on a screen. Users can add text, images, and other media elements to the slides. Microsoft's PowerPoint is the most popular software right now, saving its files in PPTX format.

- Some office suites include other types of software. For example, Microsoft Office includes Outlook, its e-mail package, and OneNote, an information-gathering collaboration tool. The professional version of Office also includes Microsoft Access, a database package.

Microsoft popularized the idea of the office-software productivity bundle with their release of Microsoft Office. This package continues to dominate the market and most businesses expect employees to know how to use this software. However, many competitors to Microsoft Office do exist and are compatible with the file formats used by Microsoft (see table below). Recently, Microsoft has begun to offer a web version of their Office suite. Similar to Google Drive, this suite allows users to edit and share documents online utilizing cloud-computing technology. Cloud computing will be discussed later in this chapter.

Utility software and programming software

Two subcategories of application software worth mentioning are utility software and programming software. Utility software includes software that allows you to fix or modify your computer in some way. Examples include antivirus software and disk defragmentation software. These types of software packages were invented to fill shortcomings in operating systems. Many times, a subsequent release of an operating system will include these utility functions as part of the operating system itself.

Programming software is software whose purpose is to make more software. Most of these programs provide programmers with an environment in which they can write the code, test it, and convert it into the format that can then be run on a computer.

Mobile applications

Just as with the personal computer, mobile devices such as tablet computers and smartphones also have operating systems and application software. In fact, these mobile devices are in many ways just smaller versions of personal computers. A mobile app is a software application programmed to run specifically on a mobile device.

Smartphones and tablets are becoming a dominant form of computing, with many more smartphones being sold than personal computers. This means that organizations will have to get smart about developing software on mobile devices in order to stay relevant.

As organizations consider making their digital presence compatible with mobile devices, they will have to decide whether to build a mobile app. A mobile app is an expensive proposition, and it will only run on one type of mobile device at a time. For example, if an organization creates an iPhone app, those with Android phones cannot run the application. Each app takes several thousand dollars to create, so this is not a trivial decision for many companies.

One option many companies have is to create a website that is mobile-friendly. A mobile website works on all mobile devices and costs about the same as creating an app.

Cloud computing

Historically, for software to run on a computer, an individual copy of the software had to be installed on the computer, either from a disk or, more recently, after being downloaded from the Internet. The concept of "cloud" computing changes this, however.

To understand cloud computing, we first have to understand what the cloud is. "The cloud" refers to applications, services, and data storage on the Internet. These service providers rely on giant server farms and massive storage devices that are connected via Internet protocols. Cloud computing is the use of these services by individuals and organizations.

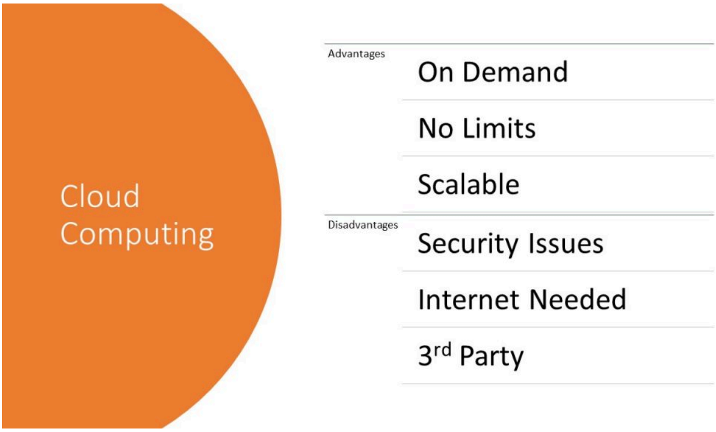
You probably already use cloud computing in some forms. For example, if you access your e-mail via your web browser, you are using a form of cloud computing. If you use Google Drive's applications, you are using cloud computing. While these are free versions of cloud computing, there is big business in providing applications and data storage over the web. Salesforce (see above) is a good example of cloud computing – their entire suite of CRM applications is offered via the cloud. Cloud computing is not limited to web applications: it can also be used for services such as phone or video streaming.

Advantages of Cloud Computing

- No software to install or upgrades to maintain.
- Available from any computer that has access to the Internet.
- Can scale to a large number of users easily.
- New applications can be up and running very quickly.
- Services can be leased for a limited time on an as-needed basis.
- Your information is not lost if your hard disk crashes or your laptop is stolen.
- You are not limited by the available memory or disk space on your computer.

Disadvantages of Cloud Computing

- Your information is stored on someone else's computer – how safe is it?
- You must have Internet access to use it. If you do not have access, you're out of luck.
- You are relying on a third-party to provide these services



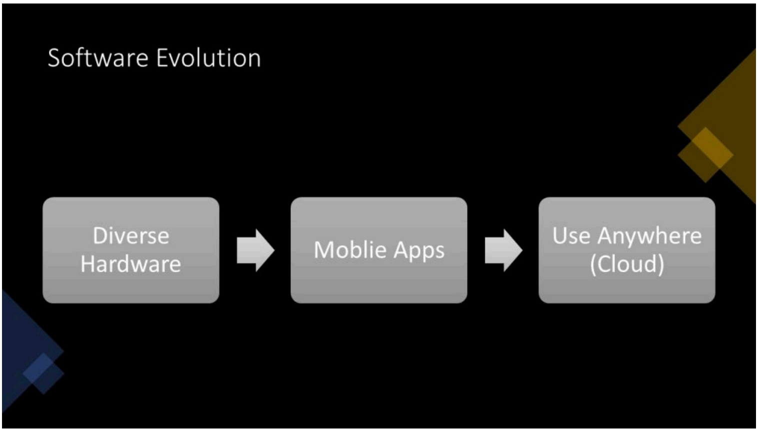
Cloud computing has the ability to really impact how organizations manage technology. For example, why is an IT department needed to purchase, configure, and manage personal computers and software when all that is really needed is an Internet connection?

Using a private cloud

Many organizations are understandably nervous about giving up control of their data and some of their applications by using cloud computing. But they also see the value in reducing the need for installing software and adding disk storage to local computers. A solution to this problem lies in the concept of a *private cloud*. While there are various models of a private cloud, the basic idea is for the cloud service provider to section off web server space for a specific organization. The organization has full control over that server space while still gaining some of the benefits of cloud computing.

Virtualization

One technology that is utilized extensively as part of cloud computing is "virtualization." Virtualization is the process of using software to simulate a computer or some other device. For example, using virtualization, a single computer can perform the functions of several computers. Companies such as EMC provide virtualization software that allows cloud service providers to provision web servers to their clients quickly and efficiently. Organizations are also implementing virtualization in order to reduce the number of servers needed to provide the necessary services.



Software creation

How is software created? If software is the set of instructions that tells the hardware what to do, how are these instructions written? If a computer reads everything as ones and zeroes, do we have to learn how to write software that way?

Modern software applications are written using a programming language. A programming language consists of a set of commands and syntax that can be organized logically to execute specific functions. This language generally consists of a set of readable words combined with symbols. Using this language, a programmer writes a program (called the source code) that can then be compiled into machine-readable form, the ones and zeroes necessary to be executed by the CPU. Examples of well-known programming languages today include Java, PHP, and various flavors of C (Visual C, C++, C#). Languages such as HTML and JavaScript are used to develop web pages. Most of the time, programming is done inside a programming environment; when you purchase a copy of Visual Studio from Microsoft, it provides you with an editor, compiler, and help for many of Microsoft's programming languages.

Software programming was originally an individual process, with each programmer working on an entire program, or several programmers each working on a portion of a larger program. However, newer methods of software development include a more collaborative approach, with teams of programmers working on code together.

When the personal computer was first released, it did not serve any practical need. Early computers were difficult to program and required great attention to detail. However, many personal-computer enthusiasts immediately banded together to build applications and solve problems. These computer enthusiasts were happy to share any programs they built and solutions to problems they found; this collaboration enabled them to innovate and fix problems quickly.

As software began to become a business, however, this idea of sharing everything fell out of favor, at least with some. When a software program takes hundreds of man-hours to develop, it is understandable that the programmers do not want to just give it away. This led to a new business model of restrictive software licensing, which required payment for software, a model that is still dominant today. This model is sometimes referred to as *closed source*, as the source code is not made available to others.

There are many, however, who feel that software should not be restricted. Just as with those early hobbyists in the

1970s, they feel that innovation and progress can be made much more rapidly if we share what we learn. In the 1990s, with Internet access connecting more and more people together, the open- source movement gained steam.

Open-source software is software that makes the source code available for anyone to copy and use. For most of us, having access to the source code of a program does us little good, as we are not programmers and won't be able to do much with it. The good news is that open-source software is also available in a compiled format that we can simply download and install. The open-source movement has led to the development of some of the most-used software in the world, including the Firefox browser, the Linux operating system, and the Apache web server. Many also think open-source software is superior to closed-source software. Because the source code is freely available, many programmers have contributed to open-source software projects, adding features and fixing bugs.

Many businesses are wary of open-source software precisely because the code is available for anyone to see. They feel that this increases the risk of an attack. Others counter that this openness decreases the risk because the code is exposed to thousands of programmers who can incorporate code changes to quickly patch vulnerabilities.

There are many arguments on both sides of the aisle for the benefits of the two models. Some benefits of the open-source model are:

- The software is available for free.
- The software source-code is available; it can be examined and reviewed before it is installed.
- The large community of programmers who work on

open-source projects leads to quick bug- fixing and feature additions.

Some benefits of the closed-source model are:

- By providing financial incentive for software development, some of the brightest minds have chosen software development as a career.
- Technical support from the company that developed the software.

Today there are thousands of open-source software applications available for download. For example, as we discussed previously in this chapter, you can get the productivity suite from Open Office. One good place to search for open-source software is sourceforge.net, where thousands of software applications are available for free download.

Chapter 2 Homework

Overview

This assignment is designed to expose you to the journey and evolution of information technology.

Assignment

Create a timeline of major events that have occurred within information technology.

Steps/Questions

- Using the Internet as a resource, you need to create a timeline of major events that include the following:

        - Major IT event for each decade: 1960s, 1970s, 1980s, 1990s, 2000s, 2010s, 2020s.
            - For 2020s you need to list what you think will happen this coming decade.
            - For all other decades you need to list the event and describe the importance of the event.
        - Major Innovations of when they began and when you believe they reached maturity (when they peaked in use, etc. – define maturity for you).
            - Smart Phones
            - PCs
            - Wearables
            - Applications
            - Social Media
        - The timeline can be of any design of your choosing but should be clean looking and professional as possible.
- Finally, answer the following question: Where is there a gap (~5 to 10 years) or gaps in the timeline? Explain the gap(s) and why you think they occurred.

Grading

A satisfactory submission will have a complete timeline and answers to the questions.

A beyond satisfactory submission will likely have an organized, appealing timeline with relevant events and a complete description of the listed technologies. Additional data/references may be used to support opinion-based responses.

3.

