Information Systems for Business and Beyond

INFORMATION SYSTEMS FOR BUSINESS AND BEYOND

Canadian Edition

SHAUNA ROCH; JAMES FOWLER; BARBARA SMITH; AND DAVID BOURGEOIS

JOSEPH MORTATI; SHOUHONG WANG; AND JAMES SMITH

This book is an adaptation of a book originally developed in 2014 by Dr. David Bourgeois as part of the [Open Textbook Challenge](#) funded by the [Saylor Foundation](#) and updated in 2019.

CONTENTS

Chapter 6: Networks

Chapter 7: Systems Development

Chapter 11: Business Process Solutions

Chapter 12: Decision Support

Chapter 13: Emerging Technology

Appendices

ACKNOWLEDGEMENTS

This open textbook has been compiled, edited and partially adapted by the authors (listed below) in partnership with the <u>OER Design Studio</u> and the Library Learning Commons at <u>Fanshawe College</u> in London, Ontario. This work is part of the FanshaweOpen learning initiative and is made available through a <u>Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License</u> unless otherwise noted.

Authors

Shauna Roch, MBA, CPA, CMA *Fanshawe College*
Barbara Smith, MBA, MET *Niagara College*
James Fowler, MBA, CPA, CGA *Mohawk College*

Attribution

This book is an adaptation of <u>Information Systems for Business and Beyond (2019)</u> by David Bourgeois which is licensed under a <u>Creative Commons Attribution-NonCommercial 4.0 International License</u>, except where otherwise noted.

Other open resources have been incorporated into the book and are listed at the end of each chapter. Links to the specific pages or sections of the open resource that have been adapted are provided.

About eCampusOntario

eCampusOntario is a not-for-profit corporation funded by the Government of Ontario. It serves as a centre of excellence in online

and technology-enabled learning for all publicly funded colleges and universities in Ontario and has embarked on a bold mission to widen access to post-secondary education and training in Ontario. This textbook is part of eCampusOntario's open textbook library, which provides free learning resources in a wide range of subject areas. These open textbooks can be assigned by instructors for their classes and can be downloaded by learners to electronic devices or printed for a low cost. These free and open educational resources are customizable to meet a wide range of learning needs, and we invite instructors to review and adopt the resources for use in their courses.

Share

If you adopt this book, as a core or supplemental resource, please report your adoption in order for us to celebrate your support of students' savings. Report your commitment at www.openlibrary.ecampusontario.ca.

We invite you to adapt this book further to meet your and your students' needs. Please let us know if you do! If you would like to use Pressbooks, the platform used to make this book, contact eCampusOntario for an account using open@ecampusontario.ca or contact your academic institution to inquire whether an existing pressbooks account is already available for you to use.

Collaborators

This project was a collaboration between the author and the team in the OER Design Studio at Fanshawe. The following staff and students were involved in the creation of this project:

- Robert Armstrong, Megan Tuckey, Lauren Rowe – *Graphic Design*
- Davandra Earle, Michele Halle-Shook & Meghan Hallam-Wood – *Ancillary Developers*
- Shauna Roch – *Project Manager & Instructional Designer*
- Andrew Stracuzzi- *Quality Assurance*

Reviewers

Thank you to all the reviewers who generously dedicated their time to review the book and provide feedback.

- Tracy Aldis, *Fanshawe College Business Accounting student*
- Karen Asssatourians, *Fanshawe College Business Accounting student*
- Nick Bell, *Fanshawe College Bachelors of Commerce – Accounting student*
- Nick Farnell, *Niagara College Faculty*
- Jay Muncaster, *Fanshawe College Faculty*
- Megan Thornton, *Niagara College Human Resources Management student*

ABOUT THIS BOOK

Information Systems for Business and Beyond – First Canadian edition introduces students to the concept of information systems, the components of information systems, their application to business, and the impacts of their use on business and society. This book is written as an introductory text, meant for those with little or no experience with computers or information systems.

While sometimes the descriptions can get a bit technical, every effort has been made to convey the information essential to understanding a topic while not getting overly focused in detailed terminology. The text is organized into thirteen chapters, and then divided into sub-chapters by concept or topic. The chapters are as follows:

Chapter 1: Information Systems	Chapter 1 provides an overview of information systems (IS), including the major components and the role of IS. As well, the different types of people involved in information systems, and how IS are used in business functions are explored.
Chapter 2: Technology Enabled Strategy	Chapter 2 examines the impact that information systems have on an organization's strategy and overall competitive advantage.
Chapter 3: Hardware	Chapter 3 provides an overview of systems hardware including the different components and impacts of their use.
Chapter 4: Software	Chapter 4 covers software and the role it plays in an organization.
Chapter 5: Data	Chapter 5 explores how organizations use information systems to turn data into information that can then be used for competitive advantage. Special attention is paid to the role of databases.
Chapter 6: Networks	Chapter 6 reviews the history of networking, how the Internet works, and the use of networks in organizations today.
Chapter 7: Systems Development	Chapter 7 examines programming, and the different methods of software development. The "build vs. buy" decision is also discussed.
Chapter 8: Security	Chapter 8 discusses the information security triad of confidentiality, integrity, and availability. Different security technologies are reviewed, and the chapter concludes with a primer on personal information security.
Chapter 9: Impacts of Information Systems	Chapter 9 outlines some of the ethical, legal, and social impacts of using information systems.
Chapter 10: E-Business	Chapter 10 reviews common concepts and definitions associated with e-business, and outlines the advantages and disadvantages of e-commerce. The chapter also provides an overview of the types of e-commerce and the technology used to facilitate it.
Chapter 11: Business Process Solutions	Chapter 11 discusses business process management, business process reengineering, and outlines the different enterprise systems used by businesses.
Chapter 12: Decision Support	Chapter 12 reviews terminology associated with decision support and analytics and explores some of the tools and techniques used to support business decision making.
Chapter 13 Emerging Technology	Chapter 13 looks at the evolution of artificial intelligence (AI) and outlines the different application's of AI. As well the chapter provides some examples of other emerging technology. New Chapter was developed in 2023 based on newly released open content.

For the Student

Each chapter in this text begins with a list of the relevant learning objectives and ends with a chapter summary. Following the summary is a list of review questions that highlight key topics in the chapter. In order to get the best learning experience, students

are encouraged to begin by reading both the learning objectives and the summary and then reviewing the questions at the end of the chapter. Interactive exercises have also been included at the end of the chapter to check retention.

For the Instructor

Please share your adoption, and any feedback you have about the book with us at oer@fanshawec.ca

The following resources are available:

- **Review questions** and assignments are provided at the end of each chapter.
- **Interactive exercises** for students to check their knowledge are provided at the end of each chapter.
- **Slide decks** can be found under ancillary resources in the appendix.
- **Video resources** for each chapter can be found in the appendix.
- **Test Banks** for each chapter can be found in the appendix. They require a password, which can be obtained by emailing oer@fanshawec.ca

Accessibility Statement

We are actively committed to increasing the accessibility and usability of the textbooks we produce. Every attempt has been made to make this OER accessible to all learners and is compatible with assistive and adaptive technologies. We have attempted to provide closed captions, alternative text, or multiple formats for on-screen and off-line access.

The web version of this resource has been designed to meet Web Content Accessibility Guidelines 2.0, level AA. In addition, it follows all guidelines in Appendix A: Checklist for Accessibility of the *Accessibility Toolkit – 2nd Edition*.

In addition to the web version, additional files are available in a number of file formats including PDF, EPUB (for eReaders), and MOBI (for Kindles).

If you are having problems accessing this resource, please contact us at oer@fanshawec.ca.

Please include the following information:

- The location of the problem by providing a web address or page description
- A description of the problem
- The computer, software, browser, and any assistive technology you are using that can help us diagnose and solve your issue (e.g., Windows 10, Google Chrome (Version 65.0.3325.181), NVDA screen reader)

Feedback

To provide feedback on this text please contact **oer@fanshawec.ca.**

CHANGES FROM PREVIOUS EDITION

Information Systems for Business and Beyond – 1st Canadian edition is largely an adaptation of <u>the book by Dr. David Bourgeois</u>, originally published in 2014 as part of the Open Textbook Challenge at the Saylor Foundation, and then updated in 2019. This book has incorporated content from a few other open textbooks and open materials as well.

Here is a summary of the changes made to this new edition:

Overall	• The overall structure was changed and chapters were moved. • The chapter structure was changed to include sub-chapters. • New and updated images were added to every chapter. Images were re-created for consistency throughout. • New Chapters added: Chapter 10 (E-business), Chapter 12 (Decision Support), and Chapter 13 (Emerging Technology). • Added in additional resources: slide decks, knowledge checks and key terms.
Chapter 1: Introduction	• Added in definition of systems thinking and clarified the definition of Information Systems. • Added in new image for information systems and its key components. • Moved the content on Data, Information, Knowledge, Wisdom from another chapter. • Added in characteristics of valuable information. • Added in content on the impact of technology on business disciplines. • Added in content from another chapter on people and IS in organizations. • Removed the history of computing.
Chapter 2: Strategy	• Moved this chapter content from chapter 7 to chapter 2. • Removed the content on the Productivity Paradox by Erik Brynjolfsson and Does IT Matter by Nicholas Carr. • Added in the section on the digital business landscape and technology enabled strategy. • Changed definition of competitive advantage and expanded the definitions. • Added the danger of relying on technology. • Moved Business Process Management to a new chapter. • Moved EDI to the e-Business chapter. • Moved Collaborative systems to the software chapter. • Moved Decision Support to its own chapter. • Added Canadian business examples.
Chapter 3: Hardware	• Added definition of a computer. • Removed the sidebar on binary. • Added in image for Moore's Law. • Added in content on e-Waste and Canadian statistics.
Chapter 4: Software	• Moved section on ERP to the business process chapter and re-wrote content. • Added content on how to obtain software. • Added in information on SaaS. • Added in open source advantages and disadvantages.
Chapter 5: Data	• Reorganized the content of the chapter. • Moved data, information, knowledge and wisdom to chapter 1. • Revised definitions and the database example. • Added in data hierarchy. • Added in more reasons to use a database. • Moved the section on business intelligence to separate chapter.

Chapter 6: Networks	• Reorganized the content of the chapter. • Added section on computer communications, and the process. • Added section on networks. • Added content on generations of the web. • Added in content on a packet's journey.
Chapter 7: Systems Development	• Moved the chapter to earlier in the book. • Added critical success factors in development projects. • Added in examples of the SDLC. • Added in feasibility. • Summarized the section on programming. • Removed content on building a website. • Added more on responsive design.
Chapter 8: Security	• Added in content and definition of cybercrime. • Added in Canadian statistics on cybercrime. • Added in content on types of cybercrime. • Added in Canadian resources.
Chapter 9: Impacts	• Re-wrote chapter for Canadian context.
Chapter 10: E-Business	• Created this new chapter. • Moved content on Blockchain and Bitcoin to this chapter. • Added Canadian content and statistics.
Chapter 11: Business Process	• Added in business and management information systems including transaction processing systems. • Added in batch processing vs real time processing. • Added enterprise systems and ERP systems. • Removed ISO certification content.
Chapter 12: Decision Support	• Created this new chapter. • Moved content on data warehouses and data marts to this chapter.
Chapter 13: Emerging Technology	• Created this new chapter.

CHAPTER 1: INFORMATION SYSTEMS

Chapter Outline

Photo by Skitterphoto CCO

1.1. CHAPTER INTRODUCTION

Learning Outcomes

Upon successful completion of this chapter, you will be able to:

- Define what an information system is by identifying its major components.
- Discuss the role information systems play in organizations.
- Distinguish between data, information and knowledge.
- List the characteristics of valuable information.
- Discuss the impact technology has on different management disciplines/functions.
- Describe the different roles that people play in the design, development, and use of information systems.
- List the different types of users of information systems.

Information systems surround us every day. From your campus's Wi-Fi networks to library database search services, to printers you use in the computer labs. Every time you go shopping you interact with an information system that manages a company's inventory and sales. Even driving to school or work results in an interaction with the transportation system, impacting traffic lights and cameras. Your car's computer system does more than just control the engine – acceleration, shifting, braking, and other data being recorded. Our smartphones also constantly connect to available networks, recording our location and other data.

Can you think of some words you would use to describe an information system? Terms like "computers," "networks," or "databases" might pop into your mind. The study of information systems encompasses various devices, software, and data systems. Defining what an information system encompasses provides a solid foundation for understanding the different systems that are used in businesses and their purpose.

1.2. INFORMATION SYSTEMS

To understand information systems it is important to first consider what a system and a systems thinking approach are. A **system** is a set of parts or components working together towards a common goal. A **systems thinking approach** looks at an entire process taking into consideration all of the parts in the system and how they work together instead of focusing on just one component. Systems thinking looks at the inputs in the process, and how they are transformed to create outputs to achieve goals. Feedback is an important consideration so that there is an opportunity to review the process and make changes if necessary.
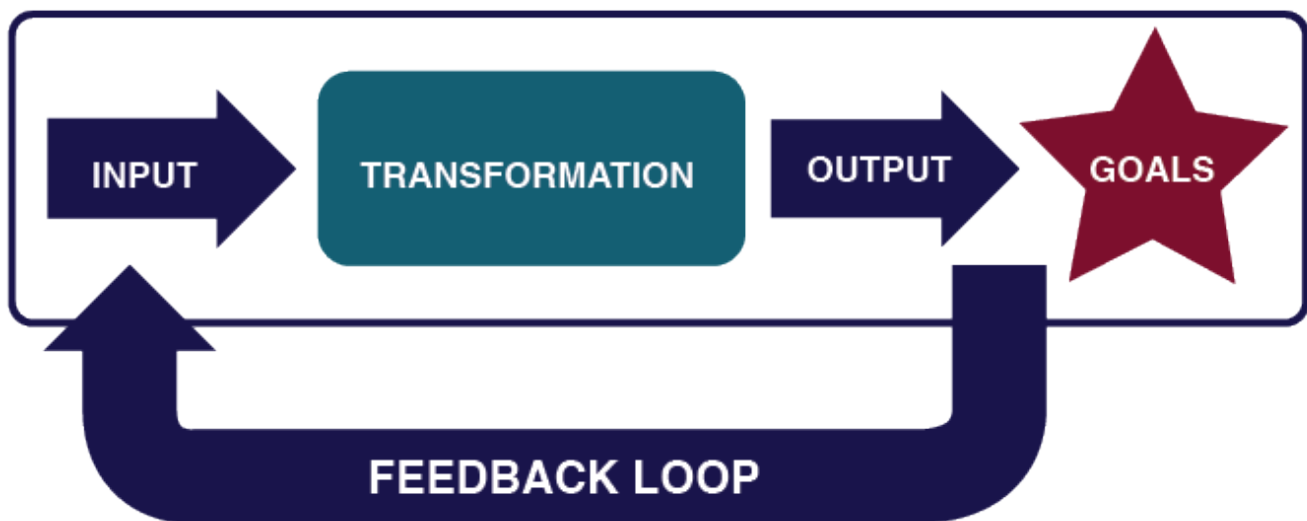
Systems Thinking Diagram

Now that we understand what a system is, it helps us to better understand information systems. **Information systems** contain interrelated components (technology, people, and process) that allow us to take and transform meaningless data into useful information for decision making. Information systems are not new; they have been around throughout human history. The digital revolution enables us all to store and process data into information at unprecedented speeds. Ultimately, we take something that has little to no value on its own and we give it meaning within the context of our thinking, our business, and our world.
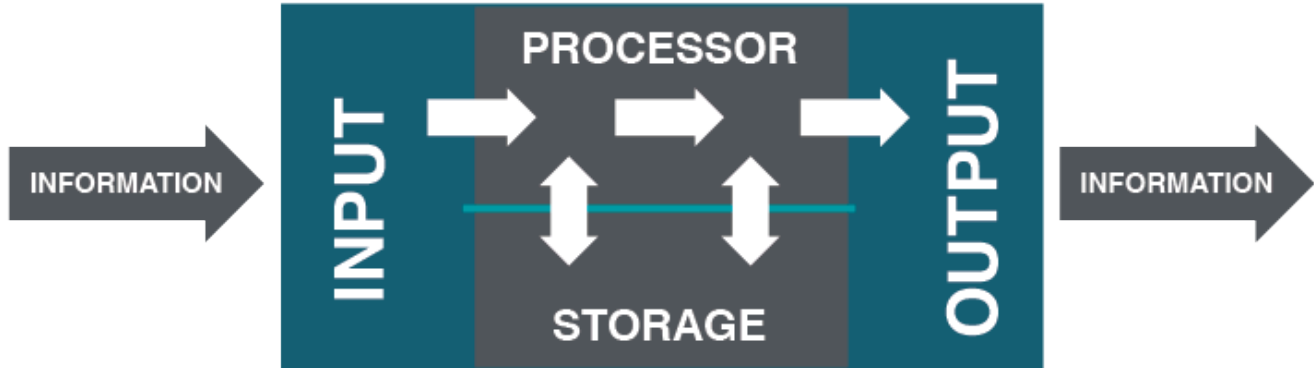
Information System

Information systems can be manual or digital, paper-based or computerized, low tech and low speed, or high tech and high speed. They can cost as little 99c in the shape of a cheap paper notebook or cost over $15 billion to develop, as IBM has spent on its sophisticated artificial intelligence system Watson.

Information systems are all around us, helping us make good decisions. We live in the age of Big Data, data that is so voluminous that we cannot store it in a single system, nor can we process it. We all contribute to the masses of global data by updating our social media, shopping online, or even reading this book online. All of that data piles up very quickly and organizations can use information systems to make sure they understand why events occur, and how to make changes for the future. Not all data gets processed, so the output of an information system will always be lower in volume than the inputs.

IT vs IS

Often Information Technology 'IT' and Information Systems 'IS' are used interchangeably, however, they are not the same. Technology is a subset, or one component of information systems as we can see from the information systems definition – *contains interrelated components that allow us to take and transform meaningless data into useful information for decision making.*

You may find discrepancies in the number of IS components identified depending on the textbook or source used, however most agree that systems are composed of hardware, software, data, procedures, and people. In this book, hardware, software, and networks are combined into 'technology'. Data is identified as the input to the system and information is the output or purpose. IS components will be explored in more detail in the next section.

1.3. INFORMATION SYSTEMS COMPONENTS

Information systems are defined by the components that make up the system, and the role those components play in an organization. Information systems can be viewed as having three core components: technology, people, and process that take the data and transform it into information.
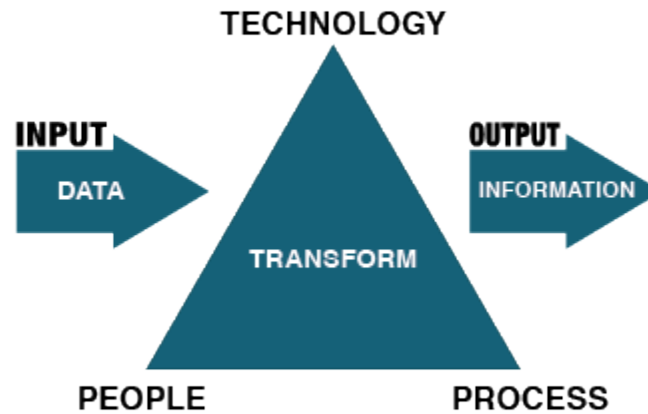
Information Systems Components

As mentioned in the previous section, technology is often what people think of when they hear the term information systems, however it is just one component. The last two components, people and processes, separate the idea of information systems from more technical fields, such as computer science. In order to fully understand information systems, you will need to understand how all of these components work together to bring value to an organization.

Book Structure

This idea forms the structure of this book.

Technology which comprises hardware, software, and networks along with an understanding of technology enabled strategy is covered in the beginning of this book in *Chapters 1 through 6*.

The book then focuses on how **information systems are developed** (*Chapter 7*) and what **impacts and issues** of information systems should be considered that involve people (*Chapters 8 & 9*).

Lastly, the end of the book looks at **business processes and the different types of information systems** that are used in business (*chapters 10-13*).

Technology

Technology is the application of scientific knowledge for practical purposes. From the invention of the wheel to the harnessing of

electricity for artificial lighting, technology has become ubiquitous in daily life, to the degree that it is assumed to always be available for use regardless of location. Technology includes: hardware, software, and networks. Each of these will be addressed in an individual chapters in this book, but a simple introduction is provided below.

- **Hardware**: is the tangible, physical portion of an information system – the part you can touch. Computers, keyboards, disk drives, and flash drives are all examples of information systems hardware. How these hardware components function and work together will be covered in **Chapter 3**.
- **Software:** is the set of instructions that tell the hardware what to do. Software is not tangible – it cannot be touched. Two main categories of software are: Operating Systems and Application software. Operating Systems software provides the interface between the hardware and the Application software. Examples of operating systems for a personal computer include Microsoft Windows and Ubuntu Linux. The mobile phone operating system market is dominated by Google Android and Apple iOS. Application software allows the user to perform tasks such as creating documents, recording data in a spreadsheet, or messaging a friend. Software will be explored more thoroughly in **Chapter 4**.
- **Networking Communication**: besides the technology components (hardware & software) which have long been considered the core technology of information systems, it has been suggested that one other component should be added: communication networks. An information system can exist without the ability to communicate – the first personal computers were stand-alone machines that did not access the Internet. However, in today's hyper-connected world, it is an extremely rare computer that does not connect to another device or to a network. Technically, the networking communication component is made up of hardware and software, but it is such a core feature of today's information systems that it has become its own category. Networking will be covered in **Chapter 6.**

People

When thinking about information systems, it is easy to focus on the technology components and forget to look beyond these tools to fully understand their integration into an organization. A focus on the people involved in information systems is the next step. From the front-line user support staff, to systems analysts, to developers, all the way up to the chief information officer (CIO), the people involved with information systems are an essential element. The roles people play in information systems is explored in this chapter, but the role people play is interwoven throughout the book as it is difficult to separate people from information systems.

Process

The last component of an information system is processes. A **process** is a series of steps undertaken to achieve a desired outcome or goal. Information systems are becoming more integrated with organizational processes, bringing greater productivity and better control to those processes. Simply automating activities using technology is not enough – businesses looking to utilize information systems must do more. The ultimate goal is to improve processes both internally and externally, enhancing interfaces with suppliers and customers. Technology buzzwords such as 'business process re-engineering,' 'business process management,' and 'enterprise resource planning' all have to do with the continued improvement of these business processes and procedures and the integration of technology with them. Businesses hoping to gain a competitive advantage over their competitors are highly focused on this component of information systems. The process element in information systems will be discussed in **Chapter 11**.

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. You can think of data as a collection of facts. For example, your address (street, city state, postal code), your phone number, and your social networking account are all pieces of data. Like software, data is also intangible, unable to be seen in its native state. Pieces of unrelated data are not very useful. But aggregated, indexed, and organized together into a database, data can become a powerful tool for businesses. Organizations collect all kinds of data and use it to make decisions which can then be analyzed as to their effectiveness. The analysis of data is then used to improve the organization's performance. **Chapter 5** will focus on data and databases, and how they are used in organizations.

"Chapter 1: What Is an Information System?" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

1.4. THE ROLE OF INFORMATION SYSTEMS

The goal of an information system is to transform data into information in order to generate knowledge that can be used for decision making. In order for information to add value to a business and the decision maker it must possess characteristics to ensure quality. The following characteristics are necessary to add value.

Data Properties

Accessible	Must be easily accessible by users to meet their needs in the right format at the right time. Access should be secure and prevent unauthorized access.
Consistent	Contains no discrepancies, and the same measurements or structure are used regardless of the data source.
Complete	Contains all information and is not missing anything.
Timely	Delivered when needed.
Accurate	Free of errors and bias, and can be verified or validated.
Cost	Balance the value of information to the cost of producing it.
Relevant	Important to decision makers.
Clear	Not overly complex, easy to understand.

The terms information and knowledge are sometimes used interchangeably. What is the difference between data, information and knowledge?

Data, Information, Knowledge, & Wisdom

Data are the raw facts, and may be devoid of context or intent. For example, a sales order is a piece of data. Data can be quantitative or qualitative. Quantitative data is numeric, the result of a measurement, count, or some other mathematical calculation. Qualitative data is descriptive. "Ruby Red," the color of a 2013 Ford Focus, is an example of qualitative data. A number can be qualitative too: if I tell you my favorite number is 5, that is qualitative data because it is descriptive, not the result of a measurement or mathematical calculation.

Information is processed data that possess context, relevance, and purpose. For example, monthly sales calculated from the collected daily sales data for the past year are information. Information typically involves the manipulation of raw data to obtain an indication of magnitude, trends, in patterns in the data for a purpose.
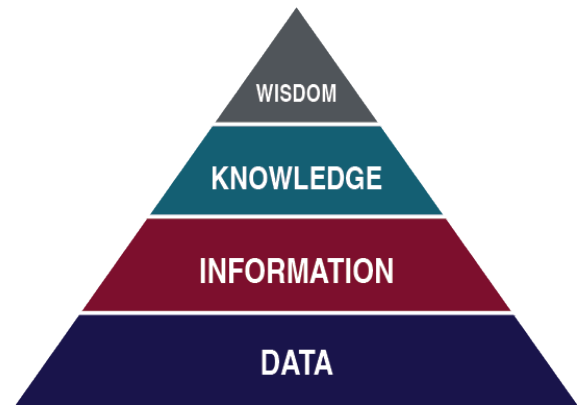
DIKW Pyramid

Example: Student Evaluations

As an example, suppose that you want to know how you're doing in a particular course. So far, you've taken two 20-question multiple-choice tests. On the first, you got questions 8, 11, and 14 wrong; on the second, you did worse, missing items 7, 15, 16, and 19. The items that you got wrong are merely data—unprocessed facts. What's important is your total score. You scored 85 on the first exam and 80 on the second. These two numbers constitute information—data that have been processed, or turned into some useful form. Knowing the questions that you missed simply supplied you with some data for calculating your scores.

Now let's fast-forward to the end of the semester. At this point, in addition to taking the two tests, you've written two papers and taken a final. You scored a 90 and 95 on the papers and a 90 on the final. You now have more processed data, but you still want to organize them into more useful information. What you want to know is your average grade for the semester. To get the information you want, you need yet more data—namely, the weight assigned to each graded item. Fortunately, you've known from day one that each test counts 20 percent, each paper 10 percent, and the final exam 40 percent. A little math reveals an average grade of 87.

Though this is the information you are interested in, it may be mere data to your instructor, who may want different information: for example, the average grade for the entire class. The moral of the story is that what constitutes information at one stage can easily become data at another, and one person's information can be another person's data.

Knowledge in a certain area is human beliefs or perceptions about relationships among facts or concepts relevant to that area.

For example, the conceived relationship between the quality of goods and the sales is knowledge. Knowledge can be viewed as information that facilitates action.

Once we have put our data into context, aggregated and analyzed it, we can use it to make decisions for our organization. We can say that this consumption of information produces knowledge. This knowledge can be used to make decisions, set policies, and even spark innovation.

Explicit knowledge typically refers to knowledge that can be expressed in words or numbers. In contrast, **tacit knowledge** includes insights and intuitions and is difficult to transfer to another person using simple communication. When information or explicit knowledge is captured and stored in a computer, it would become data if the context or intent is devoid.

We can say that someone has **wisdom** when they can combine their knowledge and experience to produce a deeper understanding of a topic. It often takes many years to develop wisdom on a particular topic, and requires patience.

1.5. TECHNOLOGY IN PROFESSIONS

As technology becomes faster and cheaper, technology skills are being embedded inside more and more job functions. Every managerial discipline today is impacted by technology.

Accounting

Accounting is built on a foundation of technology. The numbers used by accountants are all recorded, stored, and reported by information systems, and the reliability of any audit is inherently tied to the reliability of the underlying technology. Increased regulation, such as the heavy executive penalties tied to the Sarbanes-Oxley Act in the United States, have ratcheted the importance of ensuring accountants and executives get their numbers right. Negligence could mean jail time. This means the link between accounting and tech have never been tighter, and the stakes for ensuring systems accuracy have never been higher.

Every major accounting firm has a tech-focused consulting practice, and in many cases, these firms have grown to be larger than the accounting services functions from which they sprang. Today, the tech-centric consulting division of Deloitte (one of the Big Four accounting firms) is larger than the firm's audit, tax, and risk practices.

Finance

Many business school students who study finance aspire to careers in investment banking. Many i-bankers will work on initial public offerings (IPOs) which means offering stock publicly for the first time. IPO markets need new firms, and the tech industry is a fertile ground that continually sprouts new businesses. Other i-bankers will be involved in valuing merger and acquisition (M&A) deals as leading tech firms are flush with cash and constantly on the hunt for new firms to acquire.