CHAPTER 3 - DATA ANALYTICS

Learning Objectives

3.1 Understand the main components of database structure and design.

3.2 Describe the relationship between data science and data analytics

3.3 Understand the three categories of analytics

3.4 Describe the differences between data analytics and big data analytics

Database structure and design

Data! Data is the 'power' to the information system engine. Without it, the system simply would not be able to produce the information needed to reach the goal of improving decision making. But what is it? In reality it is electricity stored and interpreted as a zero or a one, yes, binary code. It is then grouped into bytes and used to fuel the processing phase to ultimately be converted into information.

How the data is stored is critical, however. Improper data storage can lead to junk data, data loss and limited processing abilities. Remember, the quality of our information is dependent on the quality of our data. Improving storage and retrieval for example, can provide new processing or analytical power, which can then improve the information for decision makers – adding value!

Database design is a complex and multi-stage process, however, beyond the scope of this text. At an introductory level, understanding how data is stored within tables and organized can help with overall system and process designs regardless of the industry. The first step in database design is to ensure everyone is speaking the same 'language'. In the data world, there is traditional vocabulary, modern vocabulary, and development vocabulary. Each of these sets (traditional, modern, development) uses unique terms that are synonymous with terms in the other sets. Traditional terms include file, record, field, key. Modern terms include table, row, column, key. Development terms include Entity, instance, attribute, identifier.

Starting with the development terms, an Entity is defined as anything that exists that can be represented or quantified by variable and static data. An example we are all familiar with is automobiles. Automobiles exist, and they can have variable and static data. Variable data can change, while static data may be data that normally would not change.

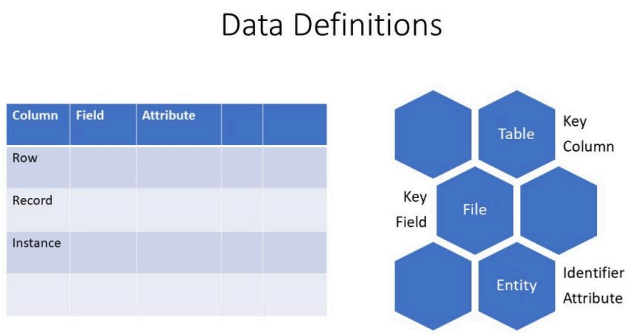
Once an Entity has been identified, the next step would be to assign attributes to the entity. Attributes are characteristics of the entity. In the case of automobiles, these may be VIN number (vehicle identification number), color, type, model, trim, mileage, location, etc. Using traditional terms, one would say the automobile file contains the following fields: VIN, color, type, model, trim, mileage, location. Using modern terms, one would say the automobile table contains the following columns: VIN, color, type, model, trim, mileage, location.

With the columns/fields/attributes defined, the database can now begin to have data added to the database. Note that a single table/entity/file database is typically just a dataset, and databases will typically have more than one table/entity/file. The rows/records/ instances of the table/entity/file can then be populated with specific examples of automobiles. For example, my car, a 2012 Subaru Impreza WRX STI would appear as follows:

123XXX456, plasma blue, Subaru, Impreza, WRX STI, 39,000, Hays, KS.

When inputting the data, it was clear that the year of the automobile was missed as there was no column available for the year. In this case, a new column (or attribute) could be added to capture the year.

The true power of databases and datasets, however, is in the ability to reference and combine the tables into powerful relational databases through establishing relationships between the datasets either within the database management system (DBMS) or other specialized software, such as Tableau. The DBMS is a specialized system that is used to secure and access the database to provide security and redundancy to help protect the actual data. Tableau, on the other hand, will allow a user to connect to and combine multiple datasets for analysis.



To tap into the power, one must first identify and remove any additional themes that may exist within the table or entity. These themes are then put into their own table and turn into an entity themselves! The easiest way to identify themes is when a cell (this is the intersection of a row and column) contains a value that is equal to another cell within the same column. In our automobile example, ‘Subaru’ is likely to appear in many other instances of automobiles as there are many Subarus in the automobile marketplace. The cell is located in the ‘type’ column, which means a new Entity, such as manufacturer, could be made for ‘type’. The new attributes for manufacturer may be name, address, categories, year established, etc.

Once each table contains a singular theme, identifiers/keys can be used to establish links, or relationships, between the datasets. In this example, the automobile has an identification number (VIN) that is used to identify the specific automobile. This unique identifying number or text is considered the 'primary key'. However, this VIN may appear multiple times in another table or dataset such as a servicing record. In the second table, it is known as a secondary key. A secondary key is a primary key in another table. While the primary key needs to be unique within its own table, the secondary key does not need to be unique, but helps 'identify' the specific row or instance within the primary table. This link between the primary key and the secondary key is very powerful in relational databases.

Imagine that in the manufacturer table, 'Subaru' has a *manufacturer ID* that is S9834. While that data is meaningless on its own, it is the identifier or primary key for Subaru. Any other table that is created and uses 'Subaru' should actually use 'S9834' *instead of* 'Subaru'. The software or DBMS would then know through the link or relationship created that any row using S9834 would be referring to Subaru. In the future Subaru may change their name to "Subiz" and this is where the keys are very important. Instead of changing the name of every mention of Subaru in all tables, a person would simply have to change the name in the manufacturer's table. The relationships between the keys would then automatically update all reports, etc. with Subiz instead of Subaru.

Data science, data analytics, and big data

In the world of data, especially recent data trends, there are many new and recycled terms that are used, many with fluid definitions. In the scope of this text, the focus is within the realm of data science, however, more focused on data analytics. The most common terms used to describe the analysis of data are data science, data analytics, and big data. What's the difference between the terms? Much like information technology and information systems, the terms are differentiated on the components involved. In the data world, the components consist of engineering, communication, and analysis.

Combining the terms in different ways will yield various 'areas of focus'. Engineering in this context refers to the design, creation, and structure of data and datasets. Communication can be defined as the flow of data from a source or multiple sources to ultimately the user. Finally, analysis refers to statistical techniques used to refine and manipulate data into desired and/or new information. Combining all three areas results in the field of data science. Some may argue that since all the areas combined results in any combination *also* being data science, the reality, much like information systems needing all five components, data science should contain all three components mentioned above. This means if a component is missing, the result, while part of data science, is also its own area of focus.

A combination of engineering and analysis results in areas of machine learning and data mining. Machine learning involves building and creating the platform for a 'machine' to mimic human learning while accomplishing tasks and 'learning' how to improve through trials and experience. Data mining, on the other hand, also utilizes building a platform in which to explore data through statistics in order to learn or expose trends within the data.

A combination of engineering and communication results in an area of focus referred to as Big Data. While analysis may occur in this area, the analysis is considerably different than traditional analysis. This area is constantly evolving and expanding as data creation and data needs continues to grow and faster, more secure communication connections are needed to handle the gigantic size of big data datasets.

The final combination is analysis and communication which results in the area of data analytics. While data analytics is heavily focused on statistics, it also incorporates information technologies into statistics. This results in familiar items such as informational dashboards (think of the stock market) along with trend analysis, goal setting, scenario analysis, etc. While data analytics is commonly used to describe data science and vice versa, the distinction or lack of engineering within the area of data analytics drastically changes the preparation needed to participate within data analytics. In particular, it requires a statistical understanding but not a strong mathematical background as the tools used within data analytics are already established, with the new trend being able to *communicate* the produced information in new ways for users.

	ENGINEERING	COMMUNICATION	ANALYSIS
ENGINEERING	Data Engineering	Big Data	Data Mining/Machine Learning
COMMUNICATION	Big Data	Data Visualization	Data Analytics
ANALYSIS	Data Mining / Machine Learning	Data Analytics	Statistics

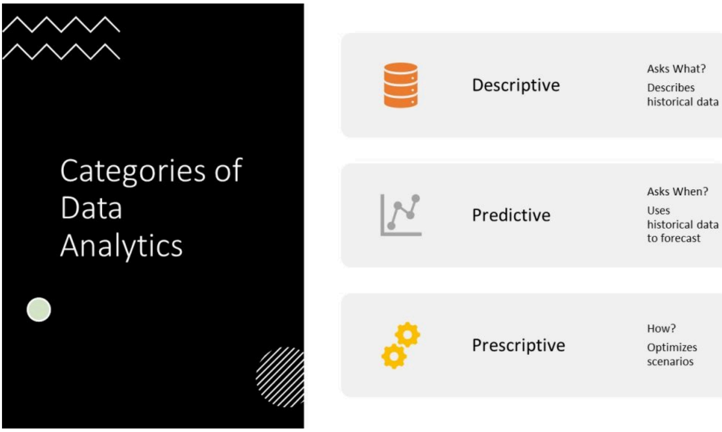
Descriptive, predictive, and prescriptive!

Data analytics is famously known as providing three primary categories. Referring back to earlier chapters, these categories help to define *how* to complete the data-to-value process. These three primary categories are descriptive, predictive, and prescriptive analytics. Much like past, present, and future, each category strives to provide a user with information based on the premise of what occurred (descriptive), what might occur (predictive), and what can occur? (prescriptive).

Descriptive analytics is almost synonymous with descriptive statistics (except it also involves the communication!) and is most commonly what we as users are used to interacting with when interacting with analytics. Descriptive analytics may be a summary report such as a student's academic records. They may also include player statistics within a sport, or a map with an overlay of recent crime data. These tables, visualizations, infographics can all be put in this category if they are communicating data that has been processed into information and that data represents the past.

Predictive analytics also uses historical data, however, has the goal of providing some type of insight and probability of a similar dataset being created in the future. While not as widespread as descriptive analytics in the world, predictive analytics are familiar to normal users. Examples may be predicting the odds of a fantasy football player scoring x number of points in the next week of games or using weather data to predict next week’s forecast. This analysis, in a statistical view, includes statistical techniques for probability and regression analysis. Predictive analytics, however, are only as accurate as their dataset and rarely 100% accurate. The shorter the amount of time included in the analysis, the more accurate the predictive models can be due to the reduced amount of change that can occur within the generation of new data.

The final category is prescriptive analytics. The goal of prescriptive analytics is not to use predictive analytics to create a future prediction, but instead create multiple predictions and then provide an optimized solution or recommendation. For example, an information system utilizing prescriptive analytics may optimize supply routes based on traffic and weather patterns. If you use GPS on a long road trip, you may have had the capability of ‘dynamic route updates’, or the suggestion of new alternate routes that may be quicker due to slowing traffic or an accident. On a larger scale, climate analysis is another example of *predictive* analytics, however, once the system is programmed to provide what-if scenarios and offer guidance on optimal solutions, the system is now using *prescriptive* analytics.



The three Vs of big data

While Big Data DOES utilize analytics, it is important to understand these analytics are constantly growing, maturing, and evolving as the world of Big Data begins to mature as an area of focus. For organizations, the ability to collect data has become much more cost effective due to advances in technology and the growth of the IoT markets. However, more data does not equal better data. As the size of a data warehouse or data supercenter increases, the ability to use traditional analytical techniques to identify the correct data and transform it into valuable information ultimately becomes too complex for the size of the data. While this line from where data analytics ends and big data analytics begins is blurry, the largely recognized 'three Vs' of big data can help.

The three Vs consist of volume, variety, and velocity. Volume refers to the size of the datasets. While data can be stored and accessed in what feels like an infinite number of ways, there isn't a set rule for how large, or how much volume is needed for the datasets. It really depends on the organization's processing power and the statistical/analytical techniques that are needed. While volume can refer to a single dataset, the plural term was purposely used as typically multiple sources of data are used when using big data analytics.

Variety, while related to volume, refers to the types of data used within the dataset or datasets being selected for analysis. If the data contains a large amount of variety, this can reduce the amount of volume needed before the analysis would be placed in the realm of big data. With more complexity introduced through the variety of the data, the traditional analytical techniques are also reduced, and with a large volume traditional statistical software may simply not be able to handle the complexity and size.

The final v of Big Data is velocity. Big datasets can be so large in size that they can't necessarily be moved from storage to analysis, but instead they need to be 'streamed' through the analysis much like cassette tapes would go through a cassette player. Velocity refers to the speed in which all sources can work together and be analyzed. So as the volume and variety increase, the ability to provide adequate velocity to traditional analysis decreases. When the reliability of this begins to falter, big data begins to emerge as the solution for the analysis.

While Big Data can sound cumbersome and bothersome, it is a very exciting area! At this current time, it is just beginning to grow, and the field is rapidly evolving and providing amazing new opportunities for data scientists and data analysts to explore large, complex, collections of data in ways that has not occurred before. An example of a current company that highly utilizes big data in order to better target consumers is Netflix. The recommendations you see were likely compiled using big data to create user profiles based on large watching patterns across the world.

Chapter 3 Homework

Overview

This assignment will help you understand the basic concepts involved with datasets and analytics.

Assignment

Locate and define a dataset and create a single source of information.

Steps/Questions

- Use a browser to navigate to: https://catalog.data.gov/dataset
    - Filter the dataset catalog by csv by clicking the csv format on the left.
    - Explore the datasets until you find one of interest to you.
- In a word document complete the following:
    - Provide a link to your dataset.
    - Provide a brief description of the dataset (in your own words).
    - List all the fields/columns included in the dataset.
    - Answer the question: How many observations (rows) are there?
- Finally, create a source of information:
    - *A source of information, in this context, refers to the visual charting of two or more fields (such as time and money) or the manipulation of a field (such as a sum, average,

etc.).

- Create a visual graphic, table, or other form of information that uses manipulation of a field or two or more fields to produce an important source of information from your dataset.
- Describe why/how this information could be useful.

Grading

A satisfactory submission will include a dataset and a relevant description of the dataset. An attempt should be made to provide a visual graphic.

A beyond satisfactory submission likely will include an accurate description of the dataset and provide a relevant source of information that adds value to the dataset and to the viewer.

4.

CHAPTER 4 - INFORMATION SECURITY

Learning Objectives

4.1 Describe the Information Security Triad

4.2 Understand Common Tools of Information Security

4.3 Identify key characteristics of good Information Security Policies

The information security triad: Confidentiality, Integrity, Availability (CIA)

When protecting information, we want to be able to restrict access to those who are allowed to see it; everyone else should be disallowed from learning anything about its contents. This is the essence of confidentiality. For example, federal law requires that universities restrict access to private student information. The university must be sure that only those who are authorized have access to view the grade records.

Integrity is the assurance that the information being accessed has not been altered and truly represents what is intended. Just as a person with integrity means what he or she says and can be trusted to consistently represent the truth, information integrity means information truly represents its intended meaning. Information can lose its integrity through malicious intent, such as when someone who is not authorized makes a change to intentionally misrepresent something. An example of this would be when a hacker is hired to go into the university's system and change a grade.

Integrity can also be lost unintentionally, such as when a computer power surge corrupts a file, or someone authorized to make a change accidentally deletes a file or enters incorrect information.

Information availability is the third part of the CIA triad. *Availability* means that information can be accessed and modified by anyone authorized to do so in an appropriate timeframe. Depending on the type of information, *appropriate timeframe* can mean different things. For example, a stock trader needs information to be available immediately, while a salesperson may be happy to get sales numbers for the day in a report the next morning. Companies such as Amazon.com will require their servers to be available twenty-four hours a day, seven days a week. Other companies may not suffer if their web servers are down for a few minutes once in a while.

Tools for information security

In order to ensure the confidentiality, integrity, and availability of information, organizations can choose from a variety of tools. Each of these tools can be utilized as part of an overall information-security policy, which will be discussed in the next section.

Authentication

The most common way to identify someone is through their physical appearance, but how do we identify someone sitting behind a computer screen or at the ATM? Tools for authentication are used to ensure that the person accessing the information is, indeed, who they present themselves to be.

Authentication can be accomplished by identifying someone through one or more of three factors: something they know, something they have, or something they are. For example, the most common form of authentication today is the user ID and password. In this case, the authentication is done by confirming something that the user knows (their ID and password). But this form of authentication is easy to compromise, and stronger forms of authentication are sometimes needed. Identifying someone only by something they have, such as a key or a card, can also be problematic. When that identifying token is lost or stolen, the identity can be easily stolen. The final factor, something you are, is much harder to compromise. This factor identifies a user through the use of a physical characteristic, such as an eye-scan or fingerprint. Identifying someone through their physical characteristics is called biometrics.

A more secure way to authenticate a user is to do multi-factor authentication. By combining two or more of the factors listed above, it becomes much more difficult for someone to misrepresent themselves. An example of this would be the use of an RSA SecurID token. The RSA device is something you have and will generate a new access code every sixty seconds. To log in to an information resource using the RSA device, you combine something you know, a four-digit PIN, with the code generated by the device. The only way to properly authenticate is by both knowing the code *and* having the RSA device.

Access control

Once a user has been authenticated, the next step is to ensure that they can only access the information resources that are appropriate. This is done through the use of access control. Access control determines which users are authorized to read, modify, add, and/or delete information. Several different access control models exist. Here we will discuss two: the access control list (ACL) and role-based access control (RBAC).

For each information resource that an organization wishes to manage, a list of users who have the ability to take specific actions can be created. This is an access control list, or ACL. For each user, specific capabilities are assigned, such as *read*, *write*, *delete*, or *add*. Only users with those capabilities are allowed to perform those functions. If a user is not on the list, they have no ability to even know that the information resource exists.

ACLs are simple to understand and maintain. However, they have several drawbacks. The primary drawback is that each information resource is managed separately, so if a security administrator wanted to add or remove a user to a large set of information resources, it would be quite difficult. And as the number of users and resources increase, ACLs become harder to maintain. This has led to an improved method of access control, called role-based access control, or RBAC. With RBAC, instead of giving specific users access rights to an information resource, users are assigned to roles and then those roles are assigned the access. This allows the administrators to manage users and roles separately, simplifying administration and, by extension, improving security.

Encryption

Many times, an organization needs to transmit information over the Internet or transfer it on external media such as a CD or flash drive. In these cases, even with proper authentication and access control, it is possible for an unauthorized person to get access to the data. Encryption is a process of encoding data upon its transmission or storage so that only authorized individuals can read it. This encoding is accomplished by a computer program, which encodes the plain text that needs to be transmitted; then the recipient receives the cipher text and decodes it (decryption). In order for this to work, the sender and receiver need to agree on the method of encoding so that both parties can communicate properly. Both parties share the encryption key, enabling them to encode and decode each other's messages. This is called symmetric key encryption. This type of encryption is problematic because the key is available in two different places.

An alternative to symmetric key encryption is public key encryption. In public key encryption, two keys are used: a public key and a private key. To send an encrypted message, you obtain the public key, encode the message, and send it. The recipient then uses the private key to decode it. The public key can be given to anyone who wishes to send the recipient a message. Each user simply needs one private key and one public key in order to secure messages. The private key is necessary in order to decrypt something sent with the public key.

Backups

Another essential tool for information security is a comprehensive backup plan for the entire organization. Not only should the data on the corporate servers be backed up, but individual computers used throughout the organization should also be backed up. A good backup plan should consist of several components.

- A full understanding of the organizational information resources. What information does the organization actually have?

Where is it stored? Some data may be stored on the organization's servers, other data on users' hard drives, some in the cloud, and some on third-party sites. An organization should make a full inventory of all of the information that needs to be backed up and determine the best way back it up.

- Regular backups of all data. The frequency of backups should be based on how important the data is to the company, combined with the ability of the company to replace any data that is lost. Critical data should be backed up daily, while less critical data could be backed up weekly.
- Offsite storage of backup data sets. If all of the backup data is being stored in the same facility as the original copies of the data, then a single event, such as an earthquake, fire, or tornado, would take out both the

original data and the backup! It is essential that part of the backup plan is to store the data in an offsite location.

- Test of data restoration. On a regular basis, the backups should be put to the test by having some of the data restored. This will ensure that the process is working and will give the organization confidence in the backup plan.

Besides these considerations, organizations should also examine their operations to determine what effect downtime would have on their business. If their information technology were to be unavailable for any sustained period of time, how would it impact the business?

Additional concepts related to backup include the following:

- Universal Power Supply (UPS). A UPS is a device that provides battery backup to critical components of the system, allowing them to stay online longer and/or allowing the IT staff to shut them down using proper procedures in order to prevent the data loss that might occur from a power failure.
- Alternate, or "hot" sites. Some organizations choose to have an alternate site where an exact replica of their critical data is always kept up to date. When the primary site goes down, the alternate site is immediately brought online so that little or no downtime is experienced.

As information has become a strategic asset, a whole industry has sprung up around the technologies necessary for implementing a proper backup strategy. A company can contract with a service provider to back up all of their data or they can purchase large amounts of online storage space and do it themselves. Technologies such as storage area networks and archival systems are now used by most large businesses.

Firewalls

Another method that an organization should use to increase security on its network is a firewall. A firewall can exist as hardware or software (or both). A hardware firewall is a device that is connected to the network and filters the packets based on a set of rules. A software firewall runs on the operating system and intercepts packets as they arrive to a computer. A firewall protects all company servers and computers by stopping packets from outside the organization's network that do not meet a strict set of criteria. A firewall may also be configured to restrict the flow of packets leaving the organization. This may be done to eliminate the possibility of employees watching YouTube videos or using Facebook from a company computer.

Physical security

An organization can implement the best authentication scheme in the world, develop the best access control, and install firewalls and intrusion prevention, but its security cannot be complete without implementation of physical security. Physical security is the protection of the actual hardware and networking components that store and transmit information resources. To implement physical security, an organization must identify all of the vulnerable resources and take measures to ensure that these resources cannot be physically tampered with or stolen. These measures include the following.

- Locked doors: It may seem obvious, but all the security in the world is useless if an intruder can simply walk in and physically remove a computing device. High-value information assets should be secured in a location with limited access.
- Physical intrusion detection: High-value information assets should be monitored through the use of security cameras and other means to detect unauthorized access to the physical locations where they exist.
- Secured equipment: Devices should be locked down to prevent them from being stolen. One employee's hard drive could contain all of your customer information, so it is essential that it be secured.
- Environmental monitoring: An organization's servers and other high-value equipment should always be kept in a room that is monitored for temperature, humidity, and airflow. The risk of a server failure rises when these factors go out of a specified range.
- Employee training: One of the most common ways thieves steal corporate information is to steal employee laptops while employees are traveling. Employees should be trained to secure their equipment whenever they are away from the office.