Those in other finance careers will evaluate the role of technology in investment portfolios, and banking. When someone in Toronto arranges for a bridge to be built in Shanghai, the money is not carried over in a suitcase, it is transferred digitally between banks. Technology also has an impact on stock exchanges, as transactions now happen digitally and information is displayed in real time. Mobile apps make it even easier for investors to make trades quickly.

Marketing

Technology has disrupted the marketing landscape, and as a result, the skill set needed by today's marketers is changing. Online channels have provided a way to track and monitor consumer activities, and firms are leveraging this insight to understand how to best serve their customer's needs. The success or failure of a campaign can often be immediately assessed based on online activity such as website visits or social media chatter. New channels continue to emerge, making it easier to gather data, reach the customer and process transactions. Smartphones can deliver location-based messages and services, and even allow for cashless payments.

Social media is also a large part of this evolving marketing landscape. Customers can leverage their digital voice, capable of broadcasting word-of-mouth influence in ways that can benefit and harm a firm. Savvy firms are using social media to generate sales, improve their reputations, better serve customers, and innovate. Search engine marketing (SEM), search engine optimization (SEO), customer relationship management (CRM), personalization systems are all central components of the new marketing toolkit.

Management & Human Resources

Technology helps firms harness the untapped power of employees. Knowledge management systems (KMS) are morphing into social media technologies that can accelerate the ability of a firm to quickly organize and leverage teams of experts. Human resources (HR) directors are using technology for employee training, screening, and evaluation. The accessibility of end-user technology means that every employee can reach the public, creating an imperative for firms to set policy on issues such as firm representation and disclosure and to continually monitor and enforce policies. The successful HR manager recognizes that technology continually changes an organization's required skill sets, as well as employee expectations.

The hiring and retention practices of the prior generation are also in flux. Recruiting hasn't just moved online; it's now grounded in information systems that scour databases for specific skill sets, allowing recruiters to cast a wider talent net than ever before. Job seekers are writing résumés with keywords in mind, aware that the first cut is likely made by a database search program, not a human being. The rise of professional social networks also puts added pressure on employee satisfaction and retention. Prior HR managers fiercely guarded employee directories for fear that a headhunter or competitive firm might raid top talent. Now the equivalent of a corporate directory can be easily pulled up via [LinkedIn](), a service complete with discrete messaging capabilities that can allow competitors to target your firm's best and brightest. Thanks to technology, the firm that can't keep employees happy, engaged, and feeling valued has never been more vulnerable.

Supply Chain & Operations

A firm's operations management function is focused on producing goods and services, and technology has helped to automate, and improve this process. Robotics and factory automation, quality programs, process redesign, supply chain management, and service operations are all ways in which technology is being leveraged to create value and competitive advantage.

Law

For those looking for careers in corporate law, many of the hottest areas involve technology. Intellectual property, patents, piracy, and privacy are all areas where activity has escalated dramatically in recent years. The number of patent applications waiting for approval has increased significantly. Firms planning to leverage new inventions and business methods need legal teams with the skills to sleuth out whether a firm can legally do what it plans to. Others will need legal expertise to help them protect proprietary methods and content, as well as to help enforce claims in the home country and abroad.

1.6. PEOPLE AND INFORMATION SYSTEMS

People are involved in information systems in just about every way. People **imagine** information systems, people **develop** information systems, people **support** information systems, and, perhaps most importantly, people **use** information systems. The jobs listed below do not represent all possible jobs within an information systems organization. Larger organizations will have more specialized roles, while smaller organizations may combine some of these roles. Many of these roles may also exist outside of the organization.

Creators

The first group of people to be considered play a role in designing, developing, and building information systems. These people are generally technical and have a background in programming, analysis, information security, or database design. The process of creating information systems will be covered in more detail in Chapter 7.

Systems Analyst	Manages projects by identifying business needs and imagining a new or redesigned computer-based system to fulfill those needs.
Programmer	Writes computer code in a programming language to fulfill the design specifications of the analyst or designer.
Computer Engineer	Designs the computing devices that we use every day. Can include software engineers, hardware engineers, systems engineer and network engineers.

Operations & Administration

Another group of information systems professionals are involved in the day-to-day operations and administration of IT. These people must keep the systems running and up-to-date so that the rest of the organization can make the most effective use of these resources.

Computer Operator	Oversees the mainframe computers and data centers in organizations. Since mainframe computers increasingly have been replaced with servers, storage management systems, and other platforms, computer operators' jobs have grown broader and include working with these specialized systems.
Database Administrator	Manages the databases for an organization.
Help Desk / I.T. Support	First line of support for computer users in a company.
Trainer	Conducts classes to teach people specific computer skills

Managing Information Systems

The management of information-systems functions is critical to the success of information systems within the organization. Here are some of the jobs associated with the management of information systems.

CIO or CTO	Chief information office (CIO) or chief technology officer (CTO) is the head of the information-systems function.
Information Managers	responsible for determining the information needs of the organization, collecting the appropriate data, converting it to information and communicating it.
Project Managers	responsible for keeping systems projects on time and on budget.
Information Security Officer	in charge of setting information-security policies for an organization, and then overseeing the implementation of those policies.

Emerging Roles

As technology evolves many new roles are becoming more common as other roles diminish. For example, as we enter the age of "big data," we are seeing the need for more data analysts and business intelligence specialists. Many companies are now hiring social media experts and mobile technology specialists. The increased use of cloud computing and Virtual Machine (VM) technologies also is increasing demand for expertise in those areas.

Users

Besides the people who work to create, administer, and manage information systems, there is one more extremely important group of people, namely, the users of information systems. This group represents a very large percentage of an organization's employees. If the user is not able to successfully learn and use an information system, the system is doomed to failure.

One tool that can be used to understand how users will adopt a new technology comes from a 1962 study by Everett Rogers. In his book, *Diffusion of Innovation*, Rogers studied how farmers adopted new technologies and noticed that the adoption rate started slowly and then dramatically increased once adoption hit a certain point. He identified five specific types of technology adopters:
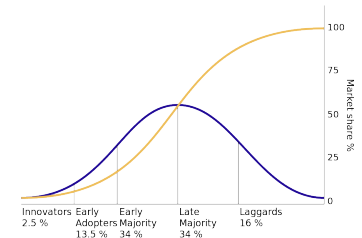
The diffusion of Innovation (click to enlarge). With successive groups of consumers adopting the new technology (shown in blue), its market share (yellow) will eventually reach the saturation level. The blue curve is broken into sections of adopters (Rogers, 1962).

- **Innovators**. Innovators are the first individuals to adopt a new technology. Innovators are willing to take risks, are the youngest in age, have the highest social class, have great financial liquidity, are very social, and have the closest contact with scientific sources and interaction with other innovators. Risk tolerance is high so there is a willingness to adopt technologies that may ultimately fail. Financial resources help absorb these failures (Rogers, 1962, p. 282).
- **Early adopters**. The early adopters are those who adopt innovation soon after a technology has been introduced and proven. These individuals have the highest degree of opinion leadership among the other adopter categories, which means that these adopters can influence the opinions of the largest majority. Characteristics include being younger in age, having a higher social status, possessing more financial liquidity, having advanced education, and being more socially aware than later adopters. These adopters are more discrete in adoption choices than innovators, and realize judicious choice of adoption will help them maintain a central communication position (Rogers, 1962, p. 283).
- **Early majority**. Individuals in this category adopt an innovation after a varying degree of time. This time of adoption is

1.6. PEOPLE AND INFORMATION SYSTEMS | 21

significantly longer than the innovators and early adopters. This group tends to be slower in the adoption process, has above average social status, has contact with early adopters, and seldom holds positions of opinion leadership in a system (Rogers, 1962, p. 283).

- **Late majority**. The late majority will adopt an innovation after the average member of the society. These individuals approach an innovation with a high degree of skepticism, have below average social status, very little financial liquidity, are in contact with others in the late majority and the early majority, and show very little opinion leadership.
- **Laggards**. Individuals in this category are the last to adopt an innovation. Unlike those in the previous categories, individuals in this category show no opinion leadership. These individuals typically have an aversion to change agents and tend to be advanced in age. Laggards typically tend to be focused on "traditions," are likely to have the lowest social status and the lowest financial liquidity, be oldest of all other adopters, and be in contact with only family and close friends.

These five types of users can be translated into information technology adopters as well, and provide additional insight into how to implement new information systems within the organization. For example, when rolling out a new system, IT may want to identify the innovators and early adopters within the organization and work with them first, then leverage their adoption to drive the rest of the implementation to the other users (Rogers, 1962).

1.7. INFORMATION SYSTEMS IN AN ORGANIZATION

In the early years of computing, the information-systems function (generally called "data processing") was placed in the finance or accounting department of the organization. As computing became more important, a separate information-systems function was formed, but it still was generally placed under the Chief Financial Officer (CFO) and considered to be an administrative function of the company. By the 1980s and 1990s, when companies began networking internally and then connecting to the internet, the information systems function was combined with the telecommunications functions and designated as the Information Technology (IT) department. As the role of information technology continued to increase, its place in the organization became more important. In many organizations today, the Chief Information Officer (CIO) or Chief Technology Officer (CTO) is the head of IT and reports directly to the head of the company – the Chief Executive Officer (CEO).

Before the advent of the personal computer, the information systems function was centralized within organizations to maximize control over computing resources. When the PC began proliferating, many departments created their own internal IS group dedicated to their needs, providing quicker turnaround and higher levels of service than a centralized IT department. However, having several IS groups within an organization leads to inefficiency, as several people perform the same jobs in different departments. Decentralization also leads to company data being stored in several places all over the company.

In some organizations, a matrix reporting structure is utilized in which IT personnel are placed within a department and report to both the department management and the functional management within IS. The advantages of dedicated IS personnel must be weighed against the need for more control over the strategic information resources of the company. For many companies, these questions are resolved by implementing an ERP system (see discussion of ERP in Chapter 11) as an ERP system consolidates data into a single database.

Outsourcing

An organization may need a specific skill for a limited period. Instead of training existing employees or hiring new staff, it may make more sense to outsource the job. **Outsourcing** can be used in many different situations within the information systems function, such as designing and creating a new website or upgrading an ERP system. Some organizations see outsourcing as a cost-cutting move, contracting out a whole group or department.

New Models of Organizations

The integration of information technology has influenced the structure of organizations. The increased ability to communicate and share information has led to a "flattening" of the organizational structure due to the removal of one or more layers of management. The network-based organizational structure is another changed enabled by information systems. In a network-based organizational structure, groups of employees can work somewhat independently to accomplish a project. People with the right skills are brought together for a project and then released to work on other projects when that project is over. These groups are somewhat informal and allow for all members of the group to maximize their effectiveness.

"Chapter 9: The People in Information Systems" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

1.8. SUMMARY

Key Takeaways

- Information systems are ubiquitous and surround us everyday.
- Information systems are essential for good decision-making. They transform data into information.
- Information systems are comprised of: technology (hardware, software, networks), people and processes.
- Data, information, knowledge and wisdom are terms that are sometimes used interchangeably, but they are not the same.
- In order for information to be valuable for decision making it must be: accessible, consistent, timely, accurate, cost effective, relevant and clear.
- Technology is impacting every major business discipline, including finance, accounting, marketing, operations, human resources, and the law.
- Information system (IS) jobs are profoundly diverse, ranging from those that require heavy programming skills to those that are focused on design, process, project management, privacy, and strategy.
- The information systems function in business has evolved over time creating new models and structures for organizations.

Review Questions

1. What is an information system? How are they used in different professions and in your everyday life?
2. What are the major components that make up an information system?
3. What is the role information systems play in an organization?
4. Are data and information different? Are knowledge and wisdom different?
5. What makes information valuable? Why?
6. How does technology impact different business disciplines and careers?
7. What roles do people play in information systems?
8. What kinds of skills do today's managers need that weren't required a decade ago?
9. How do information systems function in a changing business?

Assignment

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 within your future career industry. Complete the following questions in a separate document.

1. What industry do you plan to work in once you graduate?
2. Perform some research on the skills gap and describe what is happening within your industry. Make sure to provide references to the resources you use.
3. Finally, conclude with a plan of how you will address the skills gap with your current career path.

1.9. KEY TERMS

Chapter 1

Application Software: An application a set of computer program deigned to permit the user to perform a group of coordinated functions, tasks, or activities. It cannot run on itself but is depended on the OS. (1.3)

CIO: Chief Information Officer is the head of the information systems function and aligns the plans and operations of the information systems with the strategic goals of the function. (1.6)

Computer Engineer: Designs the computing devices that we use every day. (1.6)

Computer Operator: A person responsible for monitoring and controlling computer systems. (1.6)

Database Administrator: This person who plans, develops, monitors and maintains databases that are used as part of applications or the data warehouse. (1.6)

Data: A collection of facts, that is intangible. (1.3)

Hardware: The part of an information system you can touch–the physical components of the technology. (1.3)

HelpDesk: A place or organization that a user of information technology can call to get help with a problem. This can be internal to a company or external to customers outside the company. (1.6)

Information: is processed data that possess context, relevance, and purpose.(1.4)

Information Security Officer: In charge of setting information system policies for an organization, and then overseeing the implementation of those policies. (1.6)

Information System (IS): contain interrelated components (technology, people, and process) that allow us to take and transform meaningless data into useful information for decision making.(1.2)

Information Technology (IT): is a subset, or one component of information systems that allow us to take and transform meaningless data into useful information for decision making. (1.2)

Knowledge: in a certain area is human beliefs or perceptions about relationships among facts or concepts relevant to that area.(1.4)

Operating System (OS): The program that, after being initially loaded into the computer by a boot program, manages all the other programs in a computer. (1.3)

Outsourcing: Hiring external labor, usually at lower cost, to accomplish company work. This includes hiring low-cost labor in other countries and cheaper labor in a resident country. Outsourcing can be an effective cost saving strategy when used properly. (1.7)

Process: is a series of steps undertaken to achieve a desired outcome or goal.(1.3)

Programmer: People who write computer programs to support business functions. (1.6)

Project Managers: Responsible for keeping projects on time and budget and works with other stakeholders of the project to keep the team organized and communicates the statue of the project to management. (1.6)

Role: The function of information technology components in an organization. (1.6)

Software: A set of instructions that tells the hardware what to do, it is not tangible. (1.3)

System: is a set of parts or components working together towards a common goal. (1.2)

Systems Analyst: This individual will work with a person, team, or department with business requirements and identify the specific details of a system that needs to be built. (1.6)

Systems thinking approach: looks at an entire process taking into consideration all of the parts in the system and how they work together instead of focusing on just one component. (1.2)

Technology Adoption Curve: One tool that can be used to understand how users will adopt a new technology. (1.6)

Trainer: A person that conducts classes to teach people specific computer skills.(1.6)

User: The person who uses and operates a computer or other machine. (1.6)

Wisdom: when they can combine their knowledge and experience to produce a deeper understanding of a topic.(1.4)

1.10. KNOWLEDGE CHECK

Use the expand button to view in expanded form.

Knowledge Check 1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=210#h5p-50

Knowledge Check 2

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=210#h5p-25

Knowledge Check 3

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=210#h5p-11

Knowledge Check 4

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=210#h5p-1

CHAPTER 2: TECHNOLOGY ENABLED STRATEGY

Chapter Outline

Photo by Carl Heyerdahl, Unsplash License

2.1. CHAPTER INTRODUCTION

Learning Outcomes

Upon successful completion of this chapter, you will be able to:

- Discuss the impacts of digital technology on the business landscape;
- Explain how strategy is impacted by technology;
- Describe the components of competitive advantage;
- Outline the value chain concept;
- Recognize the role technology can play in crafting an imitation-resistant value chain; and
- Explain the danger of relying on technology.

The world is changing rapidly, and the impacts of technology are profound. Digital technologies – devices that process digital signals – are advancing faster than any other innovation in history and changing the industry's competitive dynamics. Managers who understand the impacts of a rapidly shifting environment are better prepared to recognize both opportunities and risks and are able to formulate tech-centric approaches to markets. Managers also need to see clearly through seemingly conflicting assertions about best practices.

This chapter will explain how firms can leverage technology for competitive advantage. It is important to note that technology alone is rarely the answer, but firms can weave technology into their operations in ways that create value. Two popular management frameworks, the value chain and the five forces model, will be explored to help understand competitive advantage.

2.2. DIGITAL BUSINESS LANDSCAPE

The last twenty years have been a time of considerable technological growth, changing how we live and do business. At the end of the 20th century, Google was in its infancy and well-known strategists were dismissing Internet advertising models (Porter, 2001). Today, Google generates more advertising revenue than any other firm and has risen to become the most profitable media company on the planet. Billions in advertising dollars are poured into digital efforts, and this shift has reshaped industries and redefined skills needed to reach customers.

Twenty years ago, Apple Inc. was considered a tech-industry 'has-been'. However, by the spring of 2010 Apple grew to be the most valuable tech firm in the United States, selling more media and generating more profits from mobile device sales than any firm in the world. In 2020, they became the first U.S. company to have a market capitalization of $2 trillion (Bursztynsky, 2020). Technology is more personal and portable.

The turn of the century also gave birth to social media networks, which quickly became hotbeds for digital media marketers and influencers. Facebook, the largest social media network, reached 2.9 billion active users by the fourth quarter of 2021 (Statista, 2001). Firms are harnessing the power of social media to generate new product ideas and promote sales. These new communication channels also provide a platform for anyone to share their thoughts and opinions, both good and bad. Companies must constantly review information shared to mitigate potential negative impacts to their business. These tools have also allowed misinformation to flourish.

Social media information is just one form of data that is being collected by companies for data analysis. Data analytics and business intelligence drive discovery and innovation and redefine modern marketing and business. Massive amounts of data are stored and analyzed to assist managers in decision-making, from looking for new sources of revenue to efficiencies in business operations. The growth in data collection has highlighted the need to consider customer privacy, which can shred corporate reputations if mishandled.

The way we conceive software and the software industry is also changing radically. IBM, HP, and Oracle are among the firms that collectively pay thousands of programmers to write code that is given away for free. Today, open-source software powers most of the websites you visit. The rise of open source has rewritten the revenue models for the computing industry and lowered computing costs. Cloud computing and software as a service (SaaS) is turning sophisticated, high-powered computing into a utility available to even the smallest businesses and nonprofits.

The pervasiveness of computing means many devices and appliances are now 'smart'. Smart technologies ensure electric devices are connected to a network, allowing for the exchange of information to carry out requests and provide customer convenience. Smart devices incorporate machine learning and artificial intelligence to assist users better. The data collected by these devices provides more detailed insight into consumer behaviours and can assist with marketing and product development.

Technological disruptions aren't going away and will almost certainly accelerate, impacting organizations, careers, and everyday life. It's time to place technology at the center of the managerial playbook.

2.3. TECHNOLOGY ENABLED STRATEGY

Managers are confused and with good reason. Management theorists, consultants, and practitioners often vehemently disagree on how firms should craft a tech-enabled strategy, and many widely read articles contradict one another. Headlines such as "Move First or Die" compete with "The First-Mover Disadvantage." A leading former CEO advised, "destroy your business," while others suggested firms focus on their "core competency" and "return to basics." The pages of the Harvard Business Review declare, "IT Doesn't Matter," while a New York Times bestseller hails technology as the "steroids" of modern business.

Theorists claiming to have mastered the secrets of strategic management are contentious and confusing. As a manager, the ability to size up a company's strategic position and understand its likelihood of sustainability is one of the most valuable yet difficult skills to master. Layer on thinking about technology—a key enabler to nearly every modern business strategy, but also a function often thought of as easily "outsourced"—and it's no wonder so many companies struggle at the intersection where strategy and technology meet.

Developing strong strategic thinking skills is a career-long pursuit. While this chapter can't address the breadth of strategic thought, it is meant as a primer on developing the skills for strategic thinking about technology. We will first start by understanding what competitive advantage is and how technology plays a role in it.

2.4. COMPETITIVE ADVANTAGE

Resources, Capabilities, Competitive Advantage and Strategy

A firm is described as having a **competitive advantage** when it successfully attracts more customers, earns more profit, or returns more value to its shareholders than rival firms do. A firm achieves a competitive advantage by adding value to its products and services or reducing its own costs more effectively than its rivals in the industry. Companies strive for sustainable competitive advantage. The goal is easy to state, but hard to achieve. The world is so dynamic, with new products and new competitors rising seemingly overnight, that truly sustainable advantage might seem like an impossibility. New competitors and copycat products create a race to cut costs, cut prices, and increase features that may benefit consumers but erode profits industry-wide. Nowhere is this balance more difficult than when competition involves technology. The fundamental strategic question is, "How can I possibly compete when everyone can copy my technology and the competition is just a click away?" Put that way, the pursuit of sustainable competitive advantage seems like a lost cause, but it can also be an opportunity. Being aware of major sources of competitive advantage can help managers recognize an organization's opportunities and vulnerabilities and build a strategy.

Business-level strategy is the general way that a business organizes its activities to compete against rivals in its product's industry. Michael Porter, a professor at Harvard Business School and one of the foremost scholars in business strategy, defined three generic business-level strategies that outline the basic methods of organizing to compete in a product market. A strategic information system is designed specifically to align with and implement a competitive organizational strategy. A strategic information system attempts to do one or more of the following:

- Deliver a product or a service at a lower cost;
- Deliver a product or service that is differentiated;
- Help an organization focus on a specific market segment;
- Enable innovation.

STRATEGIC ADVANTAGE
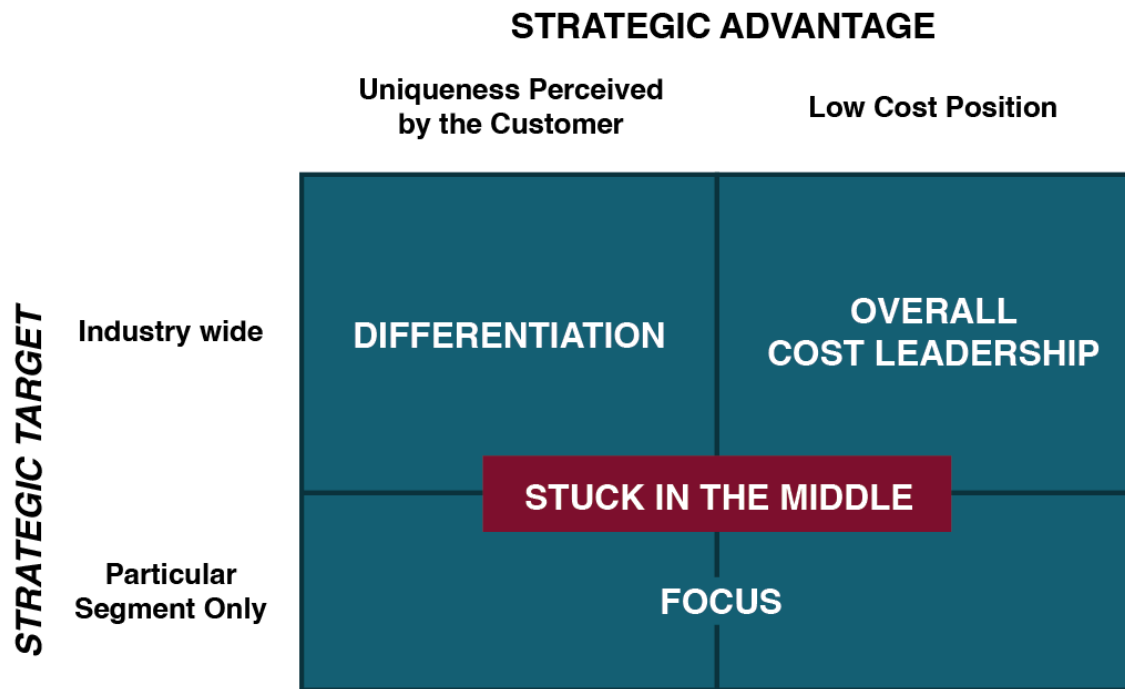
Michael Porter's Three Generic Strategies (Porter, 1980).

2.5. COMPETITIVE STRATEGY

Cost Leadership

When pursuing a **cost-leadership** (low-cost) strategy, a firm offers customers its product or service at a lower price than its rivals can. To achieve a competitive advantage over rivals in the industry, the successful cost leader tightly controls costs throughout its value chain activities. Supplier relationships are managed to guarantee the lowest prices for parts, manufacturing is conducted in the least expensive labour markets, and operations may be automated for maximum efficiency. A cost leader must spend as little as possible producing a product or providing a service to remain profitable when selling that product or service at the lowest price. Walmart is the master of cost leadership, offering a wide variety of products at lower prices than its competitors because it does not spend money on fancy stores, extracts low prices from its suppliers, and pays its employees relatively low wages. An example of an information system that supports Walmart's strategy is the Fast Unloader technology that scans and sorts incoming inventory, reducing the truck uploading process by one-third (Thomas, 2020).

Differentiation

Not all products or services in the marketplace are offered at low prices. A **differentiation strategy** is exactly the opposite of a cost-leadership strategy. While firms do not look to spend as much as possible to produce their output, firms that differentiate try to add value to their products and services so they can attract customers who are willing to pay a higher price. At each step in the value chain, the differentiator increases the quality, features, and overall attractiveness of its products or services. Research and development efforts focus on innovation, customer service, and marketing to bolster the value of the firm brand. Starbucks is a good example of a differentiator: it makes coffee, but its customers are willing to pay premium prices for a cup of Starbucks coffee because they value the restaurant atmosphere, customer service, product quality, and brand. The My Starbucks Rewards Program and Mobile Order & Pay system allow customers to customize their orders and provide convenience to order ahead and pick up later.

In some instances, products or services are nearly identical to those of the competition. These are referred to as commodities. Consumers buying commodities are price-focused. In order to break the commodity trap, many firms leverage technology to differentiate their goods and services. Dell gained attention not only because of their low prices, but also because it was one of the first PC vendors to build computers based on customer choice. Want a bigger hard drive? Don't need a fast graphics card? Dell will oblige.

Providing opportunities for personalization or customization means that companies are able to collect valuable data on their customers. The Starbucks app which stores customer's preferences and data serves as a switching cost. **Switching costs** exist when consumers incur an expense to move from one product or service to another. This means that the customer would have to go through the whole process again with another company to add in their custom drink preferences. Likewise, consider Amazon, which uses browsing records, purchase patterns, and product ratings to present a custom home page featuring products that the company hopes the visitor will like. This makes it convenient for customers to shop, and provides a barrier to them switching to another company.

Porter's typology assumes that firms can succeed through either cost leadership or differentiation. Trying to combine these two, Porter suggests, can lead to a firm being stuck in the middle.

Focus

The focus strategy is a little different from the other two. A firm that **focuses** still must choose one of the other strategies to organize its activities. It will still strive to lower costs or add value. The difference is that a firm choosing to implement a focused strategy will concentrate its marketing and selling efforts on a smaller market than a broad cost leader or differentiator. A firm following a focus-differentiation strategy, for example, will add value to its product or service that a few customers will value highly, either because the product is specifically suited to a particular use or because it is a luxury product that few can afford. For example, Lululemon is a successful differentiator in the athletics apparel market. Their products are valued by customers who are willing to pay premium prices for high-quality athletic clothing and a unique experience. To help support the customer experience and their strategy, Lululemon implemented a customer relationship management (CRM) system that collects data from every aspect of the customer's experience and provides insight into their customer's behaviours. This helps the company personalize their customers' experience and generate more sales (Mottl, 2017).

Innovation

The strategy of **innovation** can be described as a plan to encourage, mobilize, motivate, and achieve advancements in technology or service by investing in research and development activities. Innovation strategy means rethinking the development or delivery of a product or service in a particular market or industry to meet previously unmet needs of buyers or to meet these needs in a new way. In order for a firm to develop a successful innovation strategy, the organization must be readied for the effort. This requires flexibility because changes and adjustments to products and processes are filled with risk and uncertainty. Therefore, technology and innovation management must balance short-term efficiency with long-term effectiveness in the market if the firm is to add value and thrive in a changing environment(Borowski, 2021).