Security policies

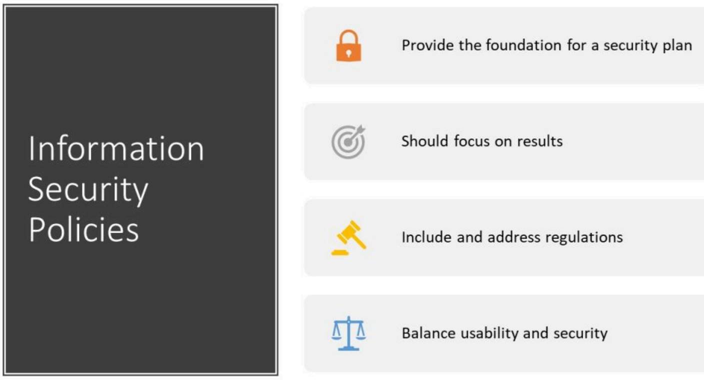
Besides the technical controls listed above, organizations also need to implement security policies as a form of administrative control. In fact, these policies should really be a starting point in developing an overall security plan.

A good information-security policy lays out the guidelines for employee use of the information resources of the company and provides the company recourse in the case that an employee violates a policy.

According to the SANS Institute, a good policy is "a formal, brief, and high-level statement or plan that embraces an organization's general beliefs, goals, objectives, and acceptable procedures for a specified subject area." Policies require compliance; failure to comply with a policy will result in disciplinary action. A policy does not lay out the specific technical details, instead it focuses on the desired results.

A good example of a security policy that many will be familiar with is a web use policy. A web use policy lays out the responsibilities of company employees as they use company resources to access the Internet. A good example of a web use policy is included in Harvard University's "Computer Rules and Responsibilities" policy.

A security policy should also address any governmental or industry regulations that apply to the organization. For example, if the organization is a university, it must be aware of the Family Educational Rights and Privacy Act (FERPA), which restricts who has access to student information. Health care organizations are obligated to follow several regulations, such as the Health Insurance Portability and Accountability Act (HIPAA).



Usability

When looking to secure information resources, organizations must balance the need for security with users' need to effectively access and use these resources. If a system's security measures make it difficult to use, then users will find ways around the security, which may make the system more vulnerable than it would have been without the security measures! Take, for example, password policies. If the organization requires an extremely long password with several special characters, an employee may resort to writing it down and putting it in a drawer since it will be impossible to memorize.

Chapter 4 Homework

Overview

This assignment will help you to begin navigating the complexities involved in user data privacy.

Assignment

In this assignment, you explore the business model of Facebook and Google, which is to collect as much personal information on its users as is technically possible and socially acceptable. Then, it sells that information to advertisers in the form of targeted advertising on websites, mobile apps, and partner websites that personalize ads based upon the information.

Steps/Questions

1. Research current issues with Facebook/google (choose one or both) in regard to user privacy. Include at least 1 article and a link/citation to the article. Briefly summarize the article (s).
2. First, take the side of Facebook/Google. What 'rights' do they have over user data posted to their systems? When would they ultimately cross the ethical line when they handle user data?
3. Next, take the side of the user. What rights do users have over their data in the US? What about in Europe?
4. Finally, what do you believe should happen with user data in the near future? List at least one positive and negative outcome if your solution would be implemented.

Grading

A satisfactory submission should outline the 'battle' between technology corporations and user rights. It should at a minimum also offer a solution to possibly solve (or resolve) the issues surrounding user data.

A beyond satisfactory submission will provide a relevant article (s) that support the view proposed in Step 4. Steps 2 and 3 will likely have a detailed description that provides the user with a clear view of the solution proposed in Step 4.

5.

CHAPTER 5 - SYSTEMS THINKING AND DESIGN

Learning Objectives

5.1 Identify the steps in the Systems Development Life Cycle (SDLC)

5.2 Compare and describe alternative development cycles

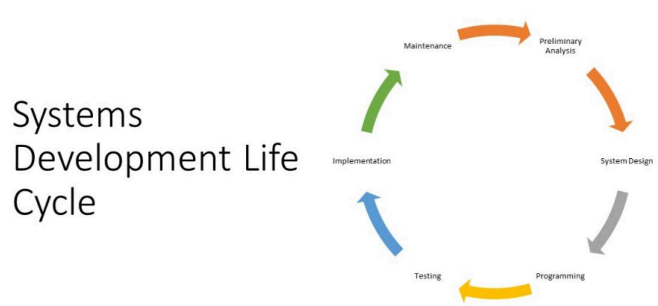
5.3 Understand the various implementation strategies for systems

When someone has an idea for a new function to be performed by a computer, how does that idea become reality? If a company wants to implement a new business process and needs new hardware or software to support it, how do they go about making it happen? In this chapter, we will discuss the different methods of taking those ideas and bringing them to reality, a process known as information systems development.

Software is created via programming. Programming is the process of creating a set of logical instructions for a digital device to follow using a programming language. The process of programming is sometimes called "coding" because the syntax of a programming language is not in a form that everyone can understand – it is in "code."

The process of developing good software is usually not as simple as sitting down and writing some code. True, sometimes a programmer can quickly write a short program to solve a need. But most of the time, the creation of software is a resource-intensive process that involves several different groups of people in an organization. In the following sections, we are going to review several different methodologies for software development.

Systems development life cycle



The first development methodology we are going to review is the systems-development life cycle (SDLC). This methodology was first developed in the 1960s to manage the large software projects associated with corporate systems running on mainframes. It is a very structured and risk-averse methodology designed to manage large projects that included multiple programmers and systems that would have a large impact on the organization.

Various definitions of the SDLC methodology exist, but most contain the following phases.

1. Preliminary Analysis. In this phase, a review is done of the request. Is creating a solution possible? What alternatives exist? What is currently being done about it? Is this project a good fit for our organization? A key part of this step is a feasibility analysis, which includes an analysis of the technical feasibility (is it possible to create this?), the economic feasibility (can we afford to do this?), and the legal feasibility (are we allowed to do this?). This step is important in determining if the project should even get started.

2. System Analysis. In this phase, one or more system analysts work with different stakeholder groups to determine the specific requirements for the new system. No programming is done in this step. Instead, procedures are documented, key players are interviewed, and data requirements are developed in order to get an overall picture of exactly what the system is supposed to do. The result of this phase is a system-requirements document.

3. System Design. In this phase, a designer takes the system-requirements document created in the previous phase and develops the specific technical details required

for the system. It is in this phase that the business requirements are translated into specific technical requirements. The design for the user interface, database, data inputs and outputs, and reporting are developed here. The result of this phase is a system-design document. This document will have everything a programmer will need to actually create the system.

4. Programming. The code finally gets written in the programming phase. Using the system- design document as a guide, a programmer (or team of programmers) develops the program. The result of this phase is an initial working program that meets the requirements laid out in the system-analysis phase and the design developed in the system-design phase.

5. Testing. In the testing phase, the software program developed in the previous phase is put through a series of structured tests. The first is a unit test, which tests individual parts of the code for errors or bugs. Next is a system test, where the different components of the system are tested to ensure that they work together properly. Finally, the user-acceptance test allows those that will be using the software to test the system to ensure that it meets their standards. Any bugs, errors, or problems found during testing are addressed and then tested again.

6. Implementation. Once the new system is developed and tested, it has to be implemented in the organization. This phase includes training the users, providing documentation, and conversion from any previous system to the new system. Implementation can take many forms, depending on the type of system, the number and type of users, and how urgent it is that the system become

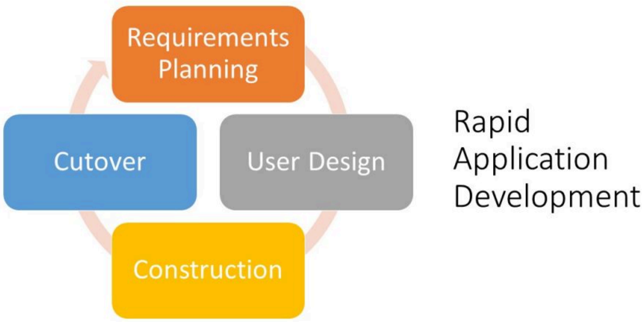
operational. These different forms of implementation are covered later in the chapter.

7. Maintenance. This final phase takes place once the implementation phase is complete. In this phase, the system has a structured support process in place: reported bugs are fixed and requests for new features are evaluated and implemented; system updates and backups are performed on a regular basis.

The SDLC methodology is sometimes referred to as the waterfall methodology to represent how each step is a separate part of the process; only when one step is completed can another step begin. After each step, an organization must decide whether to move to the next step or not. This methodology has been criticized for being quite rigid. For example, changes to the requirements are not allowed once the process has begun. No software is available until after the programming phase.

Again, SDLC was developed for large, structured projects. Projects using SDLC can sometimes take months or years to complete. Because of its inflexibility and the availability of new programming techniques and tools, many other software-development methodologies have been developed. Many of these retain some of the underlying concepts of SDLC but are not as rigid.

Rapid application development



Rapid application development (RAD) is a software-development (or systems-development) methodology that focuses on quickly building a working model of the software, getting feedback from users, and then using that feedback to update the working model. After several iterations of development, a final version is developed and implemented.

The RAD methodology consists of four phases:

1. Requirements Planning. This phase is similar to the preliminary-analysis, system-analysis, and design phases of the SDLC. In this phase, the overall requirements for the system are defined, a team is identified, and feasibility

2. User Design. In this phase, representatives of the users work with the system analysts, designers, and programmers to interactively create the design of the system. One technique for working with all of these various stakeholders is the so-called JAD session. JAD is an acronym for joint application development. A JAD

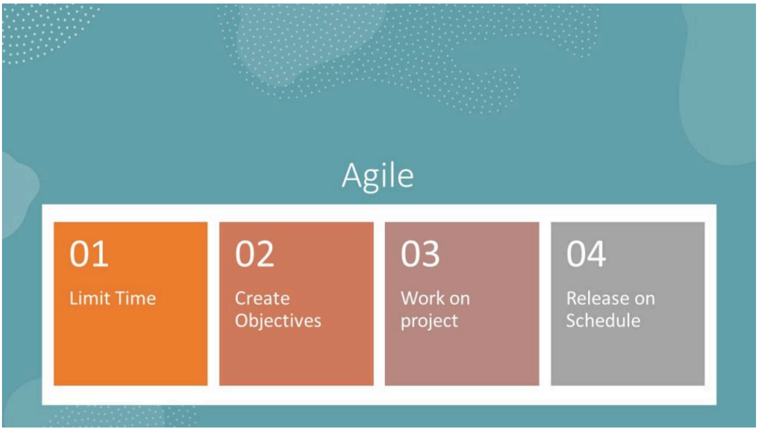
session gets all of the stakeholders together to have a structured discussion about the design of the system. Application developers also sit in on this meeting and observe, trying to understand the essence of the requirements.

3. Construction. In the construction phase, the application developers, working with the users, build the next version of the system. This is an interactive process, and changes can be made as developers are working on the program. This step is executed in parallel with the User Design step in an iterative fashion, until an acceptable version of the product is developed.

4. Cutover. In this step, which is similar to the implementation step of the SDLC, the system goes live. All steps required to move from the previous state to the use of the new system are completed here.

As you can see, the RAD methodology is much more compressed than SDLC. Many of the SDLC steps are combined and the focus is on user participation and iteration. This methodology is much better suited for smaller projects than SDLC and has the added advantage of giving users the ability to provide feedback throughout the process. SDLC requires more documentation and attention to detail and is well suited to large, resource-intensive projects. RAD makes more sense for smaller projects that are less resource- intensive and need to be developed quickly.

Agile methodologies



Agile methodologies are a group of methodologies that utilize incremental changes with a focus on quality and attention to detail. Each increment is released in a specified period of time (called a time box), creating a regular release schedule with very specific objectives. While considered a separate methodology from RAD, they share some of the same principles: iterative development, user interaction, ability to change. The agile methodologies are based on the "Agile Manifesto," first released in 2001.

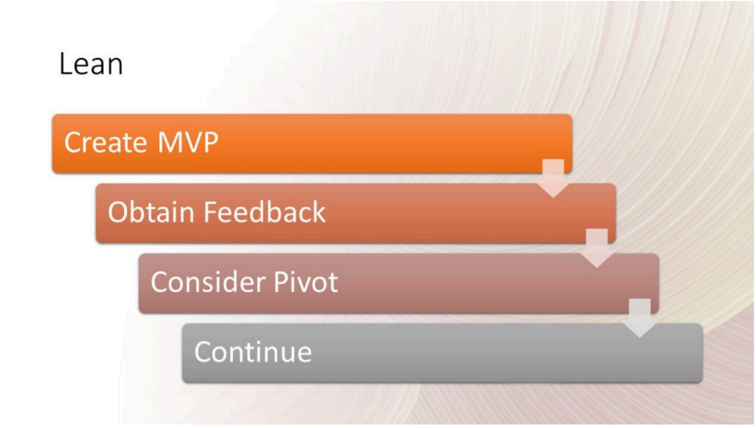
The characteristics of agile methods include:

- small cross-functional teams that include development-team members and users.
- daily status meetings to discuss the current state of the project.
- short time-frame increments (from days to one or two weeks) for each change to be completed.

and at the end of each iteration, a working project is completed to demonstrate to the stakeholders.

The goal of the agile methodologies is to provide the flexibility of an iterative approach while ensuring a quality product.

Lean methodology



One last methodology we will discuss is a relatively new concept taken from the business bestseller *The Lean Startup*, by Eric Reis. In this methodology, the focus is on taking an initial idea and developing a minimum viable product (MVP). The MVP is a working software application with just enough functionality to demonstrate the idea behind the project. Once the MVP is developed, it is given to potential users for review. Feedback on the MVP is generated in two forms: (1) direct observation and discussion with the users, and (2) usage statistics gathered from the software itself. Using these two forms of feedback, the team determines whether they should continue in the same direction or rethink the core idea behind the project, change the functions, and create a new MVP. This change in strategy is called a pivot. Several iterations of the MVP are developed, with new functions added each time based on the feedback, until a final product is completed.

The biggest difference between the lean methodology and the other methodologies is that the full set of requirements for the system are not known when the project is launched. As each iteration of the project is released, the statistics and feedback gathered are used to determine the requirements. The lean methodology works best in an entrepreneurial environment where a company is interested in determining if their idea for a software application is worth developing.

Build vs. buy

When an organization decides that a new software program needs to be developed, they must determine if it makes more sense to build it themselves or to purchase it from an outside company. This is the “build vs. buy” decision.

There are many advantages to purchasing software from an outside company. First, it is generally less expensive to purchase a software package than to build it. Second, when a software package is purchased, it is available much more quickly than if the package is built in-house. Software applications can take months or years to build; a purchased package can be up and running within a month. A purchased package has already been tested and many of the bugs have already been worked out. It is the role of a systems integrator to make various purchased systems and the existing systems at the organization work together.

There are also disadvantages to purchasing software. First, the same software you are using can be used by your competitors. If a company is trying to differentiate itself based on a business process that is in that purchased software, it will have a hard time doing so if its competitors use the same software. Another disadvantage to purchasing software is the process of customization. If you purchase a software package from a vendor and then customize it, you will have to manage those customizations every time the vendor provides an upgrade. This can become an administrative headache, to say the least!

Even if an organization determines to buy software, it still makes sense to go through many of the same analyses that they would do if they were going to build it themselves. This is an important decision that could have a long-term strategic impact on the organization.

Web services

The move to cloud computing has allowed software to be looked at as a service. One option companies have these days is to license functions provided by other companies instead of writing the code themselves. These are called web services, and they can greatly simplify the addition of functionality to a website.

For example, suppose a company wishes to provide a map showing the location of someone who has called their support line. By utilizing Google Maps API web services, they can build a Google Map right into their application. Or a shoe company could make it easier for its retailers to sell shoes online by providing a shoe-size web service that the retailers could embed right into their website.

Web services can blur the lines between "build vs. buy." Companies can choose to build a software application themselves but then purchase functionality from vendors to supplement their system.

End-User computing

In many organizations, application development is not limited to the programmers and analysts in the information-technology department. Especially in larger organizations, other departments develop their own department-specific applications. The people who build these are not necessarily trained in programming or application development, but they tend to be adept with computers. A person, for example, who is skilled in a particular software package, such as a spreadsheet or database package, may be called upon to build smaller applications for use by his or her own department. This phenomenon is referred to as end-user development, or end-user computing.

End-user computing can have many advantages for an organization. First, it brings the development of applications closer to those who will use them. Because IT departments are sometimes quite backlogged, it also provides a means to have software created more quickly. Many organizations encourage end-user computing to reduce the strain on the IT department.

End-user computing does have its disadvantages as well. If departments within an organization are

developing their own applications, the organization may end up with several applications that perform similar functions, which is inefficient, since it is a duplication of effort. Sometimes, these different versions of the same application end up providing different results, bringing confusion when departments interact. These applications are often developed by someone with little or no formal training in programming. In these cases, the software developed can have problems that then have to be resolved by the IT department.

Implementation methodologies

Once a new system is developed (or purchased), the organization must determine the best method for implementing it. Convincing a group of people to learn and use a new system can be a very difficult process. Using new software, and the business processes it gives rise to, can have far-reaching effects within the organization.

There are several different methodologies an organization can adopt to implement a new system. Four of the most popular are listed below.

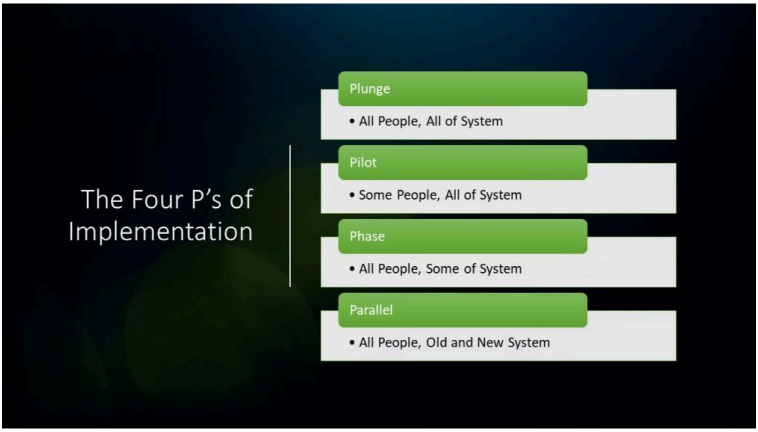
- Plunge. In the plunge implementation methodology, the organization selects a particular date that the old system is not going to be used anymore. On that date, the users begin using the new system and the old system is unavailable. The advantages to using this methodology are that it is very fast and the least expensive. However, this method is the riskiest as well. If the new system has an operational problem or if the users are not properly prepared, it could prove disastrous for the organization.
- Pilot implementation. In this methodology, a subset of the organization (called a pilot group) starts using the

new system before the rest of the organization. This has a smaller impact on the company and allows the support team to focus on a smaller group of individuals.

- Parallel operation. With parallel operation, the old and new systems are used simultaneously for a limited period of time. This method is the least risky because the old system is still being used while the new system is essentially being tested. However, this is by far the most expensive methodology since work is duplicated and support is needed for both systems in full.

- Phased implementation. In phased implementation, different functions of the new application are used as functions from the old system are turned off. This approach allows an organization to slowly move from one system to another.

Which of these implementation methodologies to use depends on the complexity and importance of the old and new systems.



Change management

As new systems are brought online and old systems are phased out, it becomes important to manage the way change is implemented in the organization. Change should never be introduced in a vacuum. The organization should be sure to communicate proposed changes before they happen and plan to minimize the impact of the change that will occur after implementation. Change management is a critical component of IT oversight.

Maintenance

Once a new system has been introduced, it enters the maintenance phase. In this phase, the system is in production and is being used by the organization. While the system is no longer actively being developed, changes need to be made when bugs are found, or new features are requested. During the maintenance phase, IT management must ensure that the system continues to stay aligned with business priorities and continues to run well.

Chapter 5 Homework

Overview

This assignment is designed to highlight major areas of the Systems Development Lifecycle (SDLC).

Assignment

Use the steps of the SDLC to outline the development of a mobile ordering application for your favorite restaurant.

Steps/Questions

You want to be able to order food from your favorite restaurant with your phone. Using the steps of the SDLC, outline (and briefly describe) each step of the SDLC as it relates to developing a mobile ordering system.

1. Systems Analysis
a. Describe your favorite restaurant and the capabilities of the mobile ordering system.
2. System Design
a. In greater detail, outline specific and unique features of the mobile system.
3. Programming
a. What are the greatest obstacles you see in developing the mobile system (software)?
4. Testing
a. How will you know the system is working correctly, how do you plan to test it?
5. Conversion
a. How will the new system be incorporated into the restaurant?
6. Production and Maintenance
a. What mechanisms will be present to upgrade the system and provide feedback?

Grading

A satisfactory submission will outline the steps of the SDLC as they relate to mobile ordering and provide basic responses to the questions in the assignment.

A beyond satisfactory submission will likely go into detail of each step of the SDLC and provide an overall flow of the project from start to finish through the details of each step/phase.

6.

CHAPTER 6 - BUSINESS SYSTEMS

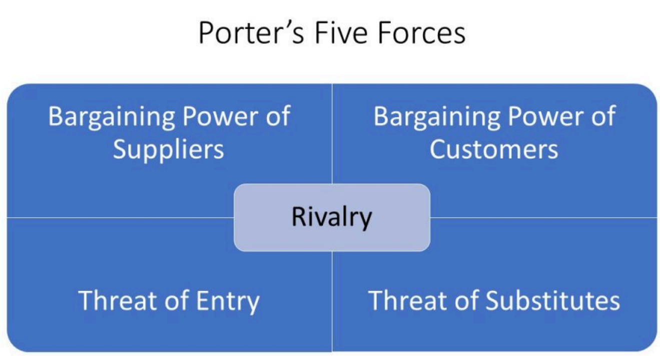
Learning Objectives

6.1 Describe Porter's five forces and how they relate to information systems
6.2 Describe competitive strategies and how they relate to information systems
6.3 Identify the components and purpose of the value chain
6.4 Describe ERP and other major business systems

Porter's five forces, an IS perspective

Michael Porter developed a general model to help explain the major forces within industries. These common forces can be used to help guide strategy and lead to sustainable competitive advantages – profitable business processes and/or units that can continue to produce profits for long periods of time.