To further explain how IT can play a key role in achieving and sustaining competitive advantage, the following sections outline two analysis frameworks developed by Michael Porter that can be used: the value chain and the five forces model.
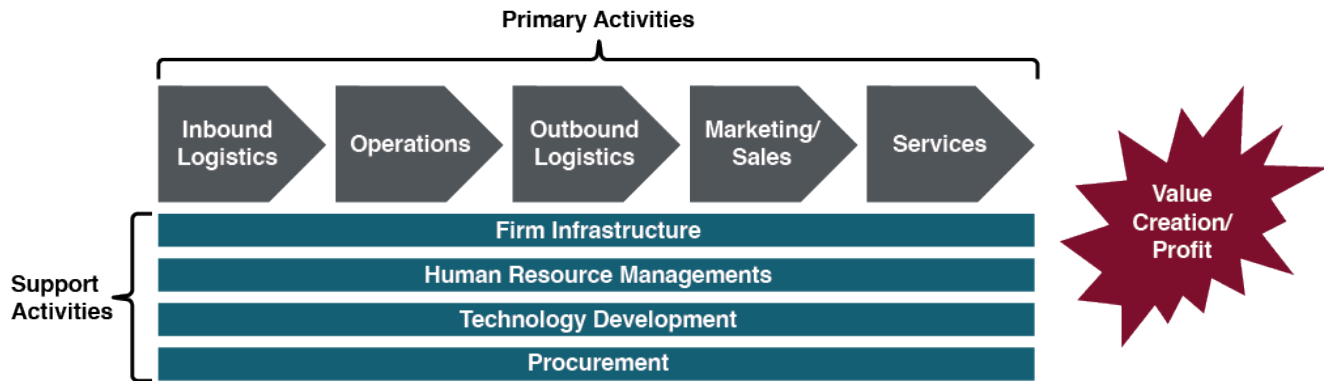
2.6. THE VALUE CHAIN

Porter's Value Chain

In his book *Competitive Advantage: Creating and Sustaining Performance* Michael Porter describes exactly how a company can create value and therefore profit. Value is built through the **value chain**, which is a series of activities undertaken by the company to produce a product or service. Each step in the value chain contributes to the overall value of a product or service. While the value chain may not be a perfect model for every type of company, it does provide a way to analyze just how a company is producing value. The value chain is made up of two sets of activities: primary activities and support activities. An explanation of these activities and a discussion of how information technology can play a role in creating value by contributing to cost advantage or differentiation advantage appears next.

Primary Activities

Primary activities are the functions that directly impact the creation of a product or service. The goal of a primary activity is to add value that is greater than the cost of that activity. The primary activities are:

- **Inbound logistics**. These are the processes that bring in raw materials and other needed inputs. Information technology can be used to make these processes more efficient, such as with supply-chain management systems which allow the suppliers to manage their own inventory.
- **Operations**. Any part of a business that converts the raw materials into a final product or service is a part of operations. From manufacturing to business process management (covered in Chapter 11), information technology can be used to provide more efficient processes and increase innovation through flows of information.
- **Outbound logistics**. These are the functions required to get the product out to the customer. As with inbound logistics, IT can be used here to improve processes, such as allowing for real-time inventory checks. IT can also be a delivery mechanism itself.
- **Sales/Marketing**. The functions that will entice buyers to purchase the products are part of sales and marketing. Information technology is used in almost all aspects of this activity. From online advertising to online surveys, IT can be used to innovate product design and reach customers as never before. The company website, or social media sites can serve as a sales channel itself.

- **Service.** Service activity involves the functions a business performs after the product has been purchased to maintain and enhance the product's value. Service can be enhanced via technology as well, including support services through websites and knowledge bases.

Support Activities

The **support activities** are the functions in an organization that support all of the primary activities. Support activities can be considered indirect costs to the organization. The support activities are:

- **Firm infrastructure**. An organization's infrastructure includes finance, accounting, enterprise systems (covered in Chapter 11) and quality control. All of these depend on information technology and represent functions where I.T. can have a positive impact.
- **Human Resource Management.** Human Resource Management (HRM) consists of recruiting, hiring, and other services needed to attract and retain employees. Using the Internet, HR departments can increase their reach when looking for candidates. I.T. also allows employees to use technology for a more flexible work environment.
- **Technology development**. Technology development provides innovation that supports primary activities. These advances are integrated across the firm to add value in a variety of departments. Information technology is the primary generator of value in this support activity.
- **Procurement**. Procurement focuses on the acquisition of raw materials used in the creation of products. Business-to-business e-commerce can be used to improve the acquisition of materials.

Imitation-resistant value chain

When a firm has an imitation-resistant value chain—one that's tough for rivals to copy while gaining similar benefits—then a firm may have a critical competitive asset. From a strategic perspective, managers can use the value chain framework to consider a firm's differences and distinctiveness compared to rivals. An analysis of a firm's value chain can also reveal operational weaknesses, and technology is often of great benefit to improving the speed and quality of execution. Firms can often buy software to improve processes and tools (covered in Chapter 11) such as supply chain management (SCM; linking inbound and outbound logistics with operations), customer relationship management (CRM; supporting sales, marketing, and in some cases R&D), and enterprise resource planning software (ERP; software implemented in modules to automate the entire value chain). These tools can have a big impact on more efficiently integrating the activities within the firm, as well as with its suppliers and customers. While valuable, such software may not yield lasting competitive advantage if it can be easily matched by competitors as well.

If a firm adopts software that changes a unique process into a generic one, it may have co-opted a key source of competitive advantage particularly if other firms can purchase the same applications. This isn't a problem with something like accounting software. Accounting processes are standardized and accounting isn't a source of competitive advantage, so most firms buy rather than build their own accounting software. Using packaged, third-party SCM, CRM, and ERP software typically requires adopting a very specific way of doing things, using software and methods that can be purchased and adopted by others.

Enterprise Resource Planning Systems & Value Chain

During its period of PC-industry dominance, Dell stopped the deployment of the logistics and manufacturing modules of a packaged ERP implementation when it realized operational changes would be necessary. The changes required to implement the software modules would eliminate the firm's unique supply chain advantages and would mean Dell would be effectively adopting the same practices as their competitors. By contrast, Apple had no problem adopting third-party ERP software because the firm competes on product uniqueness rather than operational differences.

This analysis of the value chain provides some insight into how information technology can lead to competitive advantage. Another important concept from Porter is the Five Forces Model, which is discussed in the next section.

2.7. PORTER'S FIVE FORCES

The **Five Forces model** was developed as a framework for industry analysis. This model can be used to help understand the degree of competition in an industry and analyze its strengths and weaknesses. The model consists of five elements, each of which plays a role in determining the average profitability of an industry. In 2001 Porter wrote an article entitled "Strategy and the Internet," in which he takes this model and looks at how the Internet impacts the profitability of an industry. Below is a quick summary of each of the Five Forces and the impact of the Internet.

- **Threat of substitute products or services.** The first force challenges the user to consider the likelihood of another product or service replacing the product or service you offer. The more types of products or services there are that can meet a particular need, the less profitability there will be in an industry. The Internet has made people more aware of substitute products, driving down industry profits in those industries where substitution occurs. Substitution refers to a product being replaced by a similar product to accomplish the same task. **Digital hybrid substitutes** are digital services wrapped around a physical product. An example is Uber and Lyft, where the service is administered through a digital app (Evans, 2015).
- **Bargaining power of suppliers.** A supplier's bargaining power is vital when there are few suppliers from which a company can obtain a needed product or service. Conversely, bargaining power is lower when there are many suppliers since there are many sources to choose from. This provides the opportunity to negotiate a lower price. For example, if only one company makes the controller chip for a car engine, that company can control the price, at least to some extent. In cases where network effects are strong or a seller's goods are highly differentiated, the Internet can strengthen supplier bargaining power. With e-commerce platforms like Shopify, many businesses can now create an online presence and expand their market base.
- **Bargaining power of customers.** A customer's bargaining power is strong when many companies are providing the same

product to this customer. In this instance, the customer has many sources to buy to negotiate a price reduction. If there are few suppliers in an industry, then the customer's bargaining power is considered low. Social media, and the ability to access price and review information online, has increased buyer power in commodities. Switching costs weakens buyer bargaining power.

- **Barriers to entry**. The easier it is to enter an industry, the more challenging it will be to make a profit in that industry. Imagine you are considering starting a lawn mowing business. The entry barrier is very low since all you need is a lawn mower. No special skills or licenses are required. However, this means your neighbor next door may decide to start mowing lawns also, resulting in increased competition. In contrast, a highly technical industry, such as the manufacturing of medical devices has numerous barriers to entry. You would need to find numerous suppliers for various components, hire a variety of highly skilled engineers, and work closely with Health Canada to secure approval for the sale of your products. The nature of competition is changing with the rise of new digital business models and technology innovations. Some digital businesses require little start-up, sometimes just a website, making it easier to enter the market.

- **Rivalry among existing competitors**: Rivalry among existing competitors helps you evaluate your entry into the market. When rivalry is fierce, each competitor attempts to gain additional market share from the others. This can result in aggressive pricing, increasing customer support, or other factors which might lure a customer away from a competitor. Markets in which rivalry is low may be easier to enter and become profitable sooner because all of the competitors are accepting of each other's presence. Rivalry is increasing as technological advancements are making it easier to enter markets and keep costs low. For example, platform business models that facilitate exchanges between people while producing business value are changing the industry dynamics(Evans, 2015). These models do not require physical infrastructure and they provide a focus on customer support. Examples include: Google, Facebook, Airbnb and eBay.

Porter's five forces are used to analyze an industry to determine the average profitability of a company within that industry. Adding in Porter's analysis of the Internet to his Five Forces results in the realization that technology has lowered overall profitability (Porter, 2001).

Technology plays a significant role in shaping and reshaping Porter's five forces, but it's not the only significant force that can create an industry impact. Government deregulation or intervention, political shock, and social and demographic changes can all play a role in altering the competitive landscape. Because we live in an age of constant and relentless change, managers need to continually visit strategic frameworks to consider any market-impacting shifts. Predicting the future is difficult, but ignoring change can be catastrophic. There is also a danger in relying too much on technology.

2.8. THE DANGER OF RELYING ON TECHNOLOGY

According to Porter, the reason many firms suffer aggressive, margin-eroding competition is because they have defined themselves according to operational effectiveness rather than strategic positioning. **Operational effectiveness** refers to performing the same tasks better than rivals perform them. Everyone wants to be better, but the danger in operational effectiveness is "sameness." This risk is particularly acute in firms that rely on technology for competitiveness. After all, technology can be easily acquired. Buy the same materials as your rivals, copy competitor websites, reverse engineer their products, and you can match them. The fast follower problem exists when savvy rivals watch a pioneer's efforts, learn from their successes and missteps, then enter the market quickly with a comparable or superior product at a lower cost. When technology can be copied so quickly, it is rarely a source of competitive advantage.

Operational effectiveness is critical. Firms must invest in techniques to improve quality, lower cost, and generate customer experiences, but for the most part, these efforts can be matched. Operational effectiveness is usually not sufficient enough to yield sustainable dominance over the competition. In contrast to operational effectiveness, **strategic positioning** refers to performing different activities from those of rivals, or the same activities in a different way. While technology itself is often very easy to replicate, technology is essential to creating and enabling novel approaches to business that are defensibly different from those of rivals and can be quite difficult for others to copy.

How do you know when your differences are special enough – an approach known as the resource-based view of competitive advantage. If a firm is to maintain sustainable competitive advantage, it must control a set of exploitable resources that have four critical characteristics. These resources must be:

1. valuable
2. rare
3. imperfectly imitable (tough to imitate), and
4. non-substitutable.

Having all four characteristics is key. Miss value and no one cares what you've got. Without rareness, you don't have something unique. If others can copy what you have, or others can replace it with a substitute, then any seemingly advantageous differences will be undercut. Strategy isn't just about recognizing opportunity and meeting demand. Resource-based thinking can help you avoid the trap of carelessly entering markets simply because growth is spotted.

Sustainable competitive advantage is also not guaranteed when you are the first to bring a new technology to market. Timing and technology can be enablers for competitive advantage, but it's what a firm does with its time lead and technology. True strategic positioning means that a firm has created differences that cannot be easily matched by rivals. Moving first pays off when the time lead is used to create critical resources that are valuable, rare, tough to imitate, and lack substitutes. Anything less risks the arms race of operational effectiveness.

Just purchasing and installing the latest technology will not by itself make a company more successful. Instead, the combination of the right technologies and good management will give a company the best chance for a positive result.

2.9. SUMMARY

Key Takeaways

- In the last 20 years, companies have created profound shifts in the way firms advertise and individuals and organizations communicate.
- New technologies have redefined our concepts of software and computing, cut costs, fueled data-driven decision making, and raised privacy and security concerns.
- Technology can play a key role in creating and reinforcing assets for sustainable advantage.
- Beware of those who say, "IT doesn't matter" or refer to the "myth" of the first mover. This thinking is overly simplistic. It's not a time or technology lead that provides sustainable competitive advantage; it's what a firm does with its time and technology lead to create valuable assets.
- The value chain can be used to map a firm's efficiency and to benchmark it against rivals, revealing opportunities to use technology to improve processes and procedures. When a firm is resistant to imitation, its value chain may yield sustainable competitive advantage.
- Nothing lasts forever, and shifting technologies and market conditions can render once strong assets as obsolete.
- Just purchasing and installing the latest technology will not by itself make a company more successful.

Review Questions

1. How is social media impacting firms, individuals, and society?
2. How do recent changes in computing impact consumers? How do they impact businesses? Explain.
3. What are the strategies employed to achieve competitive advantage? Provide some examples for each strategy not used in the text.
4. Do you think it is possible to use information technology to achieve competitive advantage? If so, how? If not, why not?
5. What is the value chain, and how can it be enhanced by information systems and technology?
6. What are the primary activities and support activities of the value chain?
7. What are switching costs? What role does technology play in strengthening a firm's switching costs?
8. Why is an innovation based on technology alone often subjected to intense competition?

9. Does technology lower barriers to entry or raise them? Do low entry barriers necessarily mean that a firm is threatened?
10. Is there such a thing as the first-mover advantage? Why or why not?
11. A former editor of the *Harvard Business Review*, Nick Carr, published an article with the title "IT Doesn't Matter." In the article he also offered firms the advice: "Follow, Don't Lead." What would you tell Carr about the relationship between time, technology, and competitive advantage?
12. Identify a company whose strategy might be at risk if they were to adopt a generic enterprise software. Why do you think adopting generic software would be risky to the company? What could they do as an alternative?

Exercises

Overview

This assignment will help you apply Porter's Five 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.

1. Choose an industry, and then choose an organization within that industry. Describe both briefly.
2. 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.
3. 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?
4. Finally, make a statement on what your selected organization's strategy should be.

2.10. KEY TERMS

Chapter 2

Business-level strategy: is the general way that a business organizes its activities to compete against rivals in its product's industry.(2.4)

Competitive Advantage: A company is said to have competitive advantage when it successfully attracts more customers, earns more profit, or returns more value to its shareholders than rival firms do.(2.4)

Cost Leadership: a strategy where a firm offers customers its product or service at a lower price than its rivals can.(2.5)

Differentiation: a strategy where a company tries to add value to their products and services so they can attract customers who are willing to pay a higher price.(2.5)

Entry Barrier: Are obstacles that make it difficult to enter a given market. (2.7)

Focus Strategy: is a strategy whereby a firm chooses to add value or lower costs for a smaller market. (2.5)

Innovation Strategy: a plan to encourage, mobilize, motivate, and achieve advancements in technology or service by investing in research and development activities to meet previously unmet needs of buyers or meet their needs in a new way.(2.5)

Michael Porter: Wrote the book Competitive Advantage: Creating and Sustaining Superior Performance, identifying two primary factors, Cost Advantage and Differentiation Advantage. Developed the 5 force model and the value chain model. (2.6)

Operational effectiveness: refers to performing the same operational tasks better than rivals perform them.(2.8)

Porter's 5 Force Model: A framework developed by economist Michael E. Porter to determine the profitability and attractiveness of a market or market segment. Includes Industry Rivalry, Bargaining Power of Buyers, Bargaining Power of Suppliers, Threat of New Entrants and Threat of Substitute Products. (2.7)

Strategic positioning: refers to performing different activities from those of rivals, or the same activities in a different way.(2.8)

Value Chain: A set of activities that a firm operating in a specific industry performs in order to deliver a valuable product or service for the market. (2.6)

2.11. KNOWLEDGE CHECK

Knowledge Check 1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=413#h5p-53

Knowledge Check 2

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=413#h5p-52

Knowledge Check 3

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=413#h5p-51

CHAPTER 3: HARDWARE

Chapter Outline

Photo via PxHere CC0

3.1. CHAPTER INTRODUCTION

Learning Outcomes

Upon successful completion of this chapter, you will be able to:

- Define digital devices;
- Identify the primary components of a computer system and the functions they perform;
- Explain the factors distinguishing computing power of computers;
- Describe the types of input, output, and memory devices;
- Discuss hardware trends including: mobile computing, integrating computing;
- Assess the impact of commoditization of computers; and
- Summarize the problem of e-waste.

As you learned in the first chapter, an information system is made up of three components: technology, people, and processes. In this chapter we will focus on the first element of technology-hardware. Computer hardware encompasses devices that you can physically touch including desktop computers, laptop computers, mobile phones, tablets, e-readers, storage devices, and input and output devices. Besides these more traditional computer hardware devices, many items that were once not considered digital devices are now becoming computerized themselves. Digital technologies are being integrated into many everyday objects so the days of a device being labeled categorically as computer hardware may be ending. In this chapter, you will also explore digital devices, beginning with defining what is meant by the term itself.
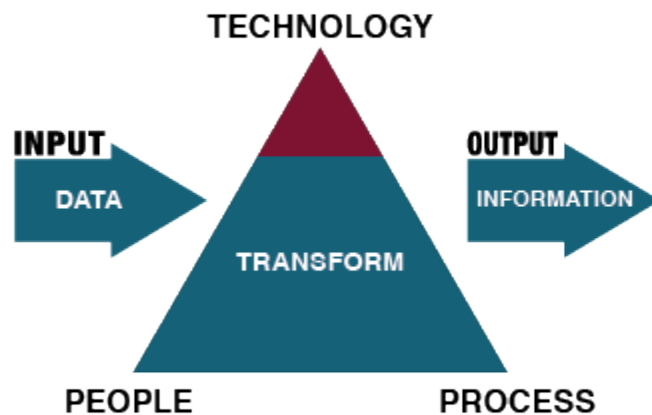
Information Systems Components: Technology

3.2. DIGITAL DEVICES

A **digital device** processes electronic signals into discrete values, of which there can be two or more. In comparison, **analog signals** are continuous and can be represented by a smooth wave pattern. You might think of digital (discrete) as the opposite of analog.

Many electronic devices process signals into two discrete values, typically know as **binary**. These values are represented as either a one ("on") or a zero ("off"). It is commonly accepted to refer to the on state as representing the presence of an electronic signal. It then follows that the off state is represented by the absence of an electronic signal. Technically, the voltages in a system are evaluated with high voltages converted into a one or on state and low voltages converted into a zero or off state.

Each one or zero is referred to as a **bit** (a blending of the two words "binary" and "digit"). A group of eight bits is known as a **byte** (think of a byte as being a single character you can type from a keyboard). The first personal computers could process 8 bits of data at once. The number of bits that can be processed by a computer's processor at one time is known as word size. Today's personal computers can process 64 bits of data at a time which is where the term 64-bit processor comes from. You are most likely using a computer with a 64-bit processor.

Bits & Bytes

As the capacities of digital devices grew, new terms were developed to identify the capacities of processors, memory, and disk storage space. Prefixes were applied to the word byte to represent different orders of magnitude. Since these are digital specifications, the prefixes were originally meant to represent multiples of 1024 (2^{10}); this usage is referred to as a binary measurement but has more recently been rounded for simplicity to mean multiples of 1000, as shown in the table below.

Prefix	Represents	Approximate Examples
kilo	one thousand bytes	1 typewritten page
mega	one million bytes	1 digital photo
giga	one billion bytes	1 Blu-ray movie 25GB
tera	one trillion bytes	Printed Collection of the library of congress 20TB
peta	one quadrillion bytes	Data generated on Facebook everyday 4PB
exa	one quintillion bytes	
zetta	one sextillion bytes	
yotta	one septillion bytes	

"Chapter 2: Hardware" from Information Systems for Business and Beyond (2019)by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

3.3. PERSONAL COMPUTER TOUR

Computers are machines that accept data as input, process that data using stored instructions, and output the information.
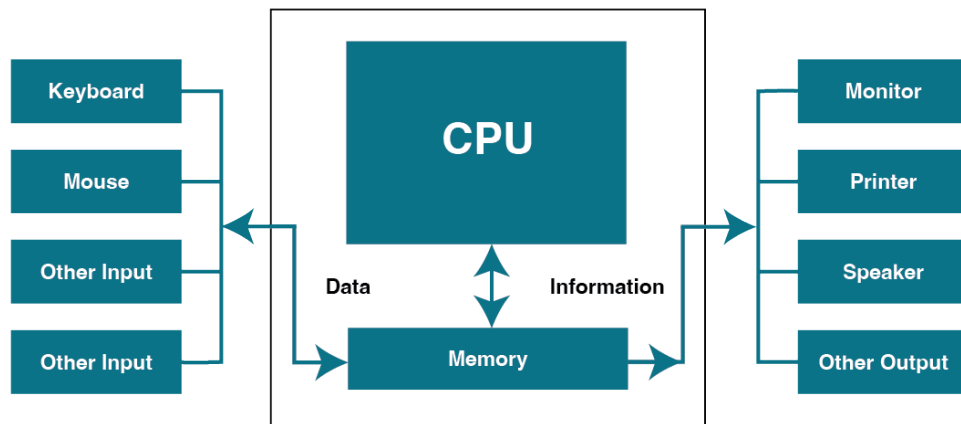
Computer Components

All personal computers consist of the same basic components:

- network connection
- motherboard
- central processing unit (CPU)
- storage/memory
- input/output devices

Almost every digital device uses the same set of components, so examining the personal computer will give you insight into the structure of various digital devices. The components will be explored in more detail in the following sections.

Anatomy of a Computer
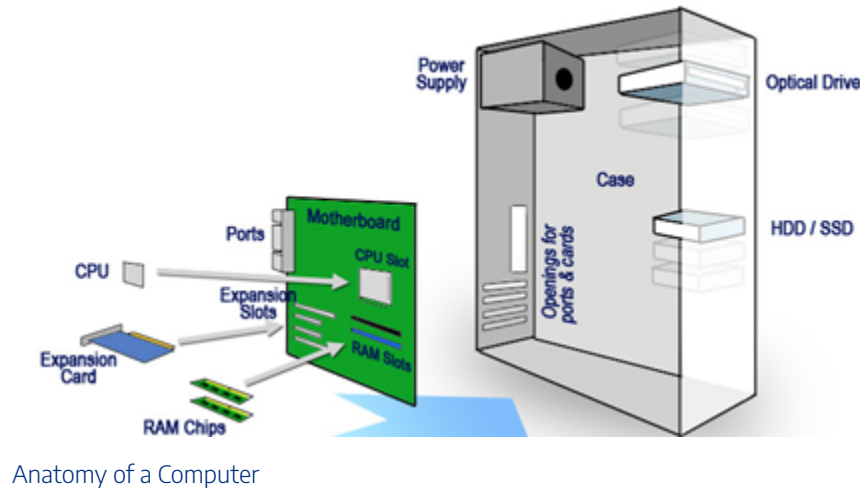
Network Connection

Personal computers were first developed as stand alone units, which meant that data was brought into the computer or removed from the computer via removable media (i.e. hard drives, USB devices, CD's). However, beginning in the mid-1980s, organizations began to see the value in connecting computers together via a digital network. Because of this, personal computers needed the ability to connect to these networks. Initially, this was done by adding an expansion card to the computer that enabled the network connection. These cards were known as Network Interface Cards (NIC). By the mid-1990s, an Ethernet network port was built into the motherboard on most personal computers. As wireless technologies began to dominate in the early 2000s, many personal computers also began including wireless networking capabilities. Digital communication technologies will be discussed further in **Chapter 6.**

Motherboard

The **motherboard** is the main circuit board on the computer. The CPU, memory, and storage components, among other things, all connect into the motherboard. Motherboards come in different shapes and sizes, depending upon how compact or expandable the computer is designed to be. Most modern motherboards have many integrated components, such as network interface card, video, and sound processing, which previously required separate components.

The motherboard provides much of the bus of the computer (the term **bus** refers to the electrical connections between different computer components). The bus is an important factor in determining the computer's speed (the combination of how fast the bus can transfer data and the number of data bits that can be moved at one time). The traces shown in the image are on the underside of

Motherboard by Darklanlan CC-BY

the motherboard and provide connections between motherboard components.

3.4. PROCESSING DATA

The CPU

The core of a computer is the Central Processing Unit, or CPU. It can be thought of as the "brains" of the device. The CPU carries out the commands sent to it by the software and returns results to be acted upon. The earliest CPUs were large circuit boards with limited functionality. Today, a CPU can perform a large variety of functions. There are two primary manufacturers of CPUs for personal computers: Intel and Advanced Micro Devices (AMD).

The speed (clock time) of a CPU is measured in hertz. A hertz is defined as one cycle per second. A kilohertz (kHz) is one thousand cycles per second, a megahertz (mHz) is one million cycles per second, and a gigahertz (gHz) is one billion cycles per second. The CPU's processing power is increasing at an amazing rate.

CPU Chip by Bru-No Pixabay License

Besides a faster clock time, today's CPU chips contain multiple processors. These chips, known as dual-core (two processors) or quad-core (four processors), increase the processing power of a computer by providing the capability of multiple CPUs all sharing the processing load. Intel's Core i7 processors contain 6 cores and their Core i9 processors contain 16 cores.

Faster & Cheaper

Faster and cheaper are two words that have driven the computer industry for decades. This phenomenon of "faster, cheaper" computing is often referred to as 'Moore's Law', after Intel co-founder, Gordon Moore. Moore recognized that microprocessor transistor counts had been doubling every year, enabling the development of more powerful chips to be manufactured at cheaper prices (Moore, 1965). Moore's Law has been generalized into the concept that computing power will double every two years for the same price point. Another way of looking at this is to think that the price for the same computing power will be cut in half every two years. Moore's Law has held true for over fifty years. (See image below).

[Moore's Law](#) by Max Roser & Hannah Ritchie [CC-BY](#) (click to enlarge)

The limits of Moore's Law are now being reached, and circuits cannot be reduced further, but a new law, [Huang's Law](#) has arrived. This law, named for Nvidia's CEO Jensen Huang, says that graphics processing units (GPUs) that power artificial intelligence is increasing faster than Moore's Law. In fact, the performance has more than doubled every year (Mims, 2020).

3.5. STORING DATA

Random-Access Memory

When a computer boots up (starts), it begins to load information from storage into its working memory. This working memory, called Random-Access Memory (RAM), can transfer data much faster than the hard disk. Any program that you are running on the computer is loaded into RAM for processing. In order for a computer to work effectively, some minimal amount of RAM must be installed. In most cases, adding more RAM will allow the computer to run faster. Another characteristic of RAM is that it is "volatile." This means that it can store data as long as it is receiving power. When the computer is turned off, any data stored in RAM is lost.

Hard Disk

While the RAM is used as working memory, the computer also needs a place to store data for the longer term. Most of today's personal computers use a hard disk for long-term data storage. A hard disk is considered non-volatile storage because when the computer is turned off the data remains in storage on the disk, ready for when the computer is turned on. Drives with a capacity less than 1 Terabyte usually have just one platter. Notice the single platter in the image. The read/write arm must be positioned over the appropriate track before accessing or writing data.

Hard Disk by Evan-Amos CC-BY-SA

Solid State Drives

Solid State Drives (SSD) are becoming more popular in personal computers. The SSD performs the same function as a hard disk, namely long-term storage. Instead of spinning disks, the SSD uses flash memory that incorporates EEPROM (Electrically Erasable Programmable Read Only Memory) chips, which is much faster.

Solid-state drives are currently a bit more expensive than hard disks. However, the use of flash memory instead of disks makes them much lighter and faster than hard disks. SSDs are primarily utilized in portable computers, making them lighter, more durable, and more efficient. Some computers combine the two storage technologies, using the SSD for the most accessed data (such as the operating system) while using the hard disk for data that is accessed less frequently. SSDs are considered more reliable since there are no moving parts.

Solid State Drive by Hans Haase CC-BY-SA

Removable Media: USB Drive

Removable storage has changed greatly over the four decades of PCs. Floppy disks have been replaced by CD-ROM drives, then they were replaced by USB (Universal Serial Bus) drives. USB drives are now standard on all PCs, and USB-C is the latest version. USB-C's shape is oblong instead of rectangular and it is symmetrical, meaning it can be inserted either way, which differs from the previous version. New specifications allow for greater data transfer speeds (Brant, 2021).

USB-C by Ajay-suresh CC-BY 2.0

Cloud Computing

In addition to the physical devices mentioned above, cloud computing offers another option for data storage. Cloud computing provides access to software applications, services and data storage through the internet. Online data storage provides many benefits including: accessibility, recovery and updates. Data is accessible from anywhere there is an internet connection and has a back-up function to mitigate the risk of data loss. As well, many service providers ensure automatic updating or syncing of data. Personal cloud storage providers include: Microsoft OneDrive, Google Drive, Dropbox. Cloud computing is explored more in Chapter 4.

3.6. COMPUTER SPEED FACTORS

The speed of a computer is determined by many elements, some related to hardware and some related to software. In hardware, speed is improved by giving the electrons shorter distances to travel in completing a circuit. Since the first CPU was created in the early 1970s, engineers have constantly worked to figure out how to shrink these circuits and put more and more circuits onto the same chip – these are known as integrated circuits. And this work has paid off as the speed of computing devices has been continuously improving.