The five forces in Porter's model include: threat of new entrants (entry), threats of substitutes (substitutions), bargaining power of customers (customers), bargaining power of suppliers (supply), and internal competition (rivals). Each of these five forces relate to one another, and when viewed from an information systems perspective, specific benefits and limitations appear depending on the overall strength of the force. In order to determine the overall 'strength' of a force, some subjectivity and overall scope needs to be incorporated into the process. Various methods can be used, particularly ranking, and the method a person will end up using can be dependent on many factors. In my experience, I tend to use a high-medium-low ranking system. While this causes many forces to be arguably medium, there are enough instances of high/low to make the ranking system somewhat effective in helping identify forces that can provide opportunities and/or threats.



Threat of new entrants

The force of 'threat of new entrants', or entry, can be described as the force that allows entry into the industry or market for new competitors or organizations. Ideally, if a company is already in the industry, the desire should be to have this threat or force be 'low'. A low threat of entry means it is very difficult to enter the market or industry for new competitors. An example of this would be the automobile industry. A 'high' force would allow entrants to enter the market easily, such as food trucks, and should be a concern for existing organizations. One way information systems could be used to combat a high threat would be to provide complicated online services that become critical in the industry, creating another hurdle for new organizations to start (as they would have to develop and purchase the technology/systems).

Threat of substitutes

The force 'threat of substitutes' can be described as the ability in which the need of a customer can be met with a different product or service. In order to minimize this threat, or make the force be considered low is to offer something unique that is difficult to copy, replace, or substitute. Coca-Cola has a unique taste that is difficult to replicate, and even off-brand items that are very similar are typically shunned by cola drinkers that want Coca-Cola. An example of where the threat of substitutes would be considered high would be the common pen/pencil industry. Many people have containers of pens and pencils and likely mix and match writing utensils as they write. From an information systems perspective, technology or specific processes can provide the uniqueness in many cases, creating a different experience for customers.

Bargaining power of suppliers

The force 'bargaining power of suppliers' refers to the collective power of suppliers in regard to the ability to supply raw materials or products for manufacturing or service. While this force can be formed through various methods, it is common to consider the force to revolve around the price-setting ability of the suppliers. An example of a low bargaining power would be if many suppliers exist that supply very similar items, creating a price war among suppliers, thus reducing their bargaining power. An example of a high force in bargaining power would be a supplier that is the exclusive supplier of an item. From an information systems perspective, this force can be reduced through establishing relationships with suppliers and providing integrations between the systems in both organizations to ideally help reduce costs and prices.

Bargaining power of customers

The force 'bargaining power of customers' is very similar to the bargaining power of suppliers force; however, refers to the ability of customers to negotiate the price of an item or service. The bargaining power of customers would be considered high if customers have a strong influence of the final price of a product or service. This is typically in the form of negotiations, etc. The force would be considered low if the customer has no control over the final price. From an information systems perspective, the processes of how a final price is applied to the customer may be modified to eliminate or minimize the ability of negotiation. An example of this could be CarMax and their ‘instant trade’ offer and set prices on their website / mobile app. While the auto industry is rather famous for negotiations, by using these systems CarMax has reduced the ability for a customer to negotiate the final price.

Internal competition

The force ‘internal competition’ is a simple force to understand as it simply relates to the strength and number of competitors in the industry. Strong and numerous competitors would result in a strong force in this area. A lack of competitors or weak competitors, however, would result in a weaker internal competition force. From an information systems perspective, internal competition can be reduced by creating alliances through collaboration and also acquiring and integrating your competitors into your business structure. While these are not direct information systems involvements, indirectly they require a tremendous amount of risk analysis and modeling, which is part of information systems!

Competitive strategies

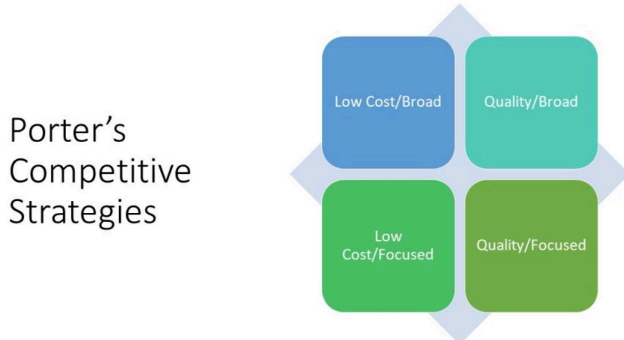
Once the industry has been outlined and ranked, this information can be used to complete a competitive strategy analysis. Porter essentially divides the entire market into four segments based on market focus and cost/quality. The four segments created are focus/cost, focus/quality, broad/cost, and broad/quality. Understand in this description quality is being used loosely, as you may be able to have a lower quality product that is sold at a premium price.

Broad/Focus

Broad/Focus, as a competitive strategy variable, refers to the overall market and how much of that market is being targeted by an organization. If the organization is dividing the market into segments (such as young/old), then that organization is using a focus strategy and should be mapped in the grid on the focus side. A broad organization, while likely still segmenting, is however attempting to reach the entirety of the market.

Cost/Quality

Cost/Quality, as a competitive strategy variable, refers to the extent in which an organization prioritizes having low-cost final products or high-quality final products (or services). An organization that chooses low cost will typically have less desirable or minimal additional services for customers in order to provide the lowest final price to the customer. An organization that chooses quality will attempt to differentiate their products or services from those of competitors and low-cost providers.



Choosing a competitive strategy

Regardless of whether an organization is considering entering the industry or already exists within the industry, one can plot out competitors on a 2×2 grid in order to better visualize a vacant quadrant or super concentrated quadrant. If a quadrant is vacant, an investigation into why that quadrant is vacant may occur. If all quadrants are covered, a discussion on the strengths of the competitors within that quadrant may occur. It is rather common for at least one competitor to be the 'leader' of a quadrant, such as Walmart is the leader of the low cost / broad market quadrant.

The value chain

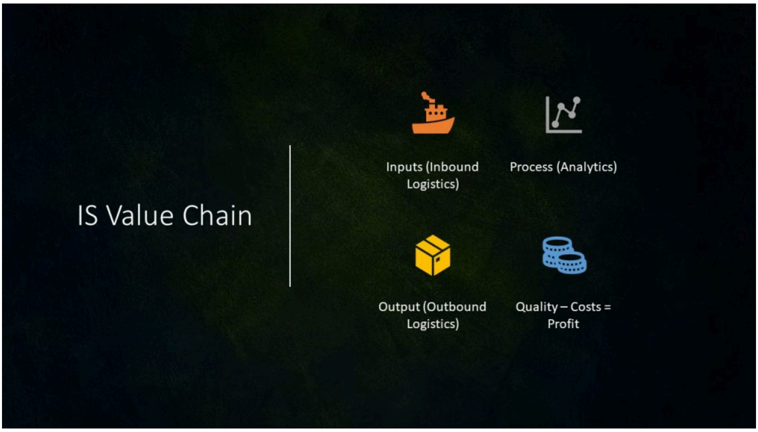
Regardless of competitive strategies and overall industry analysis of the five forces, the value chain is where an organization can begin identifying specific areas to improve. While the value chain encompasses all areas of an organization, in this text, the focus is just on information systems. By focusing just on information systems, the value chain is simplified to the three areas of Input, Processing, and Output (think Chapter 1!).

Before examining each IPO component, however, one must understand that the goal of the value chain is to increase value. In this context, 'value' is the perceived quality (or price) of a product or service. The equation for the value chain is Revenue – Cost = Margin. Or another way to express the equation is Quality – Cost = Profit. This provides two ways to increase profit – increase the perceived quality of the product or service and/or reduce the costs to make said product or service.

Inputs, in the value chain context, refer to items coming into the organization. The possibilities of enhancing quality and reducing costs are plentiful and likely dependent on the industry. However, if information is involved, increasing the quality of that information may not only help increase the quality but also reduce costs. For example, if parts are arriving in small quantity shipments, an analysis could be done to see if larger quantities could reduce loading/unloading, etc. This may make the product be assembled and ship faster, increasing quality, while taking less time, reducing costs.

Processing, in the value chain context, can refer to any process involved in transforming raw materials into finished goods. Common methods for increasing quality may be better testing systems or the introduction of robotics in order to provide more precise movements. Costs may be reduced as well through automation, or software may be created that replaces bulky, expensive outsourced software.

Outputs, in the value chain context, can refer to the processes from finished goods to delivery. This may involve new logistics to increase shipping speed, and marketing analysis to find new market segments or trends. Costs may be reduced by reducing expensive packaging, selling in bulk, and/or improving the communication within the organization in terms of selling points to raw material reordering.



Enterprise resource planning

In the 1990s, the need to bring the organization's information back under centralized control became more apparent. The enterprise resource planning (ERP) system (sometimes just called enterprise software) was developed to bring together an entire organization in one software application. Simply put, an ERP system is a software application utilizing a central database that is implemented throughout the entire organization. Let's take a closer look at this definition:

- "A software application": An ERP is a software application that is used by many of an organization's employees.

- "utilizing a central database": All users of the ERP edit and save their information from the data source. What this means practically is that there is only one customer database, there is only one calculation for revenue, etc.
- "that is implemented throughout the entire organization"

An ERP can be used to manage an entire organization's operations. If they so wish, companies can purchase modules for an ERP that represent different functions within the organization, such as finance, manufacturing, and sales. Some companies choose to purchase many modules, others choose a subset of the modules.

An ERP system not only centralizes an organization's data, but the processes it enforces are the processes the organization adopts. When an ERP vendor designs a module, it has to implement the rules for the associated business processes. A selling point of an ERP system is that it has best practices built right into it. In other words, when an organization implements an ERP, it also gets improved best practices as part of the deal!

For many organizations, the implementation of an ERP system is an excellent opportunity to improve their business practices and upgrade their software at the same time. But for others, an ERP brings them a challenge: Is the process embedded in the ERP really better than the process they are currently utilizing?

And if they implement this ERP, and it happens to be the same one that all of their competitors have, will they simply become more like them, making it much more difficult to differentiate themselves?

This has been one of the criticisms of ERP systems: that they commoditize business processes, driving all businesses to use the same processes and thereby lose their uniqueness. The good news is that ERP systems also have the capability to be configured with custom processes. For organizations that want to continue using their own processes or even design new ones, ERP systems offer ways to support this through the use of customizations.

But there is a drawback to customizing an ERP system: organizations have to

maintain the changes themselves. Whenever an update to the ERP system comes out, any organization that has created a custom process will be required to add that change to their ERP. This will require someone to maintain a listing of these changes and will also require retesting the system every time an upgrade is made. Organizations will have to wrestle with this decision: When should they go ahead and accept the best-practice processes built into the ERP system and when should they spend the resources to develop their own processes? It makes the most sense to only customize those processes that are critical to the competitive advantage of the company.

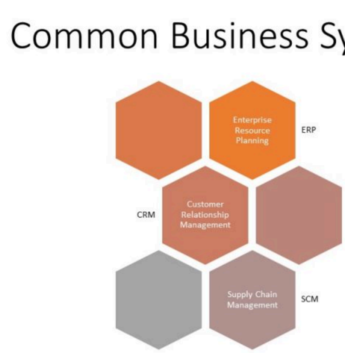
Some of the best-known ERP vendors are SAP, Microsoft, and Oracle.

Customer relationship management

A customer relationship management (CRM) system is a software application designed to manage an organization's customers. In today's environment, it is important to develop relationships with your customers, and the use of a well-designed CRM can allow a business to personalize its relationship with each of its customers. Some ERP software systems include CRM modules. An example of a well-known CRM package is Salesforce.

Supply chain management

Many organizations must deal with the complex task of managing their supply chains. At its simplest, a supply chain is the linkage between an organization's suppliers, its manufacturing facilities, and the distributors of its products. Each link in the chain has a multiplying effect on the complexity of the process: if there are two suppliers, one manufacturing facility, and two distributors, for example, then there are 2 x 1 x 2 = 4 links to handle. However, if you add two more suppliers, another manufacturing facility, and two more distributors, then you have 4 x 2 x 4 = 32 links to manage.



Chapter 6 Homework

OVERVIEW

This assignment will help you apply porter's forces to an organization to find competitive opportunities using technology.

ASSIGNMENT

In this assignment you will choose an organization, and then walk through each force and ultimately choose a technology strategy to create an advantage.

STEPS

- Choose an industry, and then choose an organization within that industry. Describe both briefly.
- Using Porter's Five Forces, for each force describe a 'problem' and an 'opportunity' within each force for the organization you selected in the above step. For Example: If I chose fast food and McDonald's, a problem for McDonalds in the customer force is that customers are increasingly becoming health focused. An opportunity for McDonald's would be to explore 'power shakes' that include workout supplements.
- Next, examine the four basic competitive strategies. For each strategy, identify your selected organization's main competitor that would fit in that strategy (describe why you feel it fits). Which

strategy (area) provides the most opportunity for your organization and which area does your organization belong to?

- Finally, make a statement on what your selected organization's strategy should be.

GRADING

A satisfactory submission will include an industry description, a problem/opportunity for each force, a competitive strategy and competitor discussion and a statement of strategy. These items should demonstrate some reflection and thought.

A beyond satisfactory submission may provide an organized layout of the journey from the five forces to organizational strategy. It would likely include detailed and logical explanations of possible pitfalls and opportunities for the organization in question at each step.

7.

CHAPTER 7 - PROCESSES AND WORKFLOWS

Learning Objectives

7.1 Define a Business Process

7.2 Describe Business Process Documentation

7.3 Understand Business Process Management

7.4 Understand Business Process Reengineering

The fourth component of information systems is *process*. But what is a process and how does it tie into information systems? And in what ways do processes have a role in business? This chapter will look to answer those questions and also describe how business processes can be used for strategic advantage.

What is a business process?

We have all heard the term *process* before, but what exactly does it mean? A process is a series of tasks that are completed in order to accomplish a goal. A business process, therefore, is a process that is focused on achieving a goal for a business. If you have worked in a business setting, you have participated in a business process. Anything from a simple process for making a sandwich at Subway to building a space shuttle utilizes one or more business processes.

Processes are something that businesses go through every day in order to accomplish their mission. The better their processes, the more effective the business. Some businesses see their processes as a strategy for achieving competitive advantage. A process that achieves its goal in a unique way can set a company apart. A process that eliminates costs can allow a company to lower its prices (or retain more profit).

Documenting a process

Every day, each of us will conduct many processes without even thinking about them: getting ready for work, using an ATM, reading our e-mail, etc. But as processes grow more complex, they need to be documented. For businesses, it is essential to do this, because it allows them to ensure control over how activities are undertaken in their organization. It also allows for standardization: McDonald's has the same process for building a Big Mac in all of its restaurants.

The simplest way to document a process is to simply create a list. The list shows each step in the process; each step can be checked off upon completion. For example, a simple process, such as how to create an account on eBay, might look like this:

1. Go to ebay.com.
2. Click on "register."
3. Enter your contact information in the "Tell us about you" box.
4. Choose your user ID and password.
5. Agree to User Agreement and Privacy Policy by clicking on "Submit."

For processes that are not so straightforward, documenting the process as a checklist may not be sufficient. For example, here is the process for determining if an article for a term needs to be added to Wikipedia:

1. Search Wikipedia to determine if the term already exists.
2. If the term is found, then an article is already written, so you must think of another term. Go to
3. If the term is not found, then look to see if there is a related term.
4. If there is a related term, then create a redirect.
5. If there is not a related term, then create a new article.

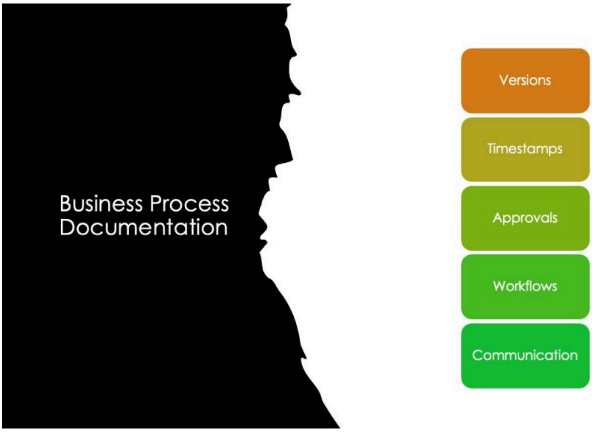
This procedure is relatively simple – in fact, it has the same number of steps as the previous example – but because it has some decision points, it is more difficult to track with as a simple list. In these cases, it may make more sense to use a diagram to document the process.

Managing business process documentation

As organizations begin to document their processes, it becomes an administrative task to keep track of them. As processes change and improve, it is important to know which processes are the most recent. It is also important to manage the process so that it can be easily updated! The requirement to manage process documentation has been one of the driving forces behind the creation of the *document management system*. A document management system stores and tracks documents and supports the following functions:

- Versions and timestamps. The document management system will keep multiple versions of documents. The most recent version of a document is easy to identify and will be served up by default.
- Approvals and workflows. When a process needs to be changed, the system will manage both access to the documents for editing and the routing of the document for approvals.
- Communication. When a process changes, those who implement the process need to be made aware of the changes. A document management system will notify the appropriate people when a change to a document is approved.

Of course, document management systems are not only used for managing business process documentation. Many other types of documents are managed in these systems, such as legal documents or design documents.



Business process management

Organizations that are serious about improving their business processes will also create structures to manage those processes. Business process management (BPM) can be thought of as an intentional effort to plan, document, implement, and distribute an organization's business processes with the support of information technology.

BPM is more than just automating some simple steps. While automation can make a business more efficient, it cannot be used to provide a competitive advantage. BPM, on the other hand, can be an integral part of creating that advantage.

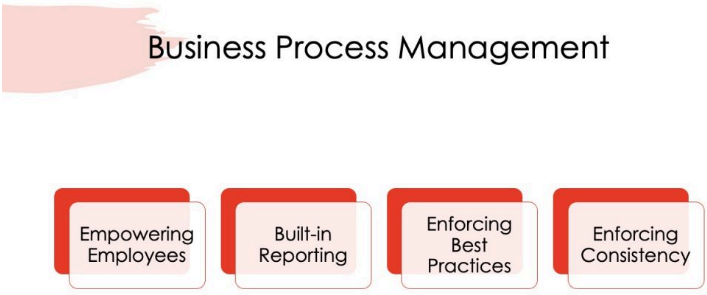
Not all of an organization's processes should be managed this way. An organization should look for processes that are essential to the functioning of the business and those that may be used to bring a competitive advantage. The best processes to look at are those that include employees from multiple departments, those that require decision-making that cannot be easily automated, and processes that change based on circumstances.

To make this clear, let's take a look at an example.

Suppose a large clothing retailer is looking to gain a competitive advantage through superior customer service. As part of this, they create a task force to develop a state-of-the-art returns policy that allows customers to return any article of clothing, no questions asked. The organization also decides that, in order to protect the competitive advantage that this returns policy will bring, they will develop their own customization to their ERP system to implement this returns policy. As they prepare to roll out the system, they invest in training for all of their customer-service employees, showing them how to use the new system and specifically how to process returns. Once the updated returns process is implemented, the organization will be able to measure several key indicators about returns that will allow them to adjust the policy as needed. For example, if they find that many women are returning their high-end dresses after wearing them once, they could implement a change to the process that limits – to, say, fourteen days – the time after the original purchase that an item can be returned. As changes to the returns policy are made, the changes are rolled out via internal communications, and updates to the returns processing on the system are made. In our example, the system would no longer allow a dress to be returned after fourteen days without an approved reason.

If done properly, business process management will provide several key benefits to an organization, which can be used to contribute to competitive advantage. These benefits include:

- Empowering employees. When a business process is designed correctly and supported with information technology, employees will be able to implement it on their own authority. In our returns-policy example, an employee would be able to accept returns made before fourteen days or use the system to make determinations on what returns would be allowed after fourteen days.
- Built-in reporting. By building measurement into the programming, the organization can keep up to date on key metrics regarding their processes. In our example, these can be used to improve the returns process and also, ideally, to reduce returns.
- Enforcing best practices. As an organization implements processes supported by information systems, it can work to implement the best practices for that class of business process. In our example, the organization may want to require that all customers returning a product without a receipt show a legal ID. This requirement can be built into the system so that the return will not be processed unless a valid ID number is entered.
- Enforcing consistency. By creating a process and enforcing it with information technology, it is possible to create a consistency across the entire organization. In our example, all stores in the retail chain can enforce the same returns policy. And if the returns policy changes, the change can be instantly enforced across the entire chain.



Business process reengineering

As organizations look to manage their processes to gain a competitive advantage, they also need to understand that their existing ways of doing things may not be the most effective or efficient. A process developed in the 1950s is not going to be better just because it is now supported by technology.

In 1990, Michael Hammer published an article in the *Harvard Business Review* entitled "Reengineering Work: Don't Automate, Obliterate." This article put forward the thought that simply automating a bad process does not make it better. Instead, companies should "blow up" their existing processes and develop new processes that take advantage of the new technologies and concepts. He states in the introduction to the article:1

Many of our job designs, workflows, control mechanisms, and organizational structures came of age in a different competitive environment and before the advent of the computer. They are geared towards greater efficiency and control. Yet the watchwords of the new decade are innovation and speed, service, and quality.

It is time to stop paving the cow paths. Instead of embedding outdated processes in silicon and software, we should obliterate them and start over. We should "reengineer" our businesses: use the power of modern information technology to radically redesign our business processes in order to achieve dramatic improvements in their performance.