Multi-core processors, or CPUs, have contributed to faster speeds. Intel engineers have also improved CPU speeds by using QuickPath Interconnect, a technique which minimizes the processor's need to communicate directly with RAM or the hard drive. Instead, the CPU contains a cache of frequently used data for a particular program. An algorithm evaluates a program's data usage and determines which data should be temporarily stored in the cache.

The hardware components that contribute to the speed of a personal computer are the CPU, the Motherboard, RAM, and the Hard Disk. In most cases, these items can be replaced with newer, faster components. The table below shows how each of these contributes to the speed of a computer. Besides upgrading hardware, there are many changes that can be made to the software of a computer to make it faster.

Component	Speed measured by	Units	Description
CPU	Clock speed	GHz (billions of cycles)	Hertz indicates the time it takes to complete a cycle.
Motherboard	Bus speed	MHz	The speed at which data can move across the bus.
RAM	Data transfer rate	Mb/s (millions of bytes per second)	The time it takes for data to be transferred from memory to system measured in Megabytes.
Hard Disk	Access time	ms (millisecond)	The time it takes for the drive to locate the data to be accessed.
	Data transfer rate	MBit/s	The time it takes for data to be transferred from disk to system.

3.7. INPUT AND OUTPUT DEVICES

In order for a personal computer to be useful, it must have channels for receiving input from the user and channels for delivering output to the user. Input and output devices connect to the computer through connection ports, which are generally part of the motherboard and are accessible outside the computer case. In early personal computers, specific ports were designed for each type of output device. The configuration of these ports has evolved over the years, becoming more and more standardized over time. Today, almost all devices plug into a computer through the use of a USB port. This has increased in its capabilities, both in its data transfer rate and power supplied.

USB Cable Connection Max Pixel CCO

Bluetooth

Besides USB, some input and output devices connect to the computer via a wireless-technology standard called Bluetooth, which was invented in 1994. Bluetooth exchanges data over short distances of 10 meters up to 100 meters using radio waves. Two devices communicating with Bluetooth must both have a Bluetooth communication chip installed. Bluetooth devices include pairing your phone to your car, computer keyboards, speakers, headsets, and home security, just to name a few.

Input Devices

INPUT DEVICES

KEYBOARD   MOUSE   JOYSTICK

SCANNER   WEB CAMERA   MICROPHONE
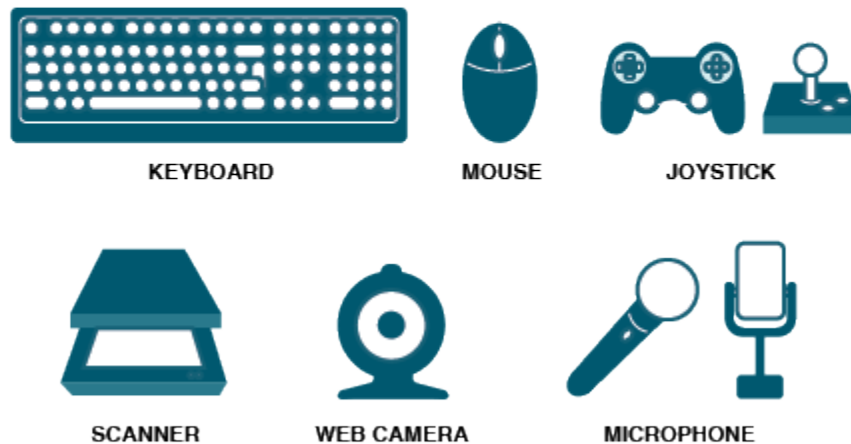
Input Devices

All personal computers need components that allow the user to input data. Early computers simply used a keyboard for entering data or selecting an item from a menu to run a program. With the advent of operating systems offering the graphical user interface, the mouse became a standard component of a computer. These two components are still the primary input devices to a personal

computer, though variations of each have been introduced with varying levels of success over the years. For example, many new devices now use a touch screen as the primary way of data entry.

Other input devices include scanners which allow users to input documents into a computer either as images or as text. Microphones can be used to record audio or give voice commands. Webcams and other types of video cameras can be used to record video or participate in a video chat session.

Output Devices

OUTPUT DEVICES

MONITOR   PRINTER   SPEAKER

HEADPHONES   PROJECTOR
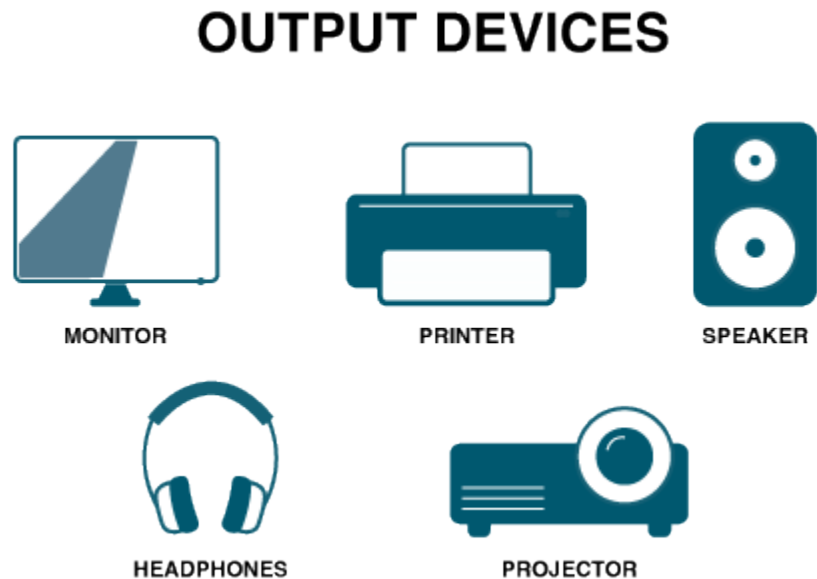
Output-Devices

Output devices are essential as well. The most obvious output device is a display or monitor, visually representing the state of the computer. In some cases, a personal computer can support multiple displays or be connected to larger-format displays such as a projector or large-screen television. Other output devices include speakers for audio output and printers for hardcopy output.

3D Printing

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 and an ear that can hear beyond the range of normal hearing. The US military now uses 3-D printed parts on aircraft such as the F-18 (The Economist, 2013).
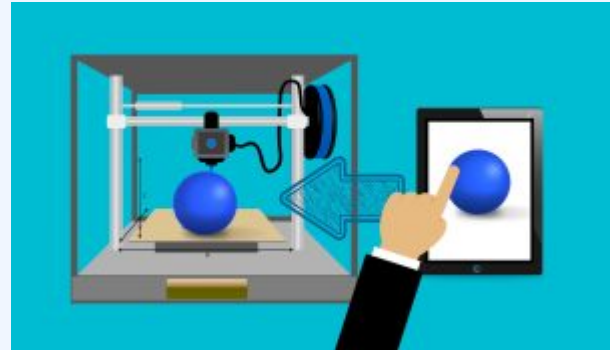
3D Printer by Mohamed Hassan CCO 1.0

3.8. TRENDS IN PERSONAL COMPUTING

A personal computer is designed to be a general-purpose device, able 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. The definition or description of what defines a computer has changed. Portability has been an important feature for most users. Here is an overview of some trends in personal computing.

Portable Computers

Portable computing today includes laptops, notebooks and netbooks, many weighing less than 4 pounds and providing longer battery life. The MacBook Air is a good example of this: it weighs less than three pounds and is only 0.68 inches thick!

Netbooks (short for Network Books) are extremely light because they do not have a hard drive, depending instead on the Internet "cloud" for data and application storage. Netbooks depend on a Wi-Fi connection and can run Web browsers as well as a word processor.

Smartphones

While cell phones were introduced in the 1970s, smartphones have only been around for the past 20 years. As cell phones evolved they gained a broader array of features and programs. Today's smartphones provide the user with telephone, email, location, and calendar services, just to name a few. They function as a highly mobile computer, able to connect to the Internet through either cell technology or Wi-Fi. Smartphones have revolutionized computing, bringing the one feature PCs and laptops could not deliver, namely mobility. The Apple iPhone was introduced in January 2007 and went on the market in June of that same year. Its ease of use and intuitive interface made it an immediate success and solidified the future of smartphones. The first Android phone was released in 2008 with functionality similar to the iPhone.

Tablet Computers

A tablet computer uses a touch screen as its primary input and is small enough and light enough to be easily transported. They generally have no keyboard and are self-contained inside a rectangular case. Apple set the standard for tablet computing with the introduction of the iPad in 2010 using iOS, the operating system of the iPhone. 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 Samsung Galaxy and Amazon Fire are both popular competitors to the iPad.

Integrated Computing and Internet of Things (IoT)

Internet of Things (IoT) by Tumisu Pixabay License

Along with advances in computers themselves, computing technology is being integrated into many everyday products. From automobiles to refrigerators to airplanes, computing technology is enhancing what these devices can do and is adding capabilities into our everyday lives thanks in part to IoT.

IoT is a network of billions of devices, each with their own unique network address, around the world with embedded electronics allowing them to connect to the Internet for the purpose of collecting and sharing data, all without the involvement of human beings (Ranger, 2018). Objects ranging from a simple light bulb to a fitness band such as FitBit to a driverless truck are all part of IoT thanks to the processors inside them. A smartphone app can control and/or communicate with each of these devices as well as others such as: electric garage door openers, kitchen appliances, thermostats (like Nest), home security systems, and audio speakers.

"Chapter 2: Hardware" from Information Systems for Business and Beyond (2019)by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

3.9. PC COMMODITIZATION AND E-WASTE

The Commoditization of the Personal Computer

Over the past forty years, as the personal computer has gone from technical marvel to part of everyday life, it has also become a commodity. There is very little differentiation between computer models and manufacturers, and the primary factor that controls their sale is their price. Hundreds of manufacturers all over the world now create parts for personal computers which are purchased and assembled. As commodities, there are essentially little or no differences between computers made by these different companies. Profit margins for personal computers are minimal, leading hardware developers to find the lowest-cost manufacturing methods.

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 design and manufacture 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, an attempt to avoid commoditization.

E-Waste

Ghanaians working in Agbogbloshie by Marlene Napoli CC0 1.0 Universal Public Domain Dedication

Advances in computing technology reduce costs, increase productivity and allow innovation to flourish. But there is a dark side to advancement. A PC has an expected lifetime of three to five years, and a cell phone is expected to last less than two years. Rapid

obsolescence means the creation of ever-growing mountains of discarded tech junk, known as electronic waste or e-waste. In 2016 alone, approximately 44.7 million metric tonnes of e-waste were created. By 2020, it is predicted that the amount will increase by 17% and we will make about 52.2 million metric tonnes of e-waste annually worldwide (Leary, n.d.) Canada is a significant contributor to this e-waste problem. A report released by Statistics Canada stated that, in 2012, we contributed 14.3 million tonnes of waste to the global e-waste problem (Statistics Canada, 2016). Consumer electronics and computing equipment can be a toxic cocktail, including cadmium, mercury, lead, and other hazardous materials. Once called the "effluent of the affluent," e-waste will only increase with living standards worldwide.

The quick answer would be to recycle, as e-waste contains materials like plastics and aluminum, as well as small bits of increasingly valuable metals such as silver, platinum, and copper. However, there's often a disconnect between consumers and managers who want to do good and those efforts that are actually doing good. The complexities of the modern value chain, the vagaries of international law, and the nefarious actions of those willing to put profits above principle show how difficult addressing this problem will be.

The process of separating the densely packed materials inside tech products so that the value in e-waste can be effectively harvested is hugely labour-intensive, more akin to reverse manufacturing than any sort of curbside recycling efforts. Therefore, much e-waste is sent abroad, which can be much cheaper than processing it at home. Much of this waste is in China, South Asia, or sub-Saharan Africa.

The modern manager must think deeply about the ethical consequences of a firm's business. A slip-up (intentional or not) can, in seconds, be captured by someone with a cell phone, uploaded to YouTube, or offered in a blog posting for the world to see. The worst cases expose firms to legal action and can tarnish a brand for years. Big firms are big targets, and environmentalists have been quick to push the best-known tech firms and retailers to take back their products for responsible recycling and to eliminate the worst toxins from their offerings.

3.10. SUMMARY

Key Takeaways

- Hardware consists of the components of digital technology that you can touch.
- A personal computer is made up of many components, most importantly the CPU, motherboard, RAM, hard disk, removable media, and input/output devices.
- Moore's Law states that computing power will double every two years for the same price point.
- The CPU, motherboard, RAM and Hard Disk all contribute to the speed of your computer.
- Personal computing is trending towards more portability, mobility and interconnected devices.
- Advances in personal computing has made the personal computer a commodity as well as contributed to the problem of e-waste.

Review Questions

1. What is a computer?
2. What are the main hardware components of a personal computer?
3. What is the difference between RAM and hard drive?
4. Name the two components of the CPU?
5. How have computers changed over time?
6. What is the best secondary storage option and why?
7. How are input and output devices changing?
8. Why is mobile computing popular?
9. Explain why the personal computer is now considered a commodity.
10. Name one company that does not fit with the theory of computer commoditization.
11. What is the impact of Moore's Law on the various hardware components described in this chapter?
12. Do some research on Shenzhen, China and discuss what is unique about this area. Why are many tech companies flourishing here?

Assignment

Overview

This assignment is designed to help you identify and understand emerging topics in computer hardware.

Assignment

In this assignment, you will explore different emerging topics related to computer hardware. Complete the following questions in a separate document.

1. Choose a topic from the following list: wearable technology, IoT, 3D printing, brain-computer interface, supercomputers, e-waste, hardware commoditization, biometrics or choose a topic of your choice related to emerging topics in computer hardware.
2. Write a short description of your topic and outline how this technology can provide positive and negative impacts for a business. Share your research with the class.

Chapter 3 Attributions

Business Computer Information Systems: 3.2 Key Computer Components by Emese Felvegi; Barbara Lave; Diane Shingledecker; Julie Romey; Noreen Brown; Mary Schatz; OpenStax; Saylor Academy; University of Minnesota Libraries; and Robert McCarn is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License, except where otherwise noted.

Information Systems for Business and Beyond (2019)- Chapter 2 by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

The Story of Canada's Digital Dumping Ground by by Alyssa Hunt, Makenna Bailey, Mark Buglioni, and Megan Berr at UBC Open Case Studies is licensed under a Creative Commons Attribution 4.0 International License

3.11. KEY TERMS

Chapter 3

Analog signals: are continuous and can be represented by smooth wave pattern. (3.2)

Binary: A number expressed in the binary numeral system, or base-2 numeral system, which represents numeric values using two different symbols: typically 0 (zero) and 1 (one). (3.2)

Bit: The smallest unit of data in a computer represented by one or zero. (3.2)

Bluetooth: A wireless technology standard for exchanging data over short distances (using shortwavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz[4]) from fixed and mobile devices, and building personal area networks. (3.7)

Bus: The electrical connection between different computer components that is an important determiner of the computer's speed. (3.3)

Byte: A unit of data that computers use to represent a character such as a letter, number, or typographic symbol with a group of eight bits. (3.2)

Central Processing Unit (CPU): The "brains" of the device, carries out the commands sent to it by the software and returns results to be acted upon. (3.4)

Digital Devices: Is an electronic device which uses discrete, numerable data and processes for all its operations. (3.2)

Electronic Waste: Used electronics which are destined for reuse, resale, salvage, recycling or disposal. (3.9)

Hard Disk: Where data is stored when the computer is turned off and where it is retrieved from when the computer is turned on. (3.5)

Hardware: The part of an information system you can touch–the physical components of the technology.

Hertz: A measure of computer processing speed. (3.7)

Input Devices: Peripheral hardware used to provide data and control signals to a computer. Examples of input devices include keyboards, mice, scanners, digital cameras and joysticks. (3.7)

Integrated Computing: Integration of computing technology into everyday products to enhancing its capabilities. (3.8)

Memory: Specifically Computer Memory. Any physical device capable of storing information temporarily or permanently. (3.3)

Moore's Law: The observation that over the history of computing hardware, the number of transistors in a dense integrated circuit has doubled approximately every two years. (3.4)

Motherboard: The main circuit board on the computer that connect to the CPU, memory, and storage components, among other things. (3.3)

Network Connection: Provides connectivity between your computer and the Internet, a network, or another computer. (3.2)

Output Devices: An output device sends data from a computer to another device or user. This includes audio and video output. Other examples are monitors, projectors, speakers, headphones and printers. (3.7)

Read Access Memory (RAM): The working memory that begins to load information from the hard disk as the computer starts up.(3.5)

Removable Media: Fixed storage components. Removable storage media that is portable. (3.5)

Storage: The retention of retrievable data on a computer or other electronic system.
Storage Devices: Is any device used to store digital data or information through input or output operations.

Solid State Drive (SSD): Performs the same function as a hard disk: long-term storage that uses spinning disks, flash memory, which is much faster. (3.5)

Adapted from Information Systems for Business and Beyond Glossary by Ruth Guthrie licensed under a CC-BY-3.0

3.12. KNOWLEDGE CHECK

Knowledge Check 1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=332#h5p-61

Knowledge Check 2

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=332#h5p-44

Knowledge Check 3

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=332#h5p-66

CHAPTER 4: SOFTWARE

Chapter Outline

Photo by Maxwell Nelson Unsplash License

4.1. CHAPTER INTRODUCTION

Learning Outcomes

Upon successful completion of this chapter, you will be able to:

- Define the term software;
- Describe the two primary categories of software;
- Discuss cloud computing and its advantages and disadvantages for use in an organization;
- List the ways in which software can be obtained; and
- Define the term open-source and identify its primary characteristics.

You will remember from the last chapter that computer hardware is the components of information technology that you can physically touch. Computing hardware is getting faster and cheaper, creating all sorts of exciting and disruptive opportunities for organizations. However, it is the software that makes the magic of computing happen. **Software** refers to a computer program or collection of programs—sets of instructions that tell the hardware what to do, and without software, the hardware would not be functional. Software gets your computer to behave like a Web browser or word processor, makes your phone play music and video, and enables your bank's ATM to spit out cash. In this chapter we will explore the different types of software, how to obtain it, and understand the importance of software from a managerial context.

Managers who understand software can better understand the possibilities and impact of technology. They can make better decisions regarding the strategic value of IT and the potential for technology-driven savings. They can appreciate the challenges, costs, security vulnerabilities, legal and compliance issues, and limitations involved in developing and deploying technology solutions.

4.2. OPERATING SYSTEMS

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. Operating systems are designed to create a platform so that programmers can write additional applications, allowing the computer to do even more useful things. **Application software** (sometimes referred to as software applications, applications or even just apps) performs specific tasks for the user.

Operating Systems

An operating system is first loaded into the computer by the boot program, then it manages all of the programs in the computer, including both programs native to the operating system such as file and memory management and application software. Operating systems provide you with these key functions:

1. Managing the hardware resources of the computer;
2. Providing the user-interface components;
3. Providing a platform for software developers to write applications.

Operating System Placement (Software)

All computing devices require an operating system. The most popular operating systems for personal computers are: Microsoft Windows, Apple's Mac OS, and various versions of Linux. Smartphones and tablets run operating systems as well, such as iOS (Apple), and Android (Google).

Microsoft provided the first operating system for the IBM-PC, released in 1981. Their initial venture into a Graphical User Interface (GUI) operating system, known as Windows, occurred in 1985. A **GUI** provides the way a user interacts with a program on a computer. It is what gives a program its look and feel. Today's Windows 10 supports the 64-bit Intel CPU. Recall that "64-bit" indicates the size of data that can be moved within the computer.

Apple introduced the Macintosh computer 1984 with the first commercially successful GUI. Apple's operating system for the Macintosh is known as "Mac OS " and also uses an Intel CPU supporting 64-bit processing. Mac OS versions used to be named after mountains (such as El Capitan) and are now named after locations in California. The most recent version is called Monterey. Multitasking, virtual memory, and voice input have become standard features of both operating systems.

The Linux operating system is open source, meaning individual developers are allowed to make modifications to the programming code. Linux is a version of the Unix operating system. Unix runs on large and expensive minicomputers (computers that are smaller and less powerful than a mainframe or supercomputer but more expensive and more powerful than a personal computer). Linux developer Linus Torvalds, a professor in Finland and the creator of Linux, wanted to find a way to make Unix run on less expensive personal computers. Linux has many variations and now powers a large percentage of web servers in the world.

Why Is Microsoft Software So Dominant in the Business World?

If you've worked in business, you may have noticed that almost all computers in business run a version of Microsoft Windows. Many businesses used IBM mainframe computers back in the 1960s and 1970s. When businesses migrated to the microcomputer (personal computer) market, they elected to stay with IBM and chose the PC. Companies took the safe route invested in the Microsoft operating system and in Microsoft software/applications.

Microsoft soon found itself as the dominant personal computer operating system for businesses. As the networked PC began to replace the mainframe computer, Microsoft developed a network operating system along with a complete suite of programs focused on business users. Today, Microsoft's desktop operating system, Windows controls 71% of the market, and their productivity software, Office 365, has 48% of the market share (Liu, 2021).

4.3. APPLICATION SOFTWARE

The second major category of software is Application Software. **Application Software** is used to accomplish a specific goal such as word processing, calculations on a spreadsheet, or surfing the internet using a web browser. There are many different types of application software, and they can work on mobile devices or desktop and laptop computers. Typically, software falls into the categories of productivity, multimedia, home, and communication and collaboration. This section will focus on a few of these categories below.

Productivity Software includes word processors, email clients, presentation and spreadsheet editors.

Productivity Software

Productivity software is a type of application software that has become a standard tool for the workplace. These programs allow office employees to complete their daily work efficiently. Many times these applications come packaged together as integrated software suites, such as in Microsoft's Office suite. Here is a list of some of these applications and their basic functions:

Word processing	Users can create and edit documents using this class of software. Functions include the ability to type and edit text, format fonts and paragraphs, as well as add, move, and delete text throughout the document. Tables and images can be inserted. Documents can be saved in a variety of electronic file formats with Microsoft Word's DOCX being the most popular. Documents can also be converted to other formats such as Adobe's PDF (Portable Document Format) or to a TXT file.
Spreadsheet	This class of software provides a way to do numeric calculations and analysis, displaying the result in charts and graphs. 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. The most popular spreadsheet package is Microsoft Excel, which saves its files in the XLSX format.
Presentation	Users can create slideshow presentations using this class of software. The slides can be projected, printed, or distributed to interested parties. Text, images, audio, and visual can all be added to the slides. Microsoft's PowerPoint is the most popular software right now, saving its files in PPTX format.
Database management system	This software serves as an electronic filing cabinet for records such as customer lists, employee data, and inventory information. Data can be sorted, manipulated and queried to create reports. (Databases are covered more in Chapter 5.)
Desktop publishing	This software combines word processing, graphics, and page layout software to create documents. Allows companies to design and produce sales brochures, catalogs, advertisements, and newsletters in-house.
Financial software	This software is used to compile accounting and financial data and create financial statements and reports.

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 the Microsoft Office Suite. 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.. Microsoft also offers a cloud-based version of their office suite named Microsoft Office 365. Similar to Google Drive, this suite allows users to edit and share documents online utilizing cloud-computing technology.

The "Killer" App: Spreadsheets

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. 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.

The first spreadsheet was created by an MBA student at Harvard University who tired of making repeated calculations to determine the optimal result on a problem and decided to create a tool that allowed the user to easily change values and recalculate formulas. The result was the spreadsheet. Today's dominant spreadsheet is Microsoft Excel which still retains the basic functionality of the first spreadsheet.

Collaborative Systems

As organizations began to implement networking technologies, information systems emerged that allowed employees to begin collaborating in different ways. These systems allowed users to brainstorm ideas together without the necessity of physical, face-

to-face meetings. Tools such as video conferencing with Zoom or WebEx, collaboration and document sharing with Microsoft SharePoint or Teams, and project management with SAP's Project System make collaboration possible in a variety of endeavors.

Any software that allows multiple users to interact on a document or topic could be considered collaborative. Electronic mail, a shared Word document, and social networks fall into this broad definition. However, many software tools have been created that are designed specifically for collaborative purposes. These tools offer a broad spectrum of collaborative functions. Here is just a short list of some collaborative tools available for businesses today:

- **Google Drive**. Google Drive offers a suite of office applications (such as a word processor, spreadsheet, drawing, presentation) that can be shared between individuals. Multiple users can edit the documents at the same time and the threaded comments option is available.
- **Microsoft SharePoint.** SharePoint integrates with Microsoft Office and allows for collaboration using tools most office workers are familiar with. SharePoint will be covered in greater detail in chapter 5.
- **Cisco WebEx**. WebEx combines video and audio communications and allows participants to interact with each other's computer desktops. WebEx also provides a shared whiteboard and the capability for text-based chat to be going on during the sessions, along with many other features. Mobile editions of WebEx allow for full participation using smartphones and tablets.
- **GitHub**. Programmers/developers use GitHub for web-based team development of computer software.

Utility Software and Programming Software

Utility software includes programs that allow you to fix or modify your computer in some way. Examples include anti-malware software and programs that totally remove software you no longer want installed. These types of software packages were created 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's purpose is to produce software. Most of these programs provide developers with an environment in which they can write the code, test it, and convert/compile it into the format that can then be run on a computer. This software is typically identified as the Integrated Development Environment (IDE) and is provided free from the corporation that developed the programming language that will be used to write the code.

Software Providers

There are hundreds of types of businesses that require systems to facilitate operations. A look at the software providers by category as compiled by Capterra gives you some insight into how expansive the information systems industry is.

4.4. DESKTOP AND ENTERPRISE SOFTWARE

Desktop software refers to applications installed on a personal computer—your browser, your Office suite, photo editors, and computer games are all desktop software. **Enterprise software** refers to applications that address the needs of multiple, simultaneous users in an organization or work group. Most companies run various forms of enterprise software programs to keep track of their inventory, record sales, manage payments to suppliers, cut employee paychecks, and handle other functions.

Some firms write their own enterprise software from scratch, but this can be time consuming and costly. Since many firms have similar procedures for accounting, finance, inventory management, and human resource functions, it often makes sense to buy a software package (a software product offered commercially by a third party) to support some of these functions. Enterprise resource planning (ERP) software packages serve precisely this purpose. In the way that Microsoft can sell you a suite of desktop software programs that work together, many companies sell ERP software that coordinates and integrates many of the functions of a business.

The leading ERP vendors include the firm's SAP and Oracle, although there are many firms that sell ERP software. A company does not have to install all of the modules of an ERP suite, but it might add functions over time—for example, to plug in an accounting program that is able to read data from the firm's previously installed inventory management system. And although a bit more of a challenge to integrate, a firm can also mix and match components, linking software the firm has written with modules purchased from different enterprise software vendors. We will discuss enterprise software in more detail in chapter 11 and decision support software in chapter 12.
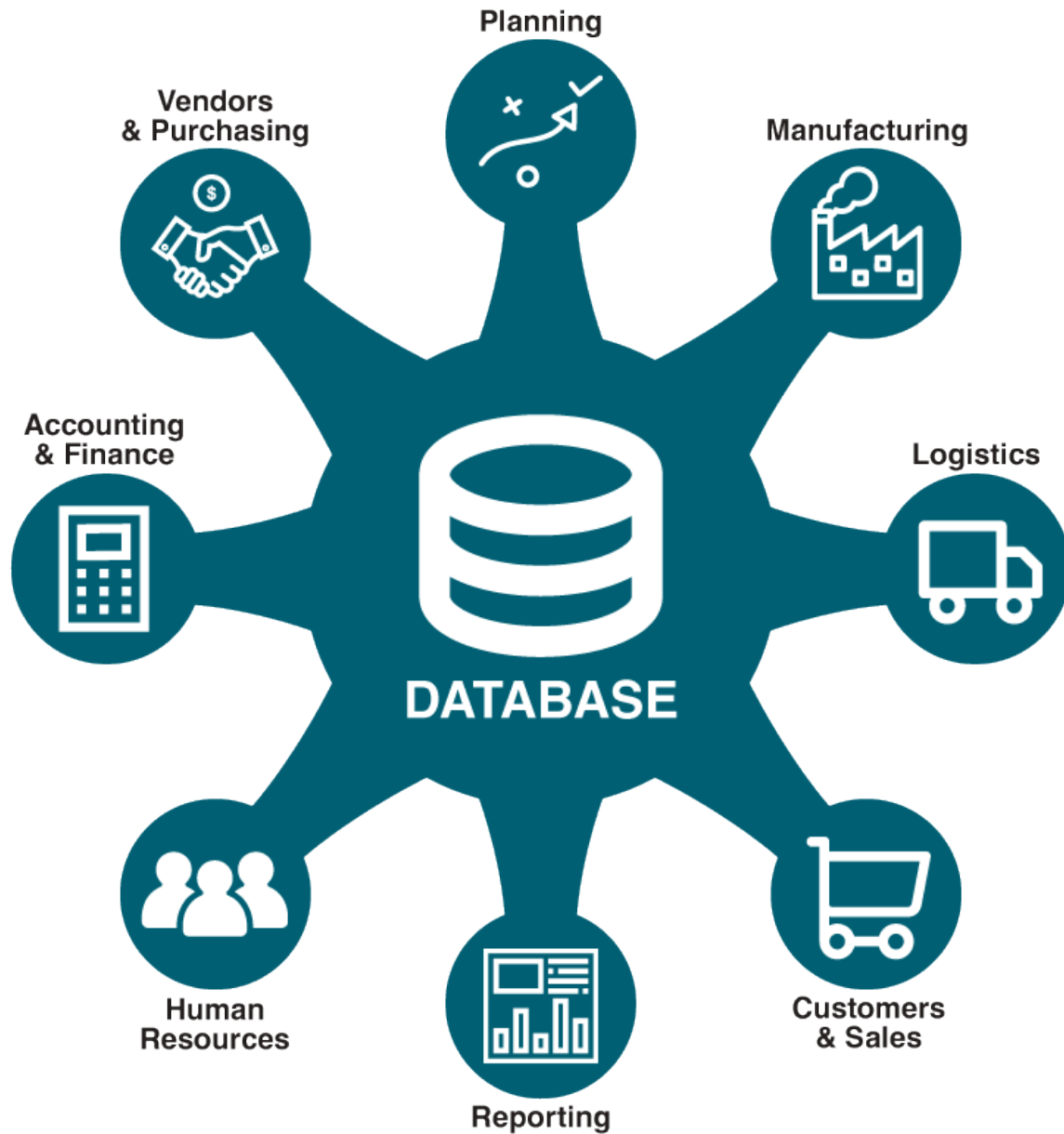
Enterprise Resource Planning System

Most enterprise software works in conjunction with a database management system (DBMS). The **database management system** stores and retrieves the data that an application creates and uses. Although the DBMS is itself considered an application, it's often useful to think of a firm's database systems as sitting above the operating system, but under the enterprise applications. Many ERP systems and enterprise software programs are configured to share the same database system so that an organization's different programs can use a common, shared set of data. This system can be hugely valuable for a company's efficiency. We will discuss databases and DBMS's in chapter 5.

4.5. MOBILE SOFTWARE

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

As discussed in chapter 3 smartphones are becoming the dominant form of computing, with more smartphones being sold than personal computers. Businesses have adjusted to this trend by increasing their investment in the development of apps for mobile devices. The number of mobile apps in the Apple App Store has increased from zero in 2008 to over 2 million in 2017 (Statista, 2018).

Cloud Computing

Historically, an individual copy of the software had to be installed on the computer to use it. The concept of **cloud computing** changed this, as applications, services, and data storage are made accessible through the internet. Cloud service providers rely on giant server farms and massive storage devices that are connected via a network.

You probably already use cloud computing in some form. For example, if you access your email on your web browser, or use Google Drive's applications you are using a form of cloud computing. While these are free versions of cloud computing, there is big business in providing applications and data storage over the web. **Software as a service** (SaaS) is software that is rented rather than purchased. It is subscription based. Software as a service gives companies access to a large assortment of software packages without having to invest in hardware or install and maintain software on its own computers. The available software, which includes e-mail and collaboration systems and customer relationship management programs, can be customized and used by an individual client or shared among several clients.

Advantages of Cloud Computing	Disadvantages 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 lost or stolen. • You are not limited by the available memory or disk space on your computer.	• Your information is stored on someone else's computer. • You must have Internet access to use it. • 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? • Automatic upgrades can be done without notice causing confusion for the user.

The benefit is that all of the software requirements are outsourced to a company with expertise. However, the concern is that this can leave a company vulnerable. If a traditional software company goes out of business, in most cases its customers can still go on using its products. But if your SaaS vendor goes under, they have all the data, and even if firms could get their data out, most organizations don't have the hardware, software, staff, or expertise to quickly absorb an abandoned function. Firms that buy and install packaged software usually have the option of sticking with the old stuff as long as it works, but organizations adopting SaaS may find they are forced into adopting new versions. Keep in mind that SaaS systems are also reliant on a network connection. If a firm's link to the

Internet goes down, the link to its SaaS vendor is also severed. Relying on an Internet connection also means that data is transferred to and from a SaaS firm at Internet speeds, rather the potentially higher speeds of a firm's internal network.

Amazon Web Services (AWS)

Cloud computing is not limited to web applications. It can also be used for services such as audio or video streaming. Amazon Web Services (AWS) is the largest on-demand cloud computing platform. AWS offers more than 90 services ranging from computing, storage, networking, database, analytics application services, deployment, mobile, developer tools, and the Internet of Things (Wikiversity, n.d.).

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

Virtualization is the process of using software to simulate a computer or some other device. For example, using virtualization a single physical computer can perform the functions of several virtual computers, usually referred to as Virtual Machines (VMs). Organizations implement virtual machines in an effort to reduce the number of physical servers needed to provide the necessary services to users. This reduction in the number of physical servers also reduces the demand for electricity to run and cool the physical servers. For more detail on how virtualization works, see this informational page from VMWare.

4.6. OBTAINING SOFTWARE

Software can be obtained in a number of different ways. It can be developed internally which is referred to as proprietary software, or it can be purchased off-the-shelf, also referred to as packaged software. Proprietary software is developed for a specific problem and is owned by the company. If the company does not have the resources within, they may contract another company to build the software for them. Off-the-shelf software is software that is readily available and already developed, such as Microsoft Windows or the Office Suite.

Proprietary Software		Off-the-shelf Software	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
Get exactly what you need and want. Control over the process.	Significant investment (time and money) Need to provide ongoing support and maintenance.	Initial cost is lower. Usually will meet the basic needs of the organization, and may have the ability to customize. Support and training available.	Might pay for features that are not needed or wanted. Software may lack required features and customization can be costly.

Software Creation

Software is created via programming, which is the process of creating a set of logical instructions for a digital device to follow. The process of programming is sometimes called "coding" because the developer takes the design and encodes it into a programming language which then runs on the computer. Modern software applications are written using a programming language such as Java, Visual C, C++, Python, etc. A programming language consists of a set of commands and syntax that can be organized logically to execute specific functions. Using this language a programmer writes a program (known as source code) that can then be compiled into machine-readable form, the ones and zeroes necessary to be executed by the CPU. Languages such as HTML and Javascript are used to develop web pages.

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.

Software Ownership

When you purchase software and install it on your computer, are you the owner of that software? Technically, you are not. When you install software, you are actually just being given a license to use it. When you first install a package, you are asked to agree to the terms of service or the license agreement. In that agreement, you will find that your rights to use the software are limited. For example, in the terms of the Microsoft Office software license, you will find the following statement: "This software is licensed, not sold. This agreement only gives you some rights to use the features included in the software edition you licensed"(Microsoft, n.d.).

For the most part, these restrictions are what you would expect. You cannot make illegal copies of the software and you may not use it to do anything illegal. However, there are other, more unexpected terms in these software agreements. For example, many software agreements ask you to agree to a limit on liability. This means if a problem with the software causes harm to your business, you cannot hold Microsoft or the supplier responsible for damages.

4.7. OPEN SOURCE SOFTWARE

The last section discussed closed source software where the source code is not available to others to use or copy. However, there are many who feel that software should not be restricted in this way. Just as with those early hobbyists in the 1970s, they feel that innovation and progress can be made much more rapidly if they share what has been learned. In the 1990s, with Internet access connecting more people together, the open-source movement gained steam.

Open-source software makes the source code available for anyone to copy and use. For most people having access to the source code of a program does little good since it is challenging to modify existing programming code. However, open-source software is also available in a compiled format that can be downloaded and installed. The open-source movement has led to the development of some of the most used software in the world such as the Firefox browser, the Linux operating system, and the Apache web server.

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 actually 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 open-source model debate and can be found below.

Advantages of Open Source	Disadvantages of Open Source
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.	Technical support is not available like with traditional software products. Software companies provide updates and features as required by the users. The user interface may be more challenging to use.

Open Source Applications

There are thousands of open-source applications available for download. For example, you can get the productivity suite from Open Office. One good place to search for open-source software is sourceforge.net, where thousands of programs are available for free download.

4.8. SUMMARY

Key Takeaways

- Software gives the instructions that tell the hardware what to do.
- There are two basic categories of software: operating systems and applications
- Operating systems interface with the computer hardware and make system resources available
- Application software focuses on the work of a user or an organization.
- Desktop applications are typically designed for a single user. Enterprise software supports multiple users in an organization or work group.
- Cloud computing provides access to software and databases from the Internet via a web browser.
- The software as a service (SaaS) category of cloud computing gives companies access to a large assortment of software packages without having to invest in hardware or install and maintain software on its own computers.
- Shifting IT functions to the cloud produces a number of advantages, including cost savings, speedy delivery of software, scalability (you pay for only what you need), employee mobility, and a reduction in information technology staff.
- The following disadvantages of cloud computing are cause for concern: disruption in internet service, security issues, and unreliability of service provider systems.
- Software can be built (proprietary) or purchased (off-the-shelf).
- Open source software is software where the source code is available for anyone to copy and use.

Review Questions

1. What is software? What are the different types?
2. What does an operating system do? What are the functions?
3. What are some examples of desktop operating systems and application software?
4. What are some of the top application programs for mobile devices and smartphones?
5. How can software be obtained? What are the advantages and disadvantages of each approach?
6. What is open source software? What are the advantages and disadvantages?
7. What is software as a service?

8. What is open source software and why is it important?

Assignment

Overview

This assignment is designed to help you identify common software applications used in the industry.

Assignment

In this assignment, you will explore local job postings to identify software programs most in demand for a career in your field of study.

1. Search the internet for a job posting in your field of study that is interesting to you. Provide a link to the job posting.
2. Write a short description of the software required for the job, and discuss why this software is beneficial. You can also provide links to resources to help you and others learn the software.

4.9. KEY TERMS

Chapter 4

Android: A mobile operating system (OS) based on the Linux kernel and currently developed by Google. (4.2)

Application Software: An application is a set of computer program designed to permit the user to perform a group of coordinated functions, tasks, or activities. It cannot run on itself but is dependent on the OS. (4.2) and (4.3)

Cloud Computing: The practice of using a network of remote servers hosted on the Internet to store, manage, and process data, rather than a local server or a personal computer. (4.3)

Collaborative Systems: These systems allowed users to brainstorm ideas together without the necessity of physical, face-to-face meetings. (4.3)

Customer Relationship Management (CRM): An approach to managing a company's interactions with current and future customers. It often involves using technology to organize, automate, and synchronize sales, marketing, customer service, and technical support. (4.5)

Database Management System (DBMS): Stores and retrieves the data that an application creates and uses. Although the DBMS is itself considered an application, it's often useful to think of a firm's database systems as sitting above the operating system, but under the enterprise applications. (4.4)

Desktop Software: Refers to applications installed on a personal computer—your browser, your Office suite, photo editors, and computer games are all desktop software (4.4)

Enterprise Resources Planning (ERP): A software application utilizing a central database that is implemented throughout the entire organization. (4.4)

Enterprise Software: Refers to applications that address the needs of multiple, simultaneous users in an organization or work group. Most companies run various forms of enterprise software programs to keep track of their inventory, record sales, manage payments to suppliers, cut employee paychecks, and handle other functions (4.4)

LINUX/UNIX: 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. (4.7)

iOS(iPhone OS): An operating system used for mobile devices manufactured by Apple Inc. (4.2)

"Killer" App: An application viewed as so desirable by consumers that it can influence them to purchase devices or applications that include it. (4.3)

Mobile Applications: Programs that run on tablet computers and smartphones. (4.5)

Open Source: Software that can be freely used, changed, and shared (in modified or unmodified form) by anyone. (4.7)

Operating Systems: The program that, after being initially loaded into the computer by a boot program, manages all the other programs in a computer. (4.2)

Private Cloud: A particular model of cloud computing that involves a distinct and secure cloud based environment in which only the specified client can operate. (4.5)

Productivity Software: Software applications have become standard tools for the workplace. For example, Excel or spreadsheet software.(4.3)

SAP: Systems, Applications & Products in Data Processing. A German multinational software corporation that makes enterprise software to manage business operations and customer relations. (4.4)

Software as a service (SaaS): Is software that is rented rather than purchased. It is subscription based. Software as a service gives companies access to a large assortment of software packages without having to invest in hardware or install and maintain software on its own computers. (4.5)

Software: A set of instructions that tells the hardware what to do. (4.1)

Virtualization: Refers to the act of creating a virtual (rather than actual) version of something, including (but not limited to) a virtual computer hardware platform, operating system (OS), storage device, or computer network resources. (4.5)

Windows: Microsoft's operating system. (4.2)

Adapted from Information Systems for Business and Beyond Glossary by Ruth Guthrie licensed under a CC-BY-3.0

4.10. KNOWLEDGE CHECK

Knowledge Check 1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1784#h5p-29

Knowledge Check 2

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1784#h5p-30

Knowledge Check 3

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1784#h5p-31

Knowledge Check 4

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1784#h5p-32

CHAPTER 5: DATA

Chapter Outline

Photo by Markus Spiske Unsplash License

5.1. CHAPTER INTRODUCTION

Learning Outcomes

Upon successful completion of this chapter, you will be able to:

- Define the term database;
- Describe the role of a database management system;
- Explain the difference between a relational and flat file database;
- Outline the levels of the data hierarchy;
- Describe the different data types;
- Identify and apply the steps to create a simple relational database; and
- Discuss the advantages of the database approach.

You will remember from chapter 1 that technology, along with people and processes ensures that data is transformed into information that can be used for decision making. So far we have explored two components of information technology: hardware and software. These two components on their own have little value without data. Imagine if you turned on a computer and opened a word processor, but had nothing to work with. What if you opened a music application on your phone but there were no songs to play? What if you opened a web browser but there were no web pages to view? Without data, hardware and software are not very useful! ***Data is the fuel powering information systems*** and it is the focus of this chapter.

Remember data simply refers to the raw facts, and needs to be transformed (stored, organized and processed) to become information. This process is now occurring at unprecedented speeds, and new data is being generated faster than we can transform it.

5.2. BIG DATA

Data is everywhere, and it is being generated every second of every day. It is estimated that 463 exabytes of data will be created each day globally by 2025, which is equivalent to 212,765,957 DVDs per day (Desjardins, 2019).

There is even "data about data," which is called **metadata.** Growth in the amount and variety of digital data, as well as the speed at which it is generated, has led to the creation of the term **big data.** Big data refers to large data sets that conventional data processing technologies do not have sufficient power to analyze. Storage of all this data is also challenging. Understanding and developing the best tools and techniques to manage and analyze these large data sets are a problem that governments and businesses alike are trying to solve. We will explore big data and business intelligence more in Chapter 12 and begin our discussion here with databases.

5.3. DATABASES
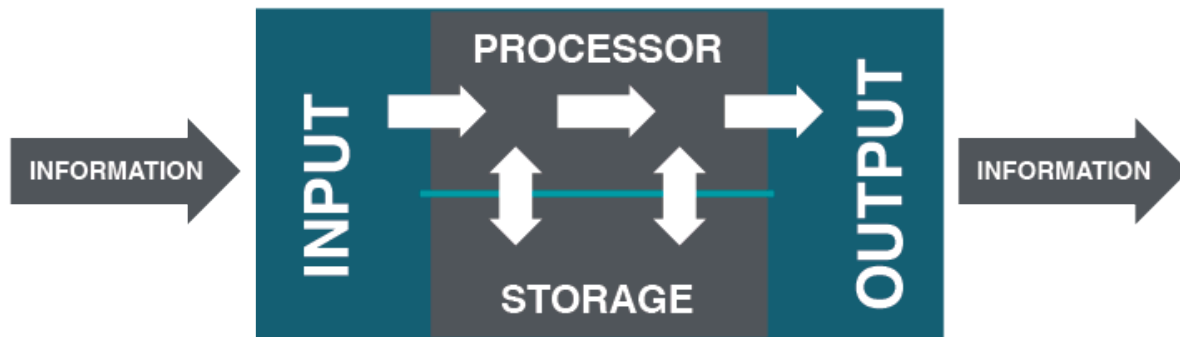
Information System

To transform data into information for decision-making, a system must be used to input and manipulate data for aggregation and analysis. A database is designed for this purpose. A **database** is an organized collection of related information. It can be thought of as a list of data or several lists of data. It is an organized collection, because in a database, all data is described and associated with other data.

It is important to note that databases are not always digital – a filing cabinet, for instance, might be considered a form of database. Most organizations have several databases—perhaps even hundreds or thousands. These various databases might be focused on any combination of functional areas (sales, product returns, inventory, payroll), geographical regions, or business units. Firms often create specialized databases for recording transactions, as well as databases that aggregate data from multiple sources in order to support reporting and analysis. Because of the versatility of databases, we find them powering all sorts of projects. A database can be linked to:

- A website that is capturing registered users
- A client-tracking application for social service organizations
- A medical record system for a healthcare facility
- Your personal address book in your email client
- A collection of word-processed documents
- A system that issues airline reservations

Database Management Systems

USER INTERACTION   DBMS   DATABASE
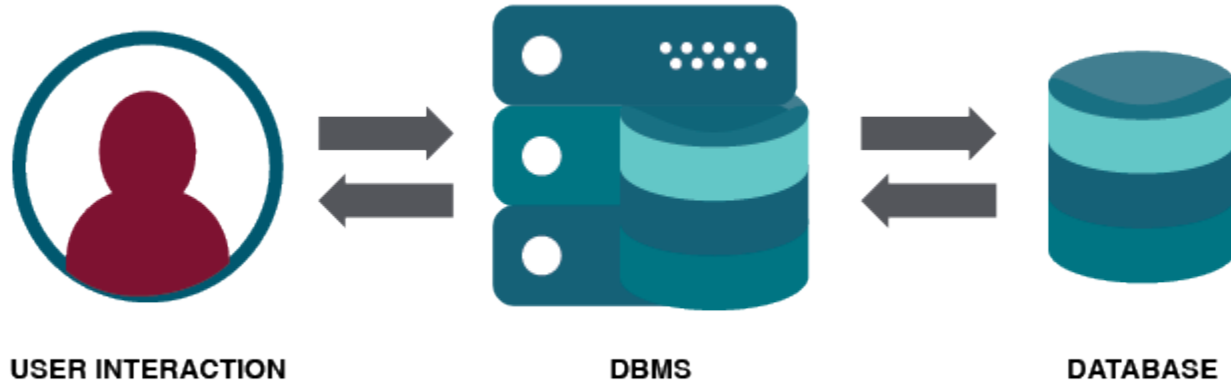
Database Management Systems

To the computer, a database looks like one or more files. In order for the data in the database to be stored, read, changed, added, or removed, a software program must access it. Many software applications have this ability: your digital music software can read its database to give you a listing of its songs (and play the songs) and your mobile-phone software can interact with your list of contacts.

A **Database Management System** (DBMS) is software for creating, storing, maintaining, and accessing database files. DBMS packages generally provide an interface for the user to interact with the database, create queries, and develop reports. Most of these packages are designed to work with a specific type of database, but generally are compatible with a wide range of databases. A DBMS include single-user personal desktop products like Microsoft Access or Filemaker Pro, and Web-based offerings like Intuit QuickBase. Enterprise solutions that can be used by many users at a time and shared across a network or the internet include products from Oracle, IBM (DB2), Sybase, Microsoft (SQL Server), and others. Oracle is the world's largest database software vendor. The open-source MySQL is also an enterprise database.

"Chapter 4: Data and Databases" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

5.4. DATABASE MODELS

Databases can be organized in different ways by using different models. The **data model** of a database is the logical structure of the data items and their relationships. There are many database models such as, hierarchical and object-oriented, but relational databases are the most popular types of databases. A **relational data model** organizes data into inter-related tables. Relational databases are easy to understand and use, and are often contrasted with a **flat file database** which contains only one file/table, with no relationships. A table created in a spreadsheet would be considered a flat file. Tables and files are terms that are used interchangeably. See an example of a flat file and relational database below. In the relational database example, the data is organized into two separate tables (grades and student) and linked together through a common field. In this case the common field is Student ID.

Flat File Database

Student ID	Student Name	Student Major	Student Email	Course	Grade
1234	John Smith	Marketing	jsmith@university.edu	MKT211	A
1234	John Smith	Marketing	jsmith@university.edu	MIS315	B
2345	Robert Jackson	MIS	rjackson@university.edu	ACT211	B
2345	Robert Jackson	MIS	rjackson@university.edu	MIS315	B
3456	Anne Sun	Accounting	asun@university.edu	ACT211	A
3456	Anne Sun	Accounting	asun@university.edu	FIN311	A
4567	Mary Brown	Finance	mbrown@university.edu	ACT211	A
4567	Mary Brown	Finance	mbrown@university.edu	FIN311	B
9991	Alex Wilson	Marketing	abrown@university.edu	MKT211	B

Flat File Database includes one dimensional table of data organized in rows and columns.

Relational Database

Grades Table		
Student ID	Course	Grade
1234	MKT211	A
1234	MIS315	B
2345	ACT211	B
2345	MIS315	B
3456	ACT211	A
3456	FIN311	A
4567	ACT211	A
4567	FIN311	B
9991	MKT211	B

Student Table			
Student ID	Student Name	Student Major	Student Email
1234	John Smith	Marketing	jsmith@university.edu
2345	Robert Jackson	MIS	rjackson@university.edu
3456	Anne Sun	Accounting	asun@university.edu
4567	Mary Brown	Finance	mbrown@university.edu
9991	Alex Wilson	Marketing	abrown@university.edu

Relational Database includes multiple tables of data that are related by a common field.

Difference Between a Database and a Spreadsheet

A database and a spreadsheet can appear to be the same. However, this is a common misconception that extends to the business world as spreadsheets are often used as a substitute for more complex database needs. A spreadsheet stores data in an organized fashion, using rows and columns, and looks like a database table. A spreadsheet can work well if a simple listing of rows and columns (a single table) is all that is needed. For example a listing of students and their information. This is referred to as a flat file database. However, when several types of data must be mixed together, or when the relationships between these types of data are complex, then a spreadsheet is not the optimal solution.

A database allows data from several entities (such as students, courses and grades) to all be related together into one whole. While a spreadsheet does allow you to define what kinds of values can be entered into its cells, a database provides more intuitive and powerful ways to define the types of data that go into each field, reducing possible errors and allowing for easier analysis. Though not good for replacing databases, spreadsheets can be ideal tools for analyzing the data stored in a database. A spreadsheet package can be connected to a specific table or query in a database and used to create charts or perform analysis on that data.
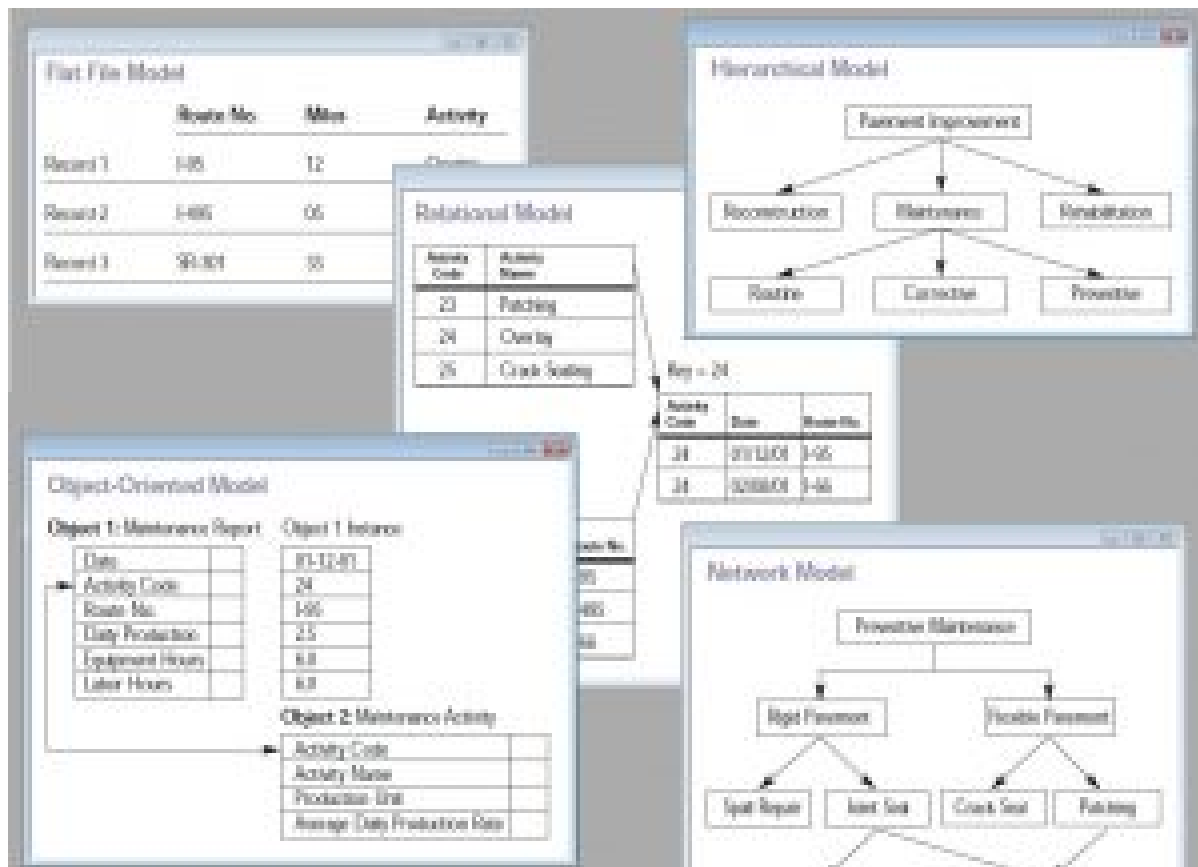
Database Models by Marcel Douwe Dekker CC-BY-SA (click to enlarge)

The relational database model is the most used database model today. However, other database models exist with different strengths.

The **hierarchical database** model, popular in the 1960s and 1970s, connected data together in a hierarchy, allowing for a parent/child relationship between data. The document-centric model allowed for a more unstructured data storage by placing data into "documents" that could then be manipulated.

Perhaps the most interesting new development is the concept of **NoSQL** (from the phrase "not only SQL"). NoSQL allows for large-scale databases to be spread over several servers or even across the world. For a relational database to work properly, it is important that only one person be able to manipulate a piece of data at a time, a concept known as record-locking. But with today's large-scale databases (think Google and Amazon), this is just not possible. A NoSQL database can work with data in a looser way, allowing for a more unstructured environment, communicating changes to the data over time to all the servers that are part of the database.

The relational database model does not scale well. The term **scale** here refers to a database getting larger and larger, distributed on a larger number of computers connected via a network. Some companies are looking to provide large-scale database solutions by moving away from the relational model to other, more flexible models. For example, Google now offers the App Engine Datastore based on NoSQL. Developers can use the App Engine Datastore to develop applications that access data from anywhere worldwide. Amazon.com offers several database services for enterprise use, including Amazon RDS, which is a relational database service, and Amazon DynamoDB, a NoSQL enterprise solution.

The following sections focus on the relational model to demonstrate how a database is designed, and the benefits and concerns of use.

5.5. DATA HIERARCHY

A relational database is composed of multiple tables, and each table holds data. Within a table, each row represents a group of related data values. A row, or **record**, is also known as a tuple. The columns in a table is referred to as a field or **attribute**. A record is one instance of a set of fields in a table. You can also think of it this way-an attribute is used to define the record and a record contains a set of attributes. A **data hierarchy** is the structure and organization of data in a database and an example can be seen below.
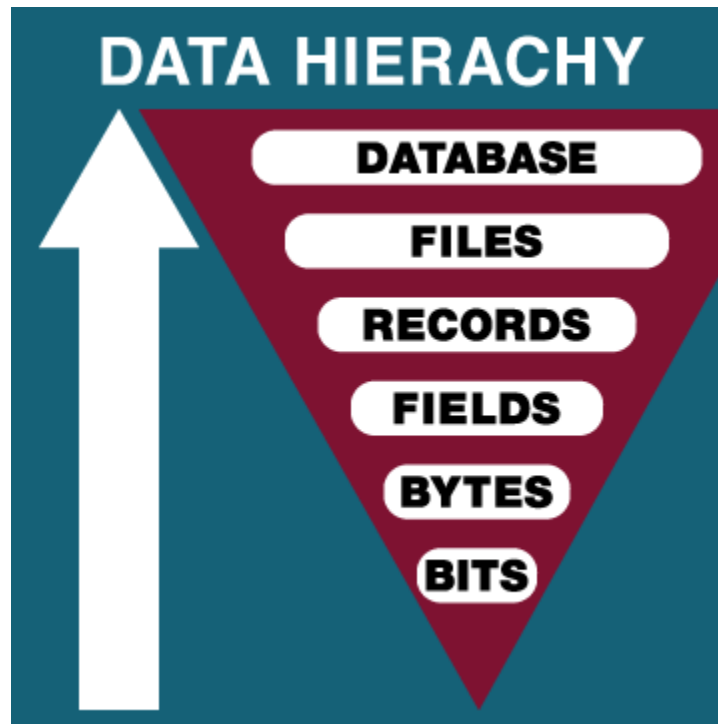
A Data Hierarchy is a series of ordered groupings in a system, beginning with the smallest unit to the largest.