Business process reengineering is not just taking an existing process and automating it. BPR is fully understanding the goals of a process and then dramatically redesigning it from the ground up to achieve dramatic improvements in productivity and quality. But this is easier said than done. Most of us think in terms of how to do small, local improvements to a process; complete redesign requires thinking on a larger scale. Hammer provides some guidelines for how to go about doing business process reengineering:

- Organize around outcomes, not tasks. This simply means to design the process so that, if possible, one person performs all the steps. Instead of repeating one step in the process over and over, the person stays involved in the process from start to finish.
- Have those who use the outcomes of the process perform the process. Using information technology, many simple tasks are now automated, so we can empower the person who needs the outcome of the process to perform it. The example Hammer gives here is purchasing: instead of having every department in the company use a purchasing department to order supplies, have the

supplies ordered directly by those who need the supplies using an information system.

- Subsume information-processing work into the real work that produces the information. When one part of the company creates information (like sales information, or payment information), it should be processed by that same department. There is no need for one part of the company to process information created in another part of the company.
- Treat geographically dispersed resources as though they were centralized. With the communications technologies in place today, it becomes easier than ever to not worry about physical location. A multinational organization does not need separate support departments (such as IT, purchasing, etc.) for each location anymore.
- Link parallel activities instead of integrating their results. Departments that work in parallel should be sharing data and communicating with each other during their activities instead of waiting until each group is done and then comparing notes.
- Put the decision points where the work is performed and build controls into the process. The people who do the work should have decision-making authority and the process itself should have built-in controls using information technology.
- Capture information once, at the source. Requiring information to be entered more than once causes delays and errors. With information technology, an organization can capture it once and then make it available whenever needed.

These principles may seem like common sense today, but in 1990 they took the business world by storm.

Hammer gives example after example of how organizations improved their business processes by many orders of magnitude without adding any new employees, simply by changing how they did things.

ISO certification

Many organizations now claim that they are using best practices when it comes to business processes. In order to set themselves apart and prove to their customers (and potential customers) that they are indeed doing this, these organizations are seeking out an ISO 9000 certification. ISO is an acronym for International Standards Organization (website here). This body defines quality standards that organizations can implement to show that they are, indeed, managing business processes in an effective way. The ISO 9000 certification is focused on quality

In order to receive ISO certification, an organization must be audited and found to meet specific criteria. In its most simple form, the auditors perform the following review:

- Tell me what you do *(describe the business process)*.
- Show me where it says that *(reference the process documentation)*.
- Prove that this is what happened *(exhibit evidence in documented records)*.

Over the years, this certification has evolved, and many branches of the certification now exist. ISO certification is one way to separate an organization from others. You can find out more about the ISO 9000 standard here.

Chapter 7 Homework

OVERVIEW

This assignment is designed to introduce you to the creation of rules that govern most systems.

ASSIGNMENT

Create a list of rules (and explain your reasoning) for the qualification of students for a university scholarship. Examples can be found at https://fhsu.edu/finaid/scholarships/index.

STEPS/QUESTIONS

You are going to create a new scholarship for FHSU students and need to decide on the rules that will qualify students for the scholarship.

- Pick 3 to 4 questions/qualifications (such as academic rank, GPA, etc.) that could be used to help decide which student(s) would qualify for the scholarship.

- Create ‘rules’ for these qualifications similar to Figure 11.3 (does not have to be visual like the figure). Explain the rationale for each rule.
- Now for each rule, come up with a scenario where the rule may disqualify a student although they should still be included (for example, a student that is 1 hour short of being a senior, but the next academic year would be the student’s senior year). How should this be handled?

GRADING

A satisfactory submission will outline the rules for a scholarship and give examples of possible failures for each rule.

A beyond satisfactory submission will likely establish the basis for each rule and explain expected ‘failures’ while introducing procedures to handle such failures. A discussion and explanation are expected.

8.

CHAPTER 8 - THE FUTURE OF INFORMATION SYSTEMS

Learning Objectives

8.1 Understand the role information systems will play in the future.

8.2 Identify new information technology that will likely shape the future.

Information systems have evolved at a rapid pace ever since their introduction in the 1950s. Today, devices that we can hold in one hand are more powerful than the computers used to land a man on the moon. The Internet has made the entire world accessible to us, allowing us to communicate and collaborate with each other like never before.

Evolving Future Trends

The first trend to note is the continuing expansion of globalization. The use of the Internet is growing all over the world, and with it the use of digital devices. The growth is coming from some unexpected places; countries such as Indonesia and Iran are leading the way in Internet growth. Social media growth is another trend that continues. Ever since the advent of Web 2.0 and e-commerce, users of information systems have expected to be able to modify their experiences to meet their personal tastes. From custom backgrounds on computer desktops to unique ringtones on mobile phones, makers of digital devices provide the ability to personalize how we use them. More recently, companies such as Netflix have begun assisting their users with personalizations by making suggestions. In the future, we will begin seeing devices perfectly matched to our personal preferences, based upon information collected about us in the past.

Perhaps the most impactful trend in digital technologies in the last decade has been the advent of mobile technologies. Beginning with the simple cellphone in the 1990s and evolving into the smartphones and tablets of today, the growth of mobile has been overwhelming.

Collaborative

As more of us use smartphones and wearables, it will be simpler than ever to share data with each other for mutual benefit. Some of this sharing can be done passively, such as reporting our location in order to update traffic statistics. Other data can be reported actively, such as adding our rating of a restaurant to a review site.

The smartphone app Waze is a community-based tool that keeps track of the route you are traveling and how fast you are making your way to your destination. In return for providing your data, you can benefit from the data being sent from all of the other users of the app. Waze will route you around traffic and accidents based upon real-time reports from other users.

Yelp! allows consumers to post ratings and reviews of local businesses into a database, and then it provides that data back to consumers via its website or mobile phone app. By compiling ratings of restaurants, shopping centers, and services, and then allowing consumers to search through its directory, Yelp! has become a huge source of business for many companies. Unlike data collected passively however, Yelp! relies on its users to take the time to provide honest ratings and reviews.

Printable

One of the most amazing innovations to be developed recently is the 3-D printer. A 3-D printer allows you to print virtually any 3-D object based on a model of that object designed on a computer. 3-D printers work by creating layer upon layer of the model using malleable materials, such as different types of glass, metals, or even wax.

3-D printing is quite useful for prototyping the designs of products to determine their feasibility and marketability. 3-D printing has also been used to create working prosthetic legs, handguns, and even an ear that can hear beyond the range of normal hearing

3-D printing is one of many technologies embraced by the "maker" movement. Chris Anderson, editor of *Wired* magazine, puts it this way.

In a nutshell, the term "Maker" refers to a new category of builders who are using open-source methods and the latest technology to bring manufacturing out of its traditional factory context, and into the realm of the personal desktop computer. Until recently, the ability to manufacture was reserved for those who owned factories. What's happened over the last five years is that we've brought the Web's democratizing power to manufacturing. Today, you can manufacture with the push of a button.

Findable

The "Internet of Things" refers to the idea of physical objects being connected to the Internet. Advances in wireless technologies and sensors will allow physical objects to send and receive data about themselves. Many of the technologies to enable this are already available – it is just a matter of integrating them together.

In a 2010 report by McKinsey & Company on the Internet of Things, six broad applications are identified:

- Tracking behavior. When products are embedded with sensors, companies can track the movements of these products and even monitor interactions with them. Business models can be fine-tuned to take advantage of this behavioral data. Some insurance companies, for example, are offering to install location sensors in customers' cars. That allows these companies to base the price of policies on how a car is driven as well as where it travels.

• Enhanced situational awareness. Data from large numbers of sensors deployed, for example, in infrastructure (such as roads and buildings), or to report on environmental conditions (including soil moisture, ocean currents, or weather), can give decision makers a heightened awareness of real-time events, particularly when the sensors are used with advanced display or visualization

technologies. Security personnel, for instance, can use sensor networks that combine video, audio, and vibration detectors to spot unauthorized individuals who enter restricted areas.

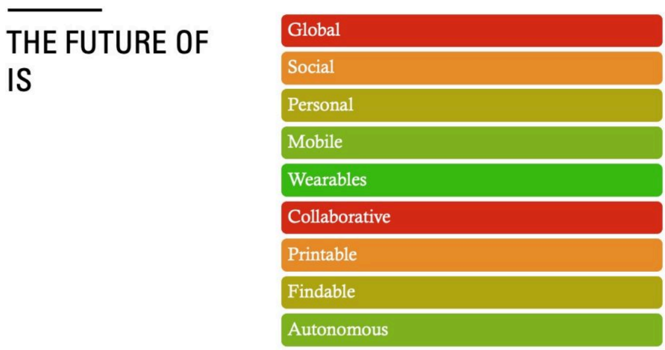
- Sensor-driven decision analysis. The Internet of Things also can support longer-range, more complex human planning and decision making. The technology requirements – tremendous storage and computing resources linked with advanced software systems that generate a variety of graphical displays for analyzing data – rise accordingly.
- Process optimization. Some industries, such as chemical production, are installing legions of sensors to bring much greater granularity to monitoring. These sensors feed data to computers, which in turn analyze the data and then send signals to actuators that adjust processes – for example, by modifying

ingredient mixtures, temperatures, or pressures.

- Optimized resource consumption. Networked sensors and automated feedback mechanisms can change usage patterns for scarce resources, such as energy and water. This can be accomplished by dynamically changing the price of these goods to increase or reduce demand.
- Complex autonomous systems. The most demanding use of the Internet of Things involves the rapid, real-time sensing of unpredictable conditions and instantaneous responses guided by automated systems. This kind of machine decision-making mimics human reactions, though at vastly enhanced performance levels. The automobile industry, for instance, is stepping up the development of systems that can detect imminent collisions and take evasive action.

Autonomous

A final trend that is emerging is an extension of the Internet of Things: autonomous robots and vehicles. By combining software, sensors, and location technologies, devices that can operate themselves to perform specific functions are being developed. These take the form of creations such as medical nanotechnology robots (nanobots), self-driving cars, or unmanned aerial vehicles (UAVs). A nanobot is a robot whose components are on the scale of about a nanometer, which is one-billionth of a meter. While still an emerging field, it is showing promise for applications in the medical field. For example, a set of nanobots could be introduced into the human body to combat cancer or a specific disease. A UAV, often referred to as a “drone,” is a small airplane or helicopter that can fly without a pilot. Instead of a pilot, they are either run autonomously by computers in the vehicle or operated by a person using a remote control.



Chapter 8 Homework

OVERVIEW

This assignment has you lightly research upcoming systems and internet technologies.

ASSIGNMENT

Research Starlink and Loon and perform a SWOT analysis for each.

STEPS/QUESTIONS

- First, you need to research Starlink (www.starlink.com) and Loon (www.loon.com) and find additional resources for the companies.

- The SWOT analysis is simply strengths, weaknesses, opportunities, threats. For each company, you should list at least 3 items in each category.
- List 3 strengths of each company.
- List 3 weaknesses of each company.
- List 3 opportunities of each company.
- List 3 threats to each company.
- Which company do you think should/will prevail?

GRADING

A satisfactory submission will provide basic SWOT items that pertain to Starlink and Loon.

A beyond satisfactory submission will likely provide an in-depth SWOT analysis that may be supported by additional data, etc.