File	a collection of related records. i.e. all student information (ID, name, major, email)
Record	a collection of related fields. i.e.John Smith's ID, major and email
Field	holds a single fact or attribute. i.e. student name
Byte	a unit of digital information 1 byte = 8 bits representing a single character
Bit	unit of measurement to quantify computer data. Single value of 0 or 1

Data Types

When defining the fields in a database table, we must give each field a data type. For example, the field 'StudentName' is text string, while 'EnrollmentCapacity' is number. Most modern databases allow for several different data types to be stored. Some of the more common data types are listed here:

Text	for storing non-numeric data that is brief, generally under 256 characters. The database designer can identify the maximum length of the text.
Number	for storing numbers. There are usually a few different number types that can be selected, depending on how large the largest number will be.
Boolean	a data type with only two possible values, such as 0 or 1, "true" or "false", "yes" or "no".
Date/Time	a special form of the number data type that can be interpreted as a number or a time.
Currency	a special form of the number data type that formats all values with a currency indicator and two decimal places.
Paragraph Text	this data type allows for text longer than 256 characters.
Object	this data type allows for the storage of data that cannot be entered via keyboard, such as an image or a music file.

There are two important reasons that we must properly define the data type of a field.

1. **First**, a data type tells the database what functions can be performed with the data. For example, if we wish to perform mathematical functions with one of the fields, we must be sure to tell the database that the field is a number data type. For example, we can subtract the course capacity from the classroom capacity to find out the number of extra seats available.
2. The **second** important reason to define data type is so that the proper amount of storage space is allocated for our data. For example, if the 'StudentName' field is defined as a Text (50) data type, this means 50 characters are allocated for each name we want to store. If a student's name is longer than 50 characters, the database will truncate it.

"Chapter 4: Data and Databases" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

"Chapter 7 The Relational Data Model" from Database Design – 2nd Edition by Adrienne Watt is licensed under a Creative Commons Attribution 4.0 International License except where otherwise noted.

5.6. DESIGNING A DATABASE

The first step in database design is data modelling. This step provides a high level conceptual representation of the database structure. Data modelling includes capturing the:

- **Entities:** the data contained in the database (e.g., students, course, grade, classroom)
- **Relationships:** between data items (e.g., students get grades in courses that are offered in classrooms)
- **Constraints**: on data (e.g., student number has exactly eight digits; a subject has four or six units of credit only)

In the data modelling phase, a **schema** is developed to provide an overall description of the database. A schema is usually represented by an **Entity Relationship Diagram** (**ERD**) which shows the relationships among the tables of data. When a database is being designed, a **data dictionary** is also created to hold the metadata, defining the fields and structure of the database. To learn more, check out the example below and this resource from the [University of Regina on data modeling and ERD diagrams.](#)

Example: School Database Design

Continuing with the example from the previous section, let's suppose a school wants to create a database to track student data. After interviewing several people, the design team learns that the goal of implementing the system is to give better insight into students' performance and academic resources. From this, the team decides that the system must keep track of the students, their grades, courses, and classrooms.

Step 1: Using this information, the design team determines that the following tables need to be created:

- **STUDENT**: student name, major, and email.
- **COURSE:** course title, enrollment capacity.
- **GRADE:** this table will correlate STUDENT with COURSE, allowing us to have any given student to enroll multiple courses and to receive a grade for each course.
- **CLASSROOM**: classroom location, classroom type, and classroom capacity

Step 2: Now that the design team has determined which tables/files to create, they need to define the specific data items that each table will hold. This requires identifying the fields that will be in each table. For example, the course title would be one of the fields in the COURSE table.

Step 3: Finally, since this will be a relational database, every table should have a field in common with at least one other table (in other words, they should have relationships with each other).

A **primary key** must be selected for each table in a relational database. This key is a unique identifier for each record in the table. For example, in the STUDENT table, it might be possible to use the student name as a way to identify a student. However, it is more than likely that some students share the same name. A student's email address might be a good choice for a primary key, since email addresses are unique. However, a primary key cannot change, so this would mean that if students changed their email address we would have to remove them from the database and then re-insert them – not an attractive proposition. Our solution is to use student ID as the primary key of the

STUDENT table. We will also do this for the COURSE table and the CLASSROOM table. This solution is quite common and is the reason you have so many IDs! The primary key of a table can be just one field, but can also be a combination of two or more fields. For example, the combination of StudentID and CourseID the GRADE table can be the primary key of the GRADE table, which means that a grade is received by a particular student for a specific course.

Database Table

Step 4: The next step is to identify and make the relationships between the tables so that you can pull the data together in meaningful ways. A relationship between two tables is implemented by using a foreign key. A **foreign key** is a field in one table that connects to the primary key data in the original table. For example, ClassroomID in the COURSE table is the foreign key that connects to the primary key ClassroomID in the CLASSROOM table. With this design, not only do we have a way to organize all of the data we need and have successfully related all the tables together to meet the requirements, but have also prevented invalid data from being entered into the database. You can see the final database design in the figure below:
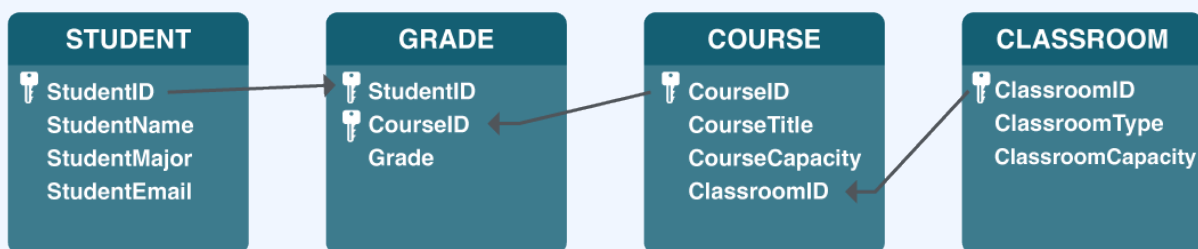
School Database Design Relationships

Normalization

When designing a database, one important concept to understand is **normalization**. In simple terms, to normalize a database means to design it in a way that:

1) reduces data redundancy; and

2) ensure data integrity.

In the School Database design, the design team worked to achieve these objectives. For example, to track grades, a simple (and wrong) solution might have been to create a Student field in the COURSE table and then just list the names of all of the students there. However, this design would mean that if a student takes two or more courses, then his or her data would have to be entered twice or more times. This means the data is redundant. Instead, the designers solved this problem by introducing the GRADE table.

In this design, when a student registers into the school system before taking a course, we first must add the student to the STUDENT table, where their ID, name, major, and email address are entered. Now we will add a new entry to denote that the student takes a specific course. This is accomplished by adding a record with the StudentID and the CourseID in the GRADE table. If this student takes a second course, we do not have to duplicate the entry of the student's name, major, and email; instead, we only need to make another entry in the GRADE table of the second course's ID and the student's ID.

The design of the School database also makes it simple to change the design without major modifications to the existing structure. For example, if the design team were asked to add functionality to the system to track instructors who teach the courses, we could easily accomplish this by adding a PROFESSOR table (similar to the STUDENT table) and then adding a new field to the COURSE table to hold the professors' ID.

5.7. WHY DATABASES?
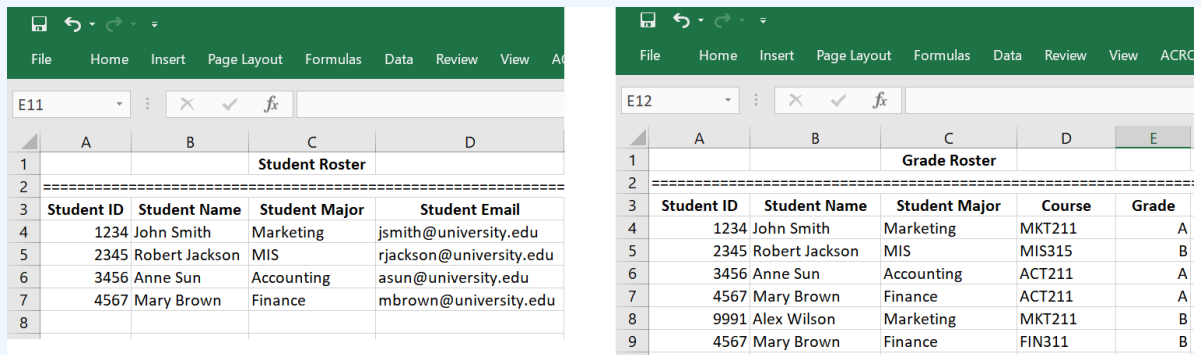
Data is a valuable resource. However, many people are unfamiliar with database software, and therefore use other products, such as spreadsheets, to store and manipulate business data. As a result, the data becomes redundant, inconsistent, inaccurate, and fails to meet the <u>characteristics of valuable information</u>. For a small data set, the use of non-database tools may not cause problems, but can soon become unmanageable and lead to serious errors. There are a number of characteristics that distinguish the **database approach** from the **file-based system** or approach. The following are the benefits of using a database approach.

Control of redundant data

Redundant data is data that is repeated in a database, which can cause the data set to be inconsistent. In the database approach, ideally each data item is stored in only one place in the database. In some cases redundancy still exists to improve system performance, but such redundancy is controlled and kept to a minimum. See below for an illustrative example to explain why redundant data are harmful.

Example of Redundant Data

Suppose the registrar's office has two separate files that store student data: one is the registered student roster which records all students who have registered and paid their tuition, and the other is student grade roster which records all students and their grades.

As you can see from the two spreadsheets, this data management system has redundancies. The student's name and major are recorded in both lists. Redundant data can make data access convenient, but it can have negative consequences. For example, if Mary Brown changes her name or her major, then this information will need to be updated everywhere it is listed. For small data systems, this may be a simple task. However, when the data system is huge, making changes to all redundant data is difficult if not impossible. As a result of data redundancy, the entire data set can be corrupted.

Data Integrity

Data integrity means consistency among the stored data. We use the above illustrative example to explain the concept of data integrity and how data integrity can be violated if the data system is flawed. You can find that Alex Wilson received a grade in MKT211; however, you can't find Alex Wilson in the student roster. That is, the two rosters are not consistent. Suppose we have a data integrity control to enforce the rules, say, "no student can receive a grade unless she/he has registered and paid tuition", then such a violation of data integrity can never happen. Database management systems provide capabilities to define and enforce certain constrains to ensure integrity.

Data Sharing

The integration of the whole data in an organization leads to the ability to produce more information from a given amount of data. When the data is centralized in one database it makes it easier.

Security & Recovery

Database management systems allow for restricting unauthorized access through security features that allow for control of user accounts. Not all users of the system have the same accessing privileges. In addition, users may have different views of the database itself as users may not need to be aware of how and where the data they refer to is stored.

As well, if the computer system fails in the middle of a complex update program, the recovery subsystem is responsible for making sure that the database is restored to the stage it was in before the program started executing.

5.8. DATABASE MANIPULATION

Once you have a database designed and loaded with data, how will you do something useful with it? The primary way to work with a relational database is to use Structured Query Language (SQL) to analyze and manipulate relational data. **Database Manipulation** is the use of a programming language to modify data in a database to make it easier to view or for the purpose of decision making.

SQL (often pronounced sequel) stands for Structured Query Language, and is the most common language for creating and manipulating databases. You'll find variants of SQL inhabiting everything from desktop software, to high-powered enterprise products. Given this popularity, if you're going to learn one language for database use, SQL is a pretty good choice. To give you a taste of what SQL might look like, see the examples below using the School database data.

Example of a SQL Query

A query to retrieve the major of student John Smith from the Student table:

    SELECT StudentMajor

    FROM Student

    WHERE StudentName = 'John Smith';

A query to retrieve the total # of students in the Student table:

    SELECT COUNT(*)

    FROM Student;

SQL can be embedded in many computer languages that are used to develop platform-independent web-based applications. An in-depth description of how SQL works is beyond the scope of this introductory text, but these examples should give you an idea of the power of using SQL to manipulate relational databases. Many DBMS, such as Microsoft Access, allow you to use **QBE** (Query-by-Example), a graphical query tool, to retrieve data though visualized commands. QBE generates SQL for you, and is easy to use. In comparison with SQL, QBE has limited functionalities and is unable to work without the DBMS environment.

5.9. SUMMARY

Key Takeaways

- Data is made up of facts of the world. You must process data to get information.
- A database is an organized collection of related data.
- A database management system (DBMS) is a software application that is used to create and manage databases, and can take the form of a personal DBMS, used by one person, or an enterprise DBMS that can be used by multiple users
- Relational databases are the most widely used type of database, where data is structured into tables and all tables must be related to each other through unique identifiers.
- Designing a relational database involves determining how the data is organized into tables, setting primary keys and creating relationships among the tables.
- Normalization is the process of designing a database to reduce redundancy and ensure integrity.
- The database approach allows for the control of redundant data, data integrity, data sharing, and security and recovery.
- There are many data types, and it is important to use the correct one.

Exercises

1. What is metadata?
2. Explain in your own words how the data component relates to the hardware and software components of information systems.
3. What is a database management system and how does it work?
4. What is the difference between a spreadsheet and a database? List three differences between them.
5. What are the characteristics of a relational database?
6. Outline the steps of the data hierarchy using an example.
7. How do you go about choosing a primary key? What are some of the characteristics you would look for?
8. Describe what the term normalization means.
9. What are the benefits of using the database approach?

10. What language can be used to create queries in databases?
11. Why is it important to define the data type of a field when designing a relational database?
12. Name a database you interact with frequently. What would some of the field names be?

Assignment

Overview

This assignment is designed to help you understand how to model a relational database.

Assignment

1. Using the data in the Cake Order Database, decide what tables of data could be created, and what fields would be included in the tables.
2. Identify what field would serve as the primary key for the tables.
3. Create an entity relationship diagram showing the tables (with fields) and relationships among the tables.
4. What other data could be included in this database? What benefits are there from organizing the data this way as opposed to in an Excel file?

5.10 KEY TERMS

Chapter 5

Attribute: A record is one instance of a set of fields in a table. (5.5)

Big Data: A broad term for data sets so large or complex that traditional data processing applications are inadequate (5.2)

Database: An organized collection of related information. (5.3)

Data Dictionary: Created to hold the metadata, defining the fields and structure of the database. To learn more, check out the example below and this resource from the University of Regina on data modeling and ERD diagrams. (5.6)

Data Hierarchy: The structure and organization of data in a database (5.5)

Data Integrity: Consistency among the stored data. (5.7)

Database Management Systems (DBMS): Programs that provide user-friendly, interfaces to view and change a database, create queries, and develop reports. (5.3)

Database Manipulation: The use of a programming language to modify data in a database to make it easier to view or for the purpose of decision making. (5.8)

Data Model: of a database is the logical structure of the data items and their relationships. (5.4)

Data Sharing:The integration of the whole data in an organization leads to the ability to produce more information from a given amount of data. When the data is centralized in one database it makes it easier.(5.7)

Data Types: When defining the fields in a database table, we must give each field a data type. For example, the field 'StudentName' is text string, while 'EnrollmentCapacity' is number. Most modern databases allow for several different data types to be stored. (5.5)

Entities: the data contained in the database (e.g., students, course, grade, classroom) (5.6)

Entity Relationship Diagram (ERD): Which shows the relationships among the tables of data. When a database is being designed. (5.6)

Flat File Database: Which contains only one file/table, with no relationships.A table created in a spreadsheet would be considered a flat file. (5.4)

Hierarchical Database Model: Popular in the 1960s and 1970s, connected data together in a hierarchy, allowing for a parent/child relationship between data.(5.4)

Metadata: Data that describes other data. (5.2)

Normalization: To normalize a database means to design it in a way that reduces data redundancy; and ensure data integrity. (5.6)

NoSQL Databases: Not Only SQL Database. A type of database that operates using means other than relational tables. NoSQL became popular with the growth of Web 2.0 and the need for faster data retrieval. (5.4)

Query-by-Example (QBE): A graphical query tool, to retrieve data though visualized commands. (5.8)

Record(row): Records as the rows of the table. (5.5)

Redundant Data: Redundant data is data that is repeated in a database, which can cause the data set to be inconsistent. In the database approach, ideally each data item is stored in only one place in the database. (5.7)

Relational Database: One in which data is organized into one or more related tables. (5.3)

Relationships: between data items (e.g., students get grades in courses that are offered in classrooms) (5.6)

Scale: Refers to a database getting larger and larger, being distributed on a larger number of computers connected via a network. (5.4)

Schema: Developed to provide an overall description of the database.(5.6)

Structured Query Language (SQL): The most common language for creating and manipulating databases. SQL inhabiting everything from desktop software, to high-powered enterprise products. (5.8)

Adapted from Information Systems for Business and Beyond Glossary by Ruth Guthrie licensed under a CC-BY-3.0

5.11. KNOWLEDGE CHECK

Knowledge Check 1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1787#h5p-33

Knowledge Check 2

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1787#h5p-35

Knowledge Check 3

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1787#h5p-55

CHAPTER 6: NETWORKS

Chapter Outline

Photo by NASA Unsplash License

6.1. CHAPTER INTRODUCTION

Learning Outcomes

Upon successful completion of this chapter, you will be able to:

- Outline the major components of a data communication system;
- Identify the different types of networks;
- Define the key concepts associated with networking technologies;
- Explain the makeup of the Internet and World Wide Web;
- Describe organizational networking and
- Summarize widely used web applications for business activities.

In the early days of computing, computers were seen as devices for making calculations, storing data, and automating business processes. However, as the devices evolved, it became apparent that many of the telecommunications functions could be integrated into the computer. During the 1980s, many organizations began combining their once-separate telecommunications and information systems departments into an Information Technology (IT) department. This ability for computers to communicate with one another and to facilitate communication between individuals and groups has had a significant impact on the growth of computing over the past several decades.

Computer networking began in the 1960s with the birth of the Internet. However, while the Internet and web were evolving, corporate networking was also taking shape in the form of local area networks and client-server computing. The Internet went commercial in 1994 as technologies began to pervade all areas of the organization. Today it would be unthinkable to have a computer that did not include communications capabilities. This chapter reviews the different technologies that have been put in place to enable this communications revolution.

6.2. COMMUNICATIONS PROCESS

Before delving into the details of networking, it is important to understand how data is communicated between computers. **Data communication** is the electronic transmission of encoded information to, from and between computers. Data communication requires a number of devices in order for information to be transferred. The process begins when a computer sends an instruction to transmit information.

- A **modem** converts the format of the data so it may be transmitted between computers.
- A **medium** provides a path for signals to be transmitted. This can be in a physical format like copper cable, coaxial cable or fibre optics. It can also be radiated or wireless.
- The receiving computer accepts the transmission.

Data Communication

Sending Computer Device: Modem   Medium   Device: Modem Receiver Computer

Data Communication Process

In communicating data, speed is important. The amount of data that can be transferred from one point to another in a certain period of time is referred to as **bandwidth.** Bandwidth can be narrow or broad, and it depends on the access technology. Broadband is when a high amount of data is transmitted simultaneously by digital subscriber line, cable and fibre optic technologies. Narrowband is when a limited amount of data is transferred over a specified time period.

Communication Through the Ages

Communication modes and technologies have changed dramatically over time from cave paintings to social media platforms. To check out the history of communication review this communication timeline from BizTech Magazine.

6.3. NETWORKS

Today most businesses use networks to deliver information to employees, suppliers, and customers. A **computer network** is a group of two or more computer systems linked together by communications channels to share data and information. Networks often link thousands of users and can transmit audio and video as well as data.

Networks include clients and servers. The **client** is the application that runs on a personal computer or workstation. It relies on a **server** that manages network resources or performs special tasks such as storing files, managing one or more printers, or processing database queries. Any user on the network can access the server's capabilities.

By making it easy and fast to share information, networks have created new ways to work and increase productivity. They provide more efficient use of resources, permitting communication and collaboration across distance and time. With file-sharing, all employees, regardless of location, have access to the same information. Shared databases also eliminate duplication of effort. Employees at different sites can "screen-share" computer files, working on data as if they were in the same room. Their computers are connected by phone or cable lines, they all see the same thing on their display, and anyone can make changes that are seen by the other participants. The employees can also use the networks for videoconferencing.
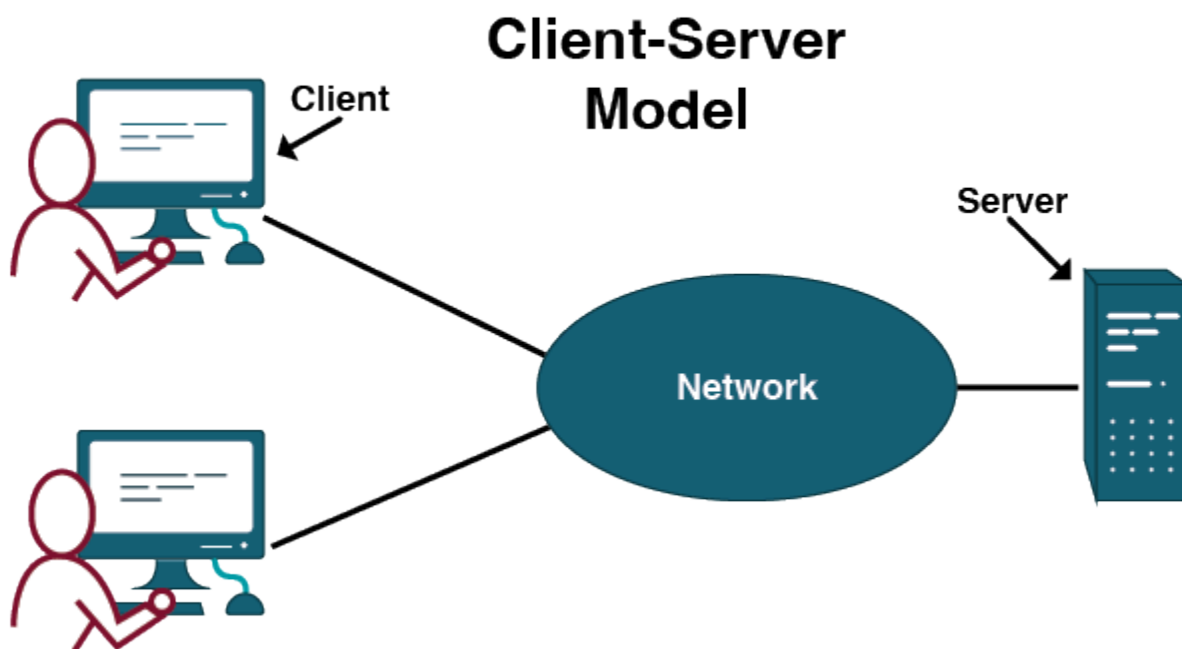
Client-Server Modell

Networks also make it possible for companies to run enterprise software, large programs with integrated modules that manage all of the corporation's internal operations. We will discuss enterprise systems more in Chapter 11.

Connecting Near and Far

WAN, MAN, LAN Networks (click to enlarge)

There are three types of networks distinguished by the area they cover: local area networks, wide area networks and metropolitan area networks. A **local area network (LAN)** lets people at one site exchange data and share the use of hardware and software. LANs offer companies a more cost-effective way to link computers than linking terminals to a mainframe computer. The most common uses of LANs at small businesses, for example, are office automation, accounting, and information management. LANs can be set up with wired or wireless connections.

A **Metropolitan area network (MAN)** spans a larger area like a city or region whereas a **wide area network (WAN)** connects computers at different sites via telecommunications media such as phone lines, satellites, and microwaves. A modem connects the computer or a terminal to the telephone line and transmits data almost instantly, in less than a second. Telecommunications companies, such as Rogers Communications, Bell Canada, or Telus Inc., operate very large WANs. The internet is essentially a worldwide WAN.

6.4. THE INTERNET

The **internet** is a network of networks—millions of them, actually. If the network at your university, your employer, or your home has internet access, it connects to an **internet service provider** (ISP). Many, but not all, ISPs are big telecommunications companies like Rogers Communications, Bell Canada, or Telus Inc . These providers connect to one another, exchanging traffic, and ensure your messages get to other computers that are online and willing to communicate with you.

The internet has no center and no one owns it. That's a good thing. The internet was designed to be redundant and fault-tolerant—meaning that if one network, connecting wire, or server stops working, everything else should keep on running. Rising from military research and work at educational institutions dating as far back as the 1960s, the internet really took off in the 1990s, when graphical web browsing was invented. Much of the internet's operating infrastructure was transitioned to be supported by private firms rather than government grants. We will now explore this history in more detail.

History of the Internet

In the Beginning: ARPANET

The story of the internet, and networking in general, can be traced back to the late 1950s. The United States was in the depths of the Cold War with the USSR as each nation closely watched the other to determine which would gain a military or intelligence advantage. In 1957, the Soviets surprised the U.S. with the launch of Sputnik, propelling us into the space age. In response to Sputnik, the U.S. Government created the Advanced Research Projects Agency (ARPA), whose initial role was to ensure that the U.S. was not surprised again. It was from ARPA, now called DARPA ((Defense Advanced Research Projects Agency), that the internet first sprang.

ARPA was the center of computing research in the 1960s, but there was just one problem. Many of the computers could not communicate with each other. In 1968 ARPA sent out a request for proposals for a communication technology that would allow different computers located around the country to be integrated together into one network. Twelve companies responded to the request, and a company named Bolt, Beranek, and Newman (BBN) won the contract. They immediately began work and were able to complete the job just one year later.

ARPA Net 1969

Professor Len Kleinrock of UCLA along with a group of graduate students were the first to successfully send a transmission over the ARPANET. The event occurred on October 29, 1969 when they attempted to send the word "login" from their computer at UCLA to the Stanford Research Institute. The first four nodes were at UCLA, University of California, Stanford, and the University of Utah.

The Internet

Over the next decade, the ARPANET grew and gained popularity. During this time, other networks also came into existence. Different organizations were connected to different networks. This led to a problem. The networks could not communicate with each other. Each network used its own proprietary language, or protocol to send information back and forth. A **protocol** is the set of rules that govern how communications take place on a network. This problem was solved by the invention of the **Transmission Control Protocol/Internet Protocol (TCP/IP).** TCP/IP was designed to allow networks running on different protocols to have an intermediary protocol that would allow them to communicate. So as long as your network supported TCP/IP, you could communicate with all of the other networks running TCP/IP. TCP/IP quickly became the standard protocol and allowed networks to communicate with each other.

Adapted from ARPA Net Nodes 1969 by D.Bourgeois CC-BY-NC

The 1980s witnessed a significant growth in internet usage. Internet access came primarily from government, academic, and research organizations. Much to the surprise of the engineers and developers, the early popularity of the internet was driven by the use of electronic mail. People connecting with people was the killer app (see chapter 4) for the internet.

The World Wide Web

Initially, internet use meant having to type commands, even including IP addresses, in order to access a web server. That all changed in 1990 when Tim Berners-Lee introduced his **World Wide Web** project which provided an easy way to navigate the internet through the use of hypertext. The World Wide Web gained even more steam in 1993 with the release of the Mosaic browser which allowed graphics and text to be combined as a way to present information and navigate the internet. Many times the terms "Internet" and "World Wide Web," or even just "the web," are used interchangeably. But really, they are not the same thing.

The Internet and the Web – What's the Difference?

The internet is an interconnected network of networks. Services such as email, voice and video, file transfer, and the World Wide Web (the web for short) all run across the internet. The web is simply one part of the internet. It is made up of web servers that have HTML pages that are being viewed on devices with web browsers. To see an interactive map of the world's major submarine cable systems go to TeleGeography's Submarine Cable Map. A snapshot of the interactive map can be seen below.

The Dot-Com Bubble

In the 1980s and early 1990s, the internet was being managed by the National Science Foundation (NSF). The NSF had restricted commercial ventures on the internet, which meant that no one could buy or sell anything online. In 1991, the NSF transferred its role to three other organizations, thus getting the US government out of direct control over the internet and essentially opening up commerce online.

This new commercialization of the internet led to what is now known as the dot-com bubble. A frenzy of investment in new dot-com companies took place in the late 1990s with new tech companies issuing Initial Public Offerings (IPO) and heating up the stock market. This investment bubble was driven by the fact that investors knew that online commerce would change everything. Unfortunately, many of these new companies had poor business models and anemic financial statements showing little or no profit. In 2000 and 2001, the bubble burst and many of these new companies went out of business. Some companies survived, including Amazon (started in 1994) and eBay (1995). After the dot-com bubble burst, a new reality became clear. In order to succeed online, e-business companies would need to develop business models appropriate for the online environment. E-business is explored in chapter 10.

The Generations of the Web

In the first few years of the web, creating and hosting a website required a specific set of knowledge. A person had to know how to set up a web server, get a domain name, create web pages in HTML, and troubleshoot various technical issues. Since then the web has evolved. This evolution has been referred to as different phases.

- **Web 2.0** is also referred to as the social web and occurred between 2000-2010. During this time there was a shift from read

only to read and write, which allowed individuals to be content creators. Social networking with apps such as Facebook, Twitter, Youtube, and personal blogs have allowed people to express their own view points and share content.

- **Web 3.0** is also referred to as the semantic web and is the time after 2010 when the web evolved again to allow individuals to read, write and execute. This means that the web is more intelligent and is able to interact with users. For example, algorithms that can personalize search results.

- **Web 4.0** is the future of the web, which is referred to as the intelligent web and will involve the Internet of Things and connected devices.
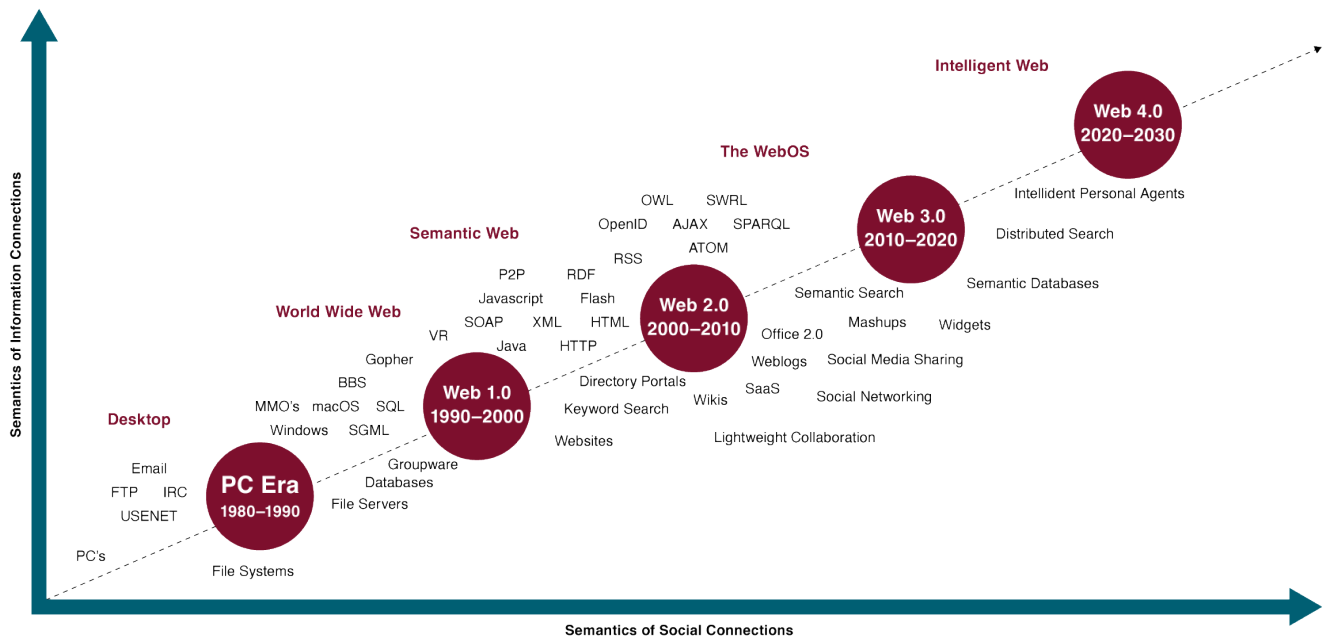
Phases of the Web (Click to enlarge)

There's Another Internet?

Internet2 is a research network created by a consortium of research, academic, industry, and government firms. These organizations have collectively set up a high-performance network running at speeds of up to one hundred gigabits per second to support and experiment with demanding applications. Examples include high-quality video conferencing; high-reliability, high-bandwidth imaging for the medical field; and applications that share huge data sets among researchers.

"5.1 The Internet" from Business Computer Information Systems by Emese Felvegi; Barbara Lave; Diane Shingledecker; Julie Romey; Noreen Brown; Mary Schatz; OpenStax; Saylor Academy; University of Minnesota Libraries; and Robert McCarn is

6.5. A PACKET'S JOURNEY

= Router
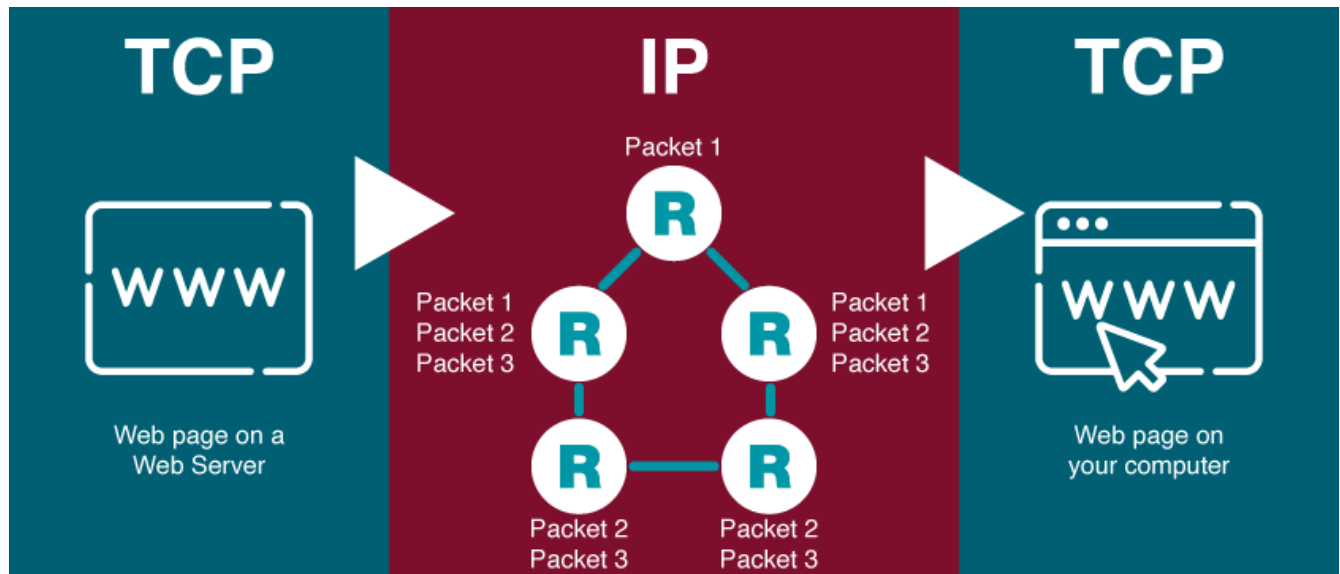
Have you ever wondered how information is transmitted over the internet? In this example, a server on the left sends a webpage to the user on the right. The application (the web server) passes the contents of the page to TCP (which is built into the server's operating system). TCP slices the webpage into smaller chunks of data called packets. The **packets** are like little envelopes containing part of the entire transmission—they're labeled with a destination address (where it's going) and a source address (where it came from).

Then IP takes over, forwarding packets from router to router across the internet until it arrives at the user's computer. **Routers** speak to each other and to other computers using IP. Since routers are connected to the internet, they have IP addresses, too. Every computer on the internet is connected to a router, and all routers are connected to at least one (and usually more than one) other router, linking up the networks that make up the internet. This chatter between the routers also keeps the internet decentralized and fault-tolerant. Even if one path out of a router goes down (a networking cable gets cut, a router breaks, the power to a router goes out), as long as there's another connection out of that router, then your packet will get forwarded. Networks fail, so good, fault-tolerant network design involves having alternate paths into and out of a network.

Routers try and find the optimal route for each packet's journey, so sometimes packets take different routes, and occasionally arrive out of order. TCP running on the receiving system on the right checks that all packets have arrived, requests that damaged or lost packets be resent, puts them in the right order, and sends a perfect, exact copy of the web page to your browser. TCP (Transmission Control Protocol) works its magic at the start and endpoint of the trip—on both your computer and on the destination computer you're communicating with.

This progression—application at the source to TCP at the source (slice up the data being sent), to IP (for forwarding among routers), to TCP at the destination (put the transmission back together and make sure it's perfect), to application at the destination—takes place in both directions, starting at the server for messages coming to you, and starting on your computer when you're sending messages to another computer.

IP Addresses and Domain Names

Every device on the internet (personal computer, a tablet, a smartphone, etc.) is assigned a unique identifying number called an IP (Internet Protocol) address. Originally, the IPv4 (version 4) standard was used. It had a format of four numbers with values ranging from 0 and 255 separated by a period. For example, the domain Dell.com has the IPv4 address 107.23.196.166. The IPv4 standard has a limit of 4,294,967,296 possible addresses. As the use of the internet has grown, the number of IP addresses needed has increased to the point where the use of IPv4 addresses will be exhausted. This has led to the new IPv6 standard. The IPv6 standard is formatted as eight groups of four hexadecimal digits, such as 2001:0db8:85a3:0042:1000:8a2e:0370:7334. The IPv6 standard has a limit of 3.4×10^{38} possible addresses. For example, the domain LinkedIn.com has an IPv6 address of: [2620:109:c002::6cae:a0a]. You probably noticed that the address has only five groups of numbers. That's because IPv6 allows the use of two semi-colons (::) to indicate groups that are all zeroes and do not need to be displayed.

Domain Name System

If you had to try to remember the IP address of every web site you wanted to access, the internet would not be nearly as easy to use. A **domain name** is a user-friendly name, convenient for remembering a website. These names generally consist of a descriptive word followed by a dot (period) and the Top-Level Domain (TLD). For example, Wikipedia's domain name is wikipedia.org. Wikipedia describes the organization and .org is the TLD. Other well-known TLDs include .com, .net, and .gov. The Domain Name System (DNS) acts as the directory of websites on the internet.

Anatomy of a Web Address

"12.3 Getting Where You're Going" from Information Systems – A Manager's Guide to Harnessing Technology by Minnesota

Libraries is licensed under a , except where otherwise noted.

6.6. THE GROWTH OF HIGH SPEED INTERNET

In the early days of the internet, most access was accomplished via a modem over an analog telephone line. A modem was connected to the incoming phone line and then connected to a computer. Speeds were measured in bits-per-second (bps), with speeds growing from 1200 bps to 56,000 bps over the years. Connection to the Internet via modems is called dial-up access. As the web became more interactive, dial-up hindered usage when users wanted to transfer more and more data. As a point of reference, downloading a typical 3.5 MB song would take 24 minutes at 1200 bps and 2 minutes at 28,800 bps.

High-speed internet speeds, by definition, are a minimum of 256,000 bps, though most connections today are much faster, measured in millions of bits per second (megabits or Mbps) or even billions (gigabits). For the home user, a high-speed connection is usually accomplished via cable television lines or phone lines using a Digital Subscriber Line (DSL). Both cable and DSL have similar prices and speeds, though price and speed can vary in local communities. Telecommunications companies provide T1 and T3 lines for greater bandwidth and reliability. Long-haul cables, those that carry lots of data over long distances, are usually fibre-optic lines—glass-lined cables that transmit light. Light is faster and travels farther distances than electricity, but fibre-optic networking equipment is more expensive than the copper-electricity kind.

How Does My Internet Speed Compare?

So how does your own Internet speed compare? There are many online tools you can use to determine the speed at which you are connected. One of the most trusted sites is speedtest.net, where you can test both your download and upload speeds. The following chart shows how Internet speeds compare in different countries. You can find the full list of countries by going to The Countries with the Fastest Internet site.

High-speed access, also known as **broadband**, is important because it impacts how the internet is used. Communities with high-speed internet have found that residences and businesses increase their usage of digital resources. Access to high-speed internet is now considered a fundamental human right by the United Nations, as declared in their 2011 statement:

"Broadband technologies are fundamentally transforming the way we live," the Broadband Commission for Digital Development, set up in 2017 by the UN Educational Scientific and Cultural Organization (UNESCO) and the UN International Telecommunications Union (ITU), said in issuing "The Broadband Challenge" at a leadership summit in Geneva.

"It is vital that no one be excluded from the new global knowledge societies we are building. We believe that communication is not just a human need – it is a right"(International Telecommunications Union, 2018).

"Chapter 5: Networking and Communication" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

6.7. WIRELESS NETWORKING

Thanks to wireless technology, access to the Internet is available virtually everywhere, especially through a smartphone. The following section discusses the different ways to access the internet wirelessly.

Wi-Fi

Wi-Fi takes an internet signal and converts it into radio waves. These radio waves can be picked up within a radius of approximately 65 feet by devices with a wireless adapter. Several Wi-Fi specifications have been developed over the years, starting with 802.11b in 1999, followed by the 802.11g specification in 2003 and 802.11n in 2009. Each new specification improved the speed and range of Wi-Fi, allowing for more uses. One of the primary places where Wi-Fi is being used is in the home. Home users access Wi-Fi via in-home routers provided by the telecommunications firm that services the residence.

Mobile Network

As the cellphone has evolved into the smartphone, the desire for Internet access on these devices has led to data networks being included as part of the mobile phone network. While internet connections were technically available earlier, it was really with the release of the 3G networks in 2001 (2002 in the US) that smartphones and other cellular devices could access data from the Internet. This new capability drove the market for new and more powerful smartphones, such as the iPhone, introduced in 2007. In 2011, wireless carriers began offering 4G data speeds, giving the cellular networks the same speeds that customers were accustomed to getting via their home connection.

Beginning in 2019, some part of the world began seeing the implementation of 5G communication networks. Speeds associated with 5G will be greater than 1 GB/second, providing connection speeds to handle just about any type of application. Some have speculated that the 5G implementation will lead households to eliminate the purchase of wired Internet connections for their homes, just using 5G wireless connections instead.

	3G	4G	5G
Deployed	2004-2005	2006-2010	By 2020
Bandwidth	2 mbps	200 mbps	> 1 gbps
Service	Integrated high-quality audio, video and data.	Dynamic information access, variable devices.	Dynamic information access, variable devices with all capabilities.

(Dean, 2014)

Bluetooth

While Bluetooth is not generally used to connect a device to the Internet, it is an important wireless technology that has enabled many functionalities that are used every day. When created in 1994 by Ericsson, it was intended to replace wired connections between devices. Today, it is the standard method for wirelessly connecting nearby devices. Bluetooth has a range of approximately 300 feet and consumes very little power, making it an excellent choice for a variety of purposes. Some applications of Bluetooth include: connecting a printer to a personal computer, connecting a mobile phone and headset, connecting a wireless keyboard and mouse to a computer, or connecting your mobile phone to your car, resulting in hands free operation of your phone.

VoIP

Voice over IP (VoIP) allows analog signals to be converted to digital signals, then transmitted on a network. By using existing technologies and software, voice communication over the Internet is now available to anyone with a browser (think Skype, WebEx, Google Meet). Beyond this, many companies are now offering VoIP-based telephone service for business and home use.

BroadVoice Router & Phone Adapter
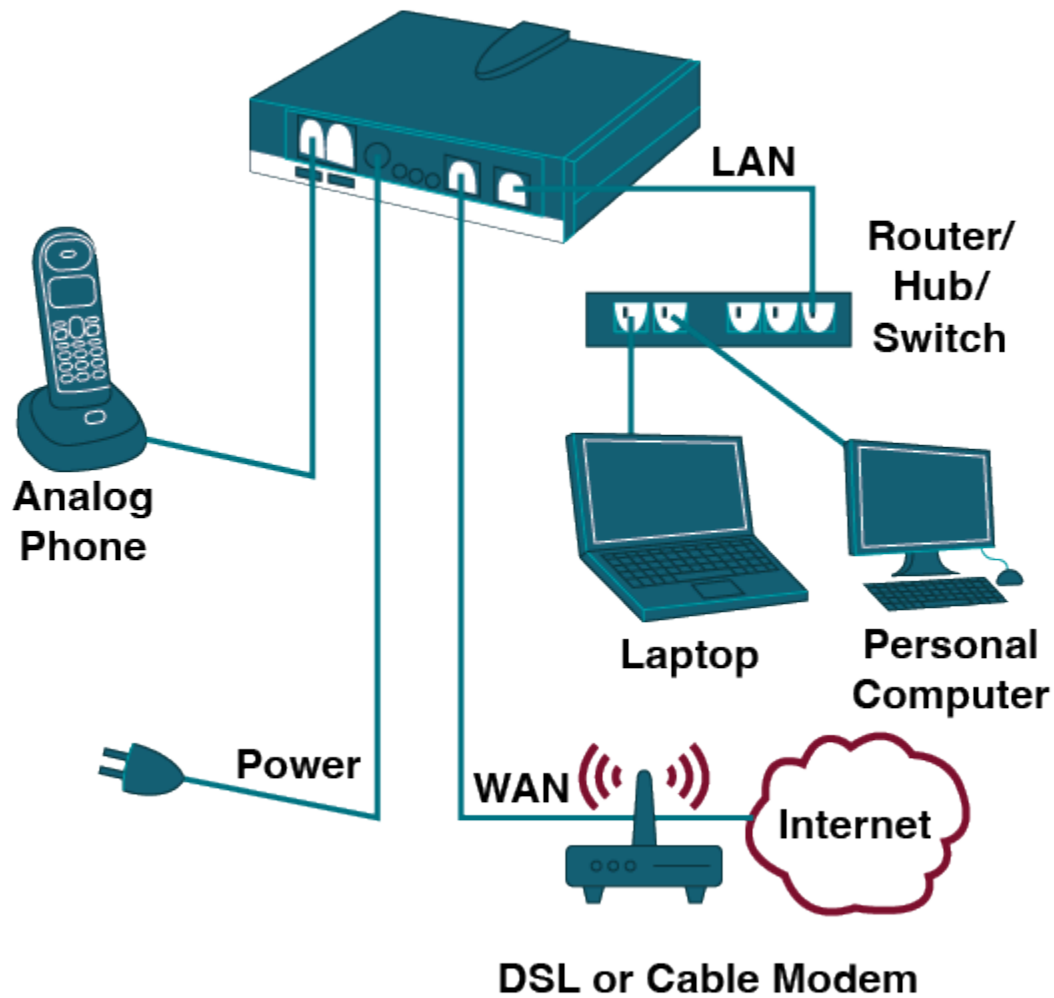
"Chapter 5: Networking and Communication" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

6.8. ORGANIZATIONAL NETWORKING
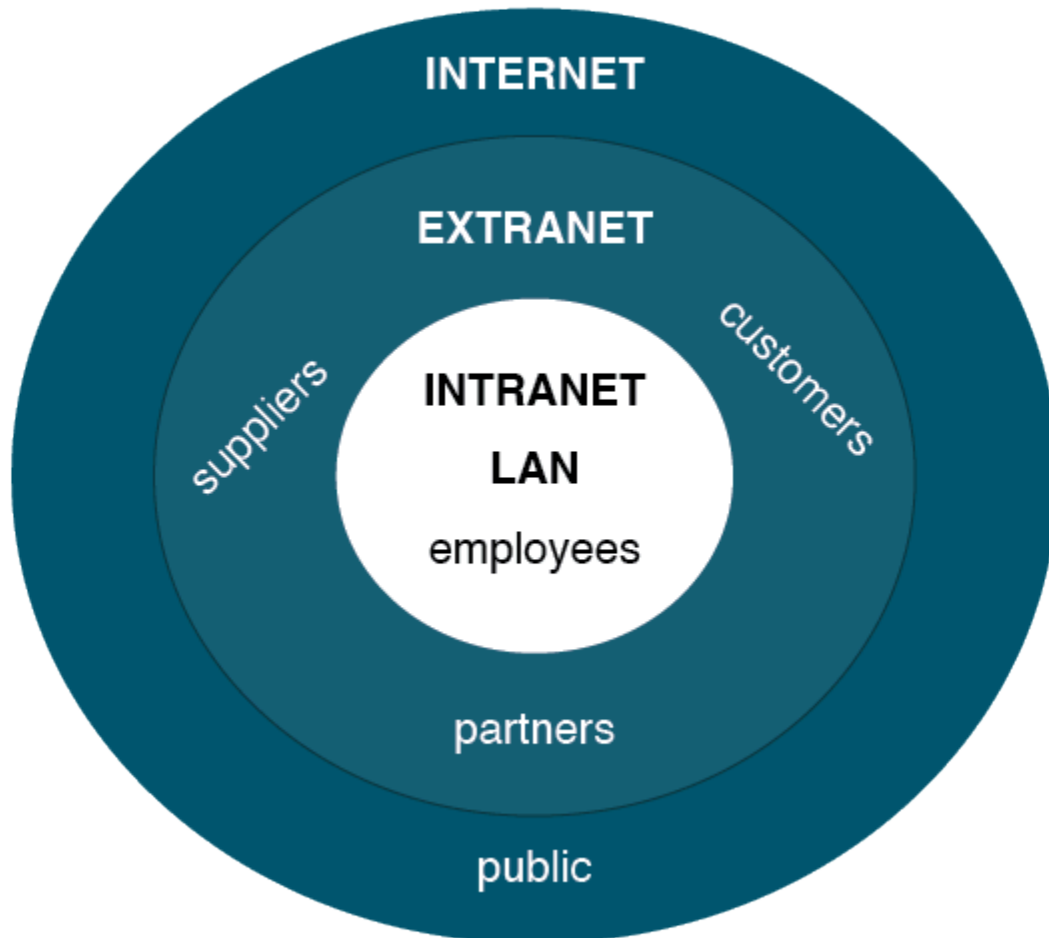
Intranet

Like LANs, **intranets** are private corporate networks. Many companies use both types of internal networks. However, because they use internet technology to connect computers, intranets are WANs that link employees in many locations and with different types of computers. Essentially mini-internets that serve only the company's employees, intranets operate behind a firewall that prevents unauthorized access. Employees navigate using a standard web browser, which makes the intranet easy to use. They are also considerably less expensive to install and maintain than other network types and take advantage of the internet's interactive features such as chat rooms and team workspaces. Many software providers now offer off-the-shelf intranet packages so that companies of all sizes can benefit from the increased access to and distribution of information.

Extranet

Sometimes an organization wants to be able to collaborate with its customers or suppliers while at the same time maintaining the security of being inside its own network. In cases like this a company may want to create an **extranet**, which is a part of a company's network that can be made available securely to those outside of the company. Extranets can be used to allow customers to log in and place orders, or for suppliers to check their customers' inventory levels.

Sometimes an organization will need to allow someone who is not located physically within its internal network to gain secure access to the intranet. This access can be provided by a virtual private network (VPN).

Virtual Private Network

Many companies use **virtual private networks** (VPNs) to connect two or more private networks (such as LANs) over a public network, such as the internet. VPNs include strong security measures to allow only authorized users to access the network and its sensitive corporate information. Companies with widespread offices may find that a VPN is a more cost-effective option than creating a network using purchased networking equipment and leasing expensive private lines. This type of private network is more limited than a VPN, because it doesn't allow authorized users to connect to the corporate network when they are at home or traveling. During the COVID-19 pandemic, many companies provided their employees with access to the company's network by VPN while working from home.
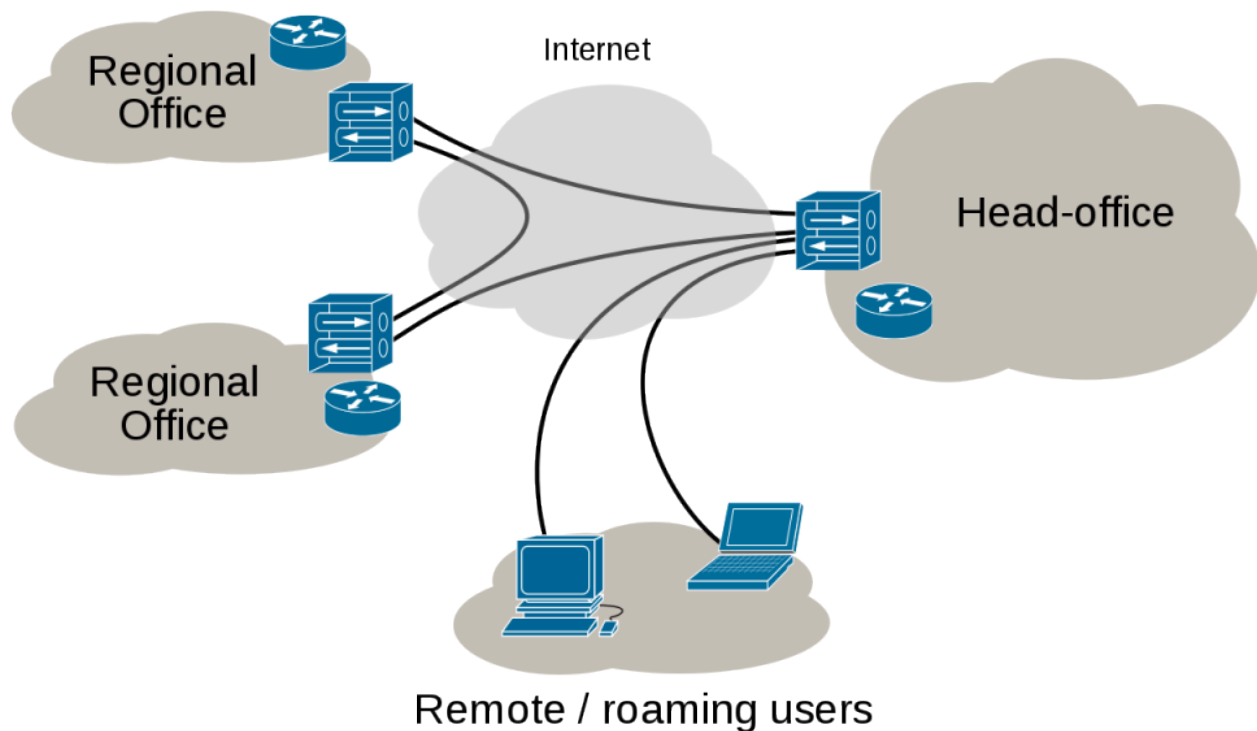
Diagram of VPN adapted from D. Bourgeois CC-BY-NC

6.9. BUSINESSES APPLICATIONS

Generally, businesses use the internet for four purposes: *presenting information, selling products, distributing digital products*, and *acquiring goods and services*. These activities will be explored in greater detail in the [Chapter 10 e-business](#).

PRESENTING INFORMATION

By posting a website, a company can tell people about itself, its products, and its activities. Customers can check the status of orders or account balances. Information should always be current, complete, and accurate. Customers should be able to find and navigate the site, and have no difficulty accessing it during high-use periods.

SELLING PRODUCTS

Selling over the Internet—whether to individuals or to other businesses—enables a business to enlarge its customer base by reaching buyers outside its geographical area. A company selling over the Internet must attract customers to its site, make the buying process simple, assure customers that the site is secure, and provide helpful information.

DISTRIBUTING DIGITAL PRODUCTS

Some companies use the Internet to sell and deliver digital products such as subscriptions to online news services, software products and upgrades, and music and video products. In these businesses, the timely delivery of products is crucial.

ACQUIRING GOODS AND SERVICES

E-purchasing saves time, speeds up delivery, reduces administrative costs, and fosters better communications between a firm and its suppliers. Most importantly, it cuts the costs of purchased products because it's now feasible for buyers to request competitive bids and do comparative shopping. Many companies now use a technology called electronic data interchange to process transactions and transmit purchasing documents directly from one IS to another.

"Chapter 15: Managing Information and Technology " from Maritime Management: Micro and Small Businesses by Matthew Pauley is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License, except where otherwise noted.

6.10. SUMMARY

Key Takeaways

- The networking revolution has completely changed how personal computers are used.
- Data communication networks transmit digital data from one computer to another computer using a variety of wired and wireless communication channels.
- One such network, the internet, is an immense global network of smaller interconnected networks linking millions of computers.
- By connecting paying subscribers into the Internet infrastructure, a company called an internet service provider provides services, such as e-mail, and online access.
- A large portion of the Internet, the World Wide Web ("the Web"), is a subsystem of computers that can be accessed by means of a special protocol known as *hypertext transfer protocol (HTTP)*.
- Though the web couldn't exist without the Internet, it's the web that provides such multimedia material as pictures, sounds, and streaming videos.
- As networking technology has matured, the use of internet technologies has become a standard for every type of organization.
- The use of intranets and extranets has allowed organizations to deploy functionality to employees and business partners alike, increasing efficiencies and improving communications.
- Businesses use the Internet for four purposes: presenting information, selling products, acquiring goods and services, and distributing digital products.

Review Questions

1. What is data communication, and why do managers need to understand this concept?
2. Explain the communication process, and list the components of a communication system.
3. What is bandwidth?
4. What is a network? List and contrast the different network types.
5. What is the internet? Who owns the Internet?
6. Explain TCP/IP.

7. How does a client-server model work?
8. What is the Web and how is it different from the Internet?
9. What are the different components of a URL?
10. How is information transferred over the internet?
11. Describe the difference between an intranet and extranet. What are they used for?
12. Discuss some web trends. What is the Internet of everything?
13. How are businesses using the internet?

Assignment

Overview

This assignment is designed to help you understand how the internet is used by businesses.

Assignment

In this assignment you will explore the different ways in which businesses use the internet. Complete the following questions in a separate document.

1. Choose a business to explore. The business can operate locally or globally.
2. Perform some research on the business and list a few ways in which the company is using the internet to improve their business processes.
3. Provide a quick summary of your findings. Be sure to include a link to the company's website and any resources you use.

6.11. KEY TERMS

Chapter 6

ARPANET (Advanced Research Projects Agency Network): An early packet switching network and the first network to implement the protocol suite TCP/IP. Both technologies became the technical foundation of the Internet. Originally developed by the US Department of Defense. (6.4)

Bandwidth: Can be narrow or broad, and it depends on the access technology. Broadband is when a high amount of data is transmitted simultaneously by digital subscriber line, cable and fibre optic technologies. Narrowband is when a limited amount of data is transferred over a specified time period. (6.2)

Bluetooth: A standard for the short-range wireless interconnection of cellular phones, computers, and other electronic devices. (6.7)

Bridge: A network device that connects two networks together and only allows packets through that are needed.

Broadband: a high capacity transmission technique using a wide range of frequencies, which enables a large number of messages to be communicated simultaneously. (6.6)

Client: The application that runs on a personal computer or workstation. (6.3)

Cloud Computing: The practice of using a network of remote servers hosted on the Internet to store, manage, and process data, rather than a local server or a personal computer.

Computer Network: A group of two or more computer systems linked together by communications channels to share data and information. Networks often link thousands of users and can transmit audio and video as well as data. (6.3)

Data Communication: The electronic transmission of encoded information to, from and between computers. Data communication requires a number of devices in order for information to be transferred. (6.2)

Domain Name System (DNS): which acts as a directory on the Internet when a request to access a device with a domain name is given. (6.5)

Domain Name: A descriptive text followed by the top level domain that is human friendly name for a device on the internet. For example cpp.edu or coke.com. (6.5)

Domain Name Extension: The extension at the end of the domain name that indicates type of organization, such as .com, .org, .net, .edu...etc. (6.5)

Extranet: An intranet that can be partially accessed by authorized outside users, enabling businesses to exchange information over the Internet securely. (6.8)

Internet: An electronic communications network that connects computer networks and organizational computer facilities around the world. (6.4)

Internet Service Provider (ISP): Many, but not all, ISPs are big telecommunications companies like Rogers Communications, Bell

Canada, or Telus Inc . These providers connect to one another, exchanging traffic, and ensure your messages get to other computers that are online and willing to communicate with you.(6.4)

Intranet: A local or restricted communications network, especially a private network created using World Wide Web software. (6.8)

IP Address: A unique identifying number assigned to every device that communicates on the internet. (6.5)

IPV4 and IPV6: Internet Protocol address standard used has been IPv4(version 4) which has the format of four numbers between 0 and 255 separated by a period. IPv6 (version 6) is formatted as eight groups of four hexadecimal digits. (6.5)

LAN: Local Area Network. A local network that connects computers and other devices in a relatively small area, typically a single building or a group of buildings. (6.3)

Medium: Provides a path for signals to be transmitted. This can be in a physical format like copper cable, coaxial cable or fibre optics. It can also be radiated or wireless.(6.2)

Metropolitan Area Network (MAN): Spans a larger area like a city or region whereas a wide area network (WAN) connects computers at different sites via telecommunications media such as phone lines, satellites, and microwaves (6.3)

Mobile Network: A cellular network or mobile network is a communications network where the last link is wireless. The network is distributed over land areas called cells, each served by at least one fixedlocation transceiver, known as a cell site or base station. (6.7)

Modem: Converts the format of the data so it may be transmitted between computers. .(6.2)

Packet: The fundamental unit of data transmitted over the internet. Each packet includes the sender's address, the destination address, a sequence number and piece of the overall message to be sent. (6.5)

Packet Switching: When a packet is passed from one router to another across the Internet until it reaches its destination.

Protocol: A specific set of communication rules used by computers. (6.4)

Router: A device that receives and analyzes packets and then routes them towards their destination. (6.5)

Server: that manages network resources or performs special tasks such as storing files, managing one or more printers, or processing database queries. Any user on the network can access the server's capabilities. (6.3)

TCP/IP: Transmission Control Protocol / Internet Protocol. Defines how electronic devices (like computers) should be connected over the Internet, and how data should be transmitted between them. (6.4)

Tim Berners Lee: Inventor of the World Wide Web by developing an easy way to navigate the Internet through the use of linked text (hypertext). (6.4)

Virtual Private Network: A method employing encryption to provide secure access to a remote computer over the Internet. (6.8)

VoIP: Voice Over IP. A methodology and group of technologies for the delivery of voice communications and multimedia sessions over Internet Protocol (IP) networks. (6.7)

WAN: A Wide Area Network, telecommunications network or computer network that extends over a large geographical area. (6.3)

Web 2.0: The second stage of development of the World Wide Web, characterized especially by the change from static web pages to dynamic or user generated content and the growth of social media. (6.4)

Web 3.0: A third phase in the evolution of the World Wide Web, based on the idea that the Internet 'understands' the pieces of information it stores and is able to make logical connections between them. (6.4)

Web 4.0 The fourth phase in the evolution of the World Wide Web is referred to as the intelligent web and will involve the Internet of Things and connected devices

WiFi: A facility allowing computers, smartphones, or other devices to connect to the Internet or communicate with one another wirelessly within a particular area. (6.7)

World Wide Web: Simply one piece of the Internet made up of web servers that have HTML pages that are being viewed on devices with web browsers. (6.4)

Adapted from Information Systems for Business and Beyond Glossary by Ruth Guthrie licensed under a CC-BY-3.0

6.12. KNOWLEDGE CHECK

Knowledge Check 1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1789#h5p-46

Knowledge Check 2

Use the expand button in the top right corner to expand the view of this timeline.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1789#h5p-37

CHAPTER 7: SYSTEMS DEVELOPMENT

Chapter Outline

Coding Programming by Negative Space CC0

7.1. CHAPTER INTRODUCTION

Learning Outcomes

Upon successful completion of this chapter, you will be able to:

- Define systems development;
- Explain the overall process of developing new systems;
- Explain the differences between system development methodologies;
- Discuss the components of a feasibility analysis;
- List the different types of programming languages used to develop software;
- Clarify some of the issues surrounding the development of mobile applications;
- Compare the build vs buy decision; and
- Identify the four primary implementation policies.

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 make it happen? This chapter covers the different methods of taking those ideas and bringing them to reality, a process known as information systems development.

"Chapter 10: Information Systems Development" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

7.2. SYSTEMS DEVELOPMENT

Systems development could be seen as the simple process of writing programs to solve the needs of users. However, in reality this process is not that simple. End users may know what they want, but lack the technical expertise to bring the idea to life. Also, programmers may understand the computer, but not the user environment. This communication gap between the user and the service provider must be addressed. Other factors like lack of management support, budget and timeline issues can all contribute to challenges with systems development. A systems development methodology can help mitigate these challenges and support development success. Several factors have been identified that are critical to ensuring success :

- well-defined system objectives
- careful test of feasibility
- top management support
- user involvement to ensure strong commitment
- rigorous analysis to ensure detailed, unambiguous user requirements
- sound detailed design to ensure an efficient, quality, maintainable system
- project management to ensure the development team is managed and controlled.

The process of developing software is usually not as simple as sitting down and writing code. Sometimes a programmer can quickly write a short program to solve a need, but in most instances the creation of software is a resource-intensive process that involves several different groups of people in an organization. In order to do this effectively, the groups agree to follow a specific software development methodology. Pressure for rapid development and future maintainability of systems has resulted in a number of alternative approaches to systems development, ranging from development by end-users, to the incorporation of formal methods to improve the quality and efficiency of the development process. The following sections review several different methodologies for software development.

7.3. SYSTEMS DEVELOPMENT LIFE CYCLE

The Systems Development Life Cycle (SDLC) was first developed in the 1960s to manage large software projects running on corporate mainframes. This approach to software development is structured and risk averse, designed to manage large projects that include multiple programmers and systems. It requires a clear, upfront understanding of what the software is supposed to do and is not amenable to design changes. This approach is roughly similar to an assembly line process, where it is clear to all stakeholders what the end product should do and that major changes are difficult and costly to implement. The following is the process of the SDLC. Various definitions of the SDLC methodology exist, but most contain the following phases.
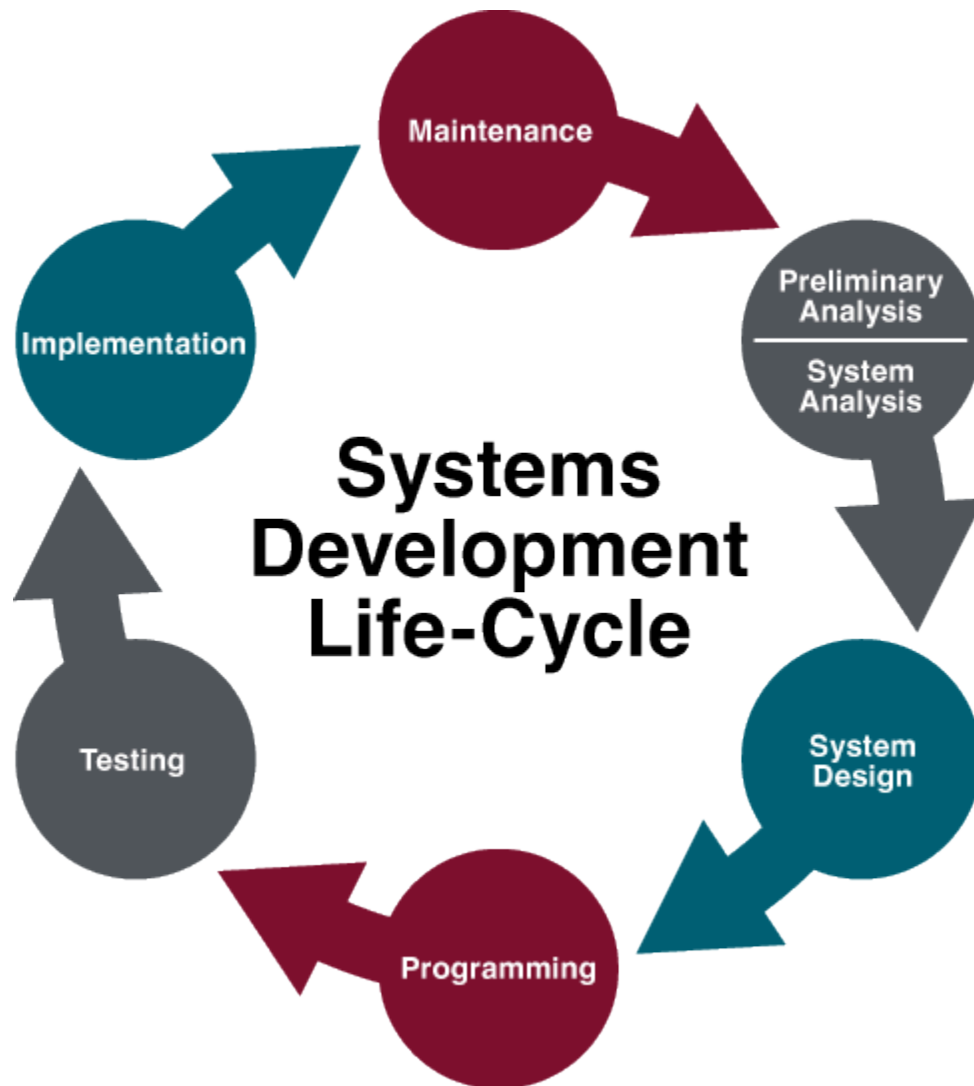
Systems Development Life-Cycle (click to enlarge).

1. ***Preliminary Analysis .*** A request for a replacement or new system is first reviewed. The review includes questions such as: What is the problem-to-be-solved? Is creating a solution possible? What alternatives exist? What is currently being done about it? Is this project a good fit for our organization? This process is referred to as a **needs analysis**. After addressing these questions, a feasibility study is launched (this will be discussed later). This step is important in determining if the project

should be initiated.

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/users are interviewed, and data requirements are developed in order to get an overall impression of exactly what the system is supposed to do. The result of this phase is a system requirements document and may be done by someone with a title of Systems Analyst.

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 needs to actually create the system and may be done by someone with a title of Systems Analyst, Developer, or Systems Architect, based on the scale of the project.

4. ***Programming.*** The code finally gets written in the programming phase. Using the system design document as a guide, programmers develop the software. The result of this phase is an initial working program that meets the requirements specified in the system analysis phase and the design developed in the system design phase. These tasks are done by persons with titles such as Developer, Software Engineer, Programmer, or Coder.

5. ***Testing.*** In the testing phase the software program developed in the programming phase is put through a series of structured tests. The first is a unit test, which evaluates individual parts of the code for errors or bugs. This is followed by a system test in which 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 resolved and then the software is tested again. These tasks are done by persons with titles such as Tester, Testing Analyst, or Quality Assurance.

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 data conversion from the 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 becomes 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 the maintenance phase the system has a structured support process in place. Reported bugs are fixed and requests for new features are evaluated and implemented. Also, system updates and backups of the software are made for each new version of the program. Since maintenance is normally an Operating Expense (OPEX) while much of development is a Capital Expense (CAPEX), funds normally come out of different budgets or cost centers.

The following table summarizes the important tasks in the stages of the SDLC and highlights the main deliverables from each task.

Stage	Tasks	Deliverables
Preliminary Analysis	Problem Definition Scope and Objectives Data Gathering Risk Assessment Feasibility Analysis	Project Charter Feasibility Study
Systems Analysis	Data Gathering Systems Modeling User Requirements Definition	User Requirements Specification
Systems Design	Make or Buy Decision Physical Systems Design Technical Design	Detailed Systems Specification
Programming & Testing	Programming and testing Platform Implementation	Production System
Systems Implementation	User Training Data Conversion Systems Conversion Post-Implementation Review	Live System
Systems Maintenance	Fix system "bugs" System enhancement	Working System

The SDLC methodology is sometimes called 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 when to move to the next step. This methodology has been criticized for being quite rigid, allowing movement in only one direction, namely, forward in the cycle. 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. Other development approaches are explored in the next section.

7.4. OTHER DEVELOPMENT METHODS

Rapid Application Development

Rapid Application Development (RAD) 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 is determined.
2. ***User Design.*** In the user design phase representatives of the users work with the system analysts, designers, and programmers to interactively create the design of the system. Sometimes a **Joint Application Development (JAD)** session is used to facilitate working with all of these various stakeholders. A JAD session brings all of the stakeholders for a structured discussion about the design of the system. Application developers also participate 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 through an interactive process. Changes can be made as developers work on the program. This step is executed in parallel with the User Design step in an iterative fashion, making modifications until an acceptable version of the product is developed.
4. ***Cutover***. Cutover involves switching from the old system to the new software. Timing of the cutover phase is crucial and is usually done when there is low activity. For example, IT systems in higher education undergo many changes and upgrades during the summer or between fall semester and spring semester. Approaches to the migration from the old to the new system vary between organizations. Some prefer to simply start the new software and terminate use of the old software. Others choose to use an incremental cutover, bringing one part online at a time. A cutover to a new accounting system may be done one module at a time such as general ledger first, then payroll, followed by accounts receivable, etc. until all modules have been implemented. A third approach is to run both the old and new systems in parallel, comparing results daily to confirm the new system is accurate and dependable. A more thorough discussion of implementation strategies appears near the end of this chapter.
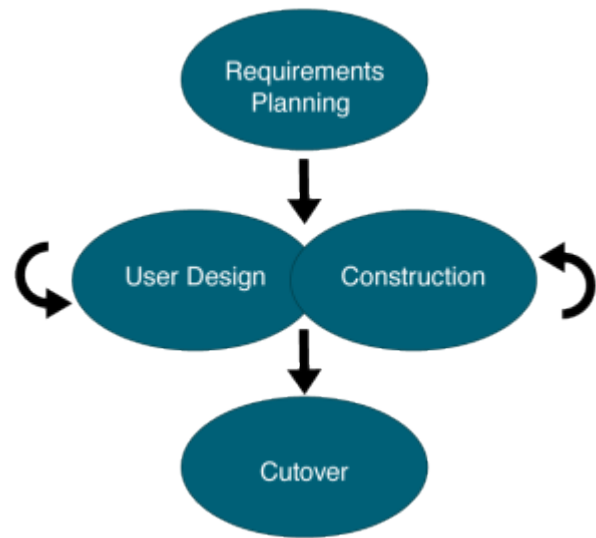
As you can see, the RAD methodology is much more compressed than SDLC. Many of the SDLC steps are combined and the focus is on user participation and iteration. This methodology is much better suited for smaller projects than SDLC and has the added advantage of giving users the ability to provide feedback 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, the two methodologies share some of the same principles such as iterative development, user interaction, and flexibility to change. The agile methodologies are based on the "Agile Manifesto" first released in 2001.
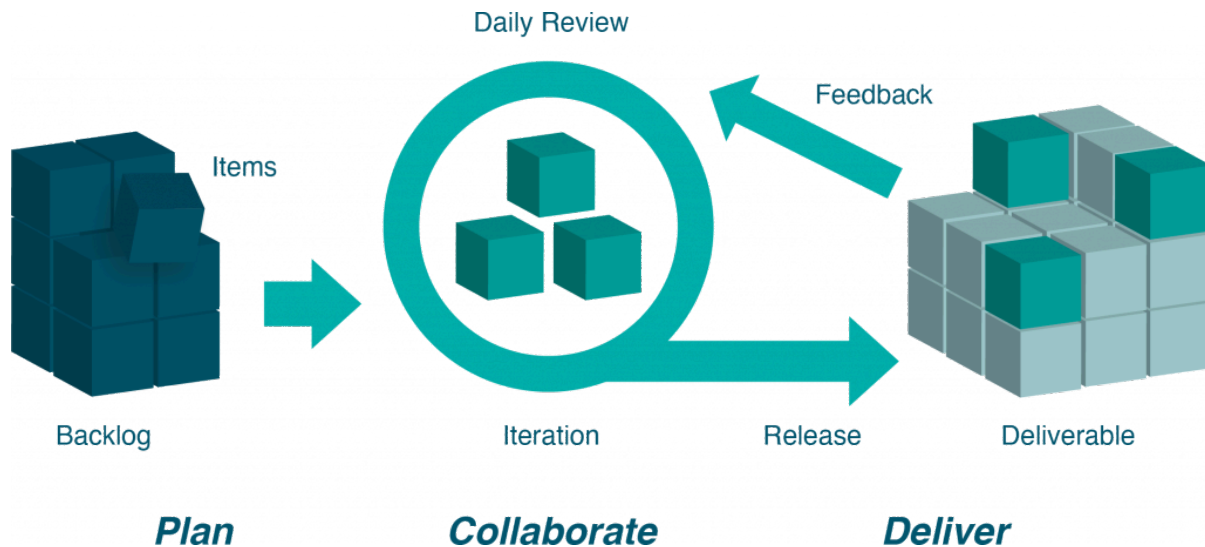
Agile Project Management (click to enlarge).Adapted from D. Bourgeois CC-BY-NC

Agile and Iterative Development

The diagram above emphasizes iterations in the center of agile development. You should notice how the building blocks of the developing system move from left to right, a block at a time, not the entire project. Blocks that are not acceptable are returned through feedback and the developers make the needed modifications. Finally, notice the Daily Review at the top of the diagram. Agile Development means constant evaluation by both developers and customers (notice the term "Collaboration") of each day's work.

The characteristics of agile methodology 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
- Working project at the end of each iteration which demonstrates progress to the stakeholders.

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

Lean Methodology
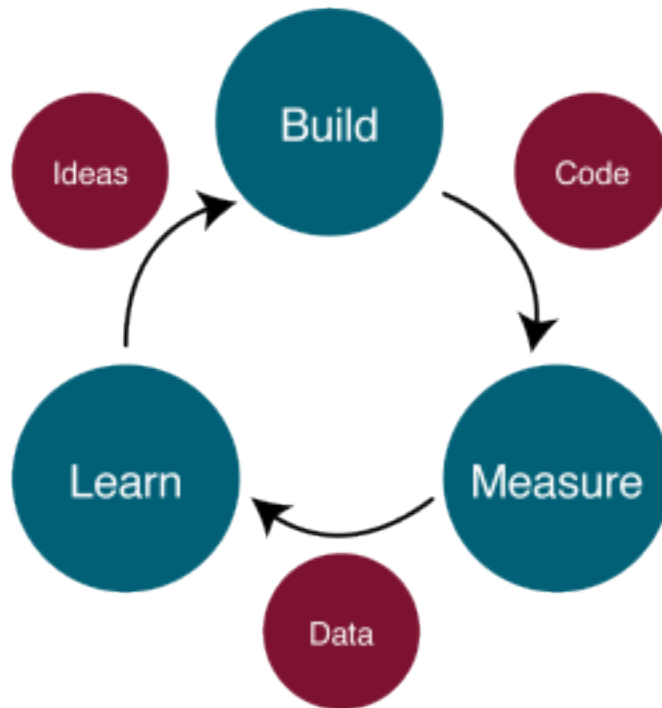
One last methodology to discuss is a relatively new concept taken from the business bestseller *The Lean Startup* by Eric Reis. Lean focuses on taking an initial idea and developing a Minimum Viable Product (MVP). The MVP is a working software application with just enough functionality to demonstrate the idea behind the project. Once the MVP is developed, the development team gives it to potential users for review. Feedback on the MVP is generated in two forms.

First, direct observation and discussion with the users and second, 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 iterative and non-iterative 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 program is worth developing.

The table below provides a comparison of the four methods: SDLC, Rapid Application, Agile and Lean.

Characteristic	SDLC	RAD	Agile	Lean
Overall Flow	Structured	Structured	Incremental	Minimalist
Analysis	Methodical	Methodical	Iterative	Iterative
Design	Methodical	Interactive	Iterative	Iterative
Development	Sequential	Interactive	Iterative	Iterative
Testing	Follows Development	Combined with Development	Combined with Development	Combined with Development

End-User Computing (EUC)

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 applications are not necessarily trained in programming or application development, but they tend to be adept with computers. A person who is skilled in a particular program, such as a spreadsheet or database package, may be called upon to build smaller applications for use by their 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 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. End-user 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.

End-user computing can be beneficial to an organization providing it is managed. The IT department should set guidelines and provide tools for the departments who want to create their own solutions. Communication between departments can go a long way towards successful use of end-user computing.

7.5. FEASIBILITY

Regardless of the development method, the scope and objectives of the new system should be investigated to determine feasibility. New applications normally originate from end-user requests and are weighed against the other requests for information systems resources before approval to develop the system is granted. At this preliminary stage an analyst or small project team is authorized to investigate the real potential of the new idea. During this brief study the analyst must investigate the problem and the existing system sufficiently to be able to identify the true extent and purpose of the new application.

In order to ensure that the new system would be of greater benefit to the organization than other competing requests for proposals, a feasibility study must be performed covering the following three major areas:

Economic feasibility:	to measure the costs and benefits of the new system.
Technical feasibility:	to ensure that the organization has sufficient hardware, software and personnel resources to develop and support the proposed system.
Operational feasibility:	the willingness and ability of management, users and information systems staff in the organization to build and use the proposed system.

Issues such as the size and complexity of the new system and the skills and availability of user and IS staff, will determine the level of potential risk to the organization in developing the system. The output from this preliminary investigation is a statement of scope and objectives (often termed the **project charter**) together with a **feasibility report**. This document is submitted to management where a decision is made as to whether or not the development project should continue.

The Quality Triangle

The quality triangle (click to enlarge). Adapted from D. Bourgeois CC-BY-NC

When developing software or any sort of product or service, a tension exists between the developers and the different stakeholder groups such as management, users, and investors. This tension relates to how quickly the software can be developed (time), how much money will be spent (cost), and how well it will be built (quality). The quality triangle is a simple concept. It states that for any product or service being developed, you can only address two of the following: time, cost, and quality.

So why can only two of the three factors in the triangle be considered? Because each of these three components are in competition with each other! If you are willing and able to spend a lot of money, then a project can be completed quickly with high quality results because you can provide more resources towards its development. If a project's completion date is not a priority, then it can be completed at a lower cost with higher quality results using a smaller team with fewer resources. Of course, these are just generalizations, and different

projects may not fit this model perfectly. But overall, this model is designed to help you understand the trade-offs that must be made when you are developing new products and services.

There are other, fundamental reasons why low-cost, high-quality projects done quickly are so difficult to achieve.

1. The human mind is analog and the machines the software runs on are digital. These are completely different natures that depend upon context and nuance versus being a 1 or a 0. Things that seem obvious to the human mind are not so obvious when forced into a 1 or 0 binary choice.
2. Human beings leave their imprints on the applications or systems they design. This is best summed up by Conway's Law (1968) – "Organizations that design information systems are constrained to do so in a way that mirrors their internal communication processes"(Conway, 1968). Organizations with poor communication processes will find it very difficult to communicate requirements and priorities, especially for projects at the enterprise level (i.e., that affect the whole organization).

7.6. DESIGN

The key to successful information systems is good design. Different people use the word design in different contexts. When information systems professionals speak of design, they are referring to business processes. Problems must be analyzed and requirements documented before solutions are designed, developed, and implemented. After all if the design does not satisfy the business need, then what's the point? However, satisfying the business need is really a baseline standard. The following characteristics should be considered in the design process.

- **Usability** describes how easy the system is to navigate. The easier the system is to navigate, the less time a user will need to spend learning to use the system. A more usable system also leaves less room for error. Usability theory provides rules of thumb (heuristics) that document best practice conventions for designing a user interface. Amazon.com has one of the most usable online systems because they follow established conventions. Following conventions tremendously increases the potential acceptance of your website or app.
- **Graphic design** refers to the visual appeal and organization of the user interface. There is obviously some overlap here with usability. Usable systems typically adhere to at least some graphic design rules. However, a usable system could be bland and uninteresting. Employing graphic design principles helps ensure that the system will have visual appeal. Designs also need to fit with the overall brand of the client. Existing colors, fonts, and logos are all a part of the brand for which the system is being created.
- **Analytical Design** describes how to best represent information—especially quantitative information—to communicate clearly and truthfully. Every information systems project has quantitative dimensions associated with project management. These include estimating costs, time schedules, and so forth.

7.7. BUILDING A MOBILE APP

In many ways building an application for a mobile device is exactly the same as building an application for a traditional computer. Understanding the requirements for the application, designing the interface, and working with users are all steps that still need to be carried out. So what's different about building an application for a mobile device? There are five primary differences:

1. **Breakthroughs in component technologies.** Mobile devices require multiple components that are not only smaller but more energy-efficient than those in full-size computers (laptops or desktops). For example, low-power CPUs combined with longer-life batteries, touchscreens, and Wi-Fi enable very efficient computing on a phone, which needs to do much less actual processing than their full-size counterparts.
2. **Sensors have unlocked the notion of context.** The combination of sensors like GPS, gyroscopes, and cameras enables devices to be aware of things like time, location, velocity, direction, altitude, attitude, and temperature. Location in particular provides a host of benefits.
3. **Simple, purpose-built, task-oriented apps are easy to use.** Mobile apps are much narrower in scope than enterprise software and therefore easier to use. Likewise, they need to be intuitive and not require any training.
4. **Immediate access to data extends the value proposition.** In addition to the app providing a simpler interface on the front end, cloud-based data services provide access to data in near real-time, from virtually anywhere (e.g., banking, travel, driving directions, and investing). Having access to the cloud is needed to keep mobile device size and power use down.
5. **App stores have simplified acquisition.** Developing, acquiring, and managing apps has been revolutionized by app stores such as Apple's App Store and Google Play. Standardized development processes and app requirements allow developers outside Apple and Google to create new apps with a built-in distribution channel. Average low app prices (including many of which that are free) has fueled demand.

In summary, the differences between building a mobile app and other types of software development look like this:

Component Technologies	Sensors	Apps	Cloud	Stores
Lower Power CPU Batteries Touchscreens Wi-FI	Unlock notion of context: -time -Location -Velocity -Direction -Altitude -Temperature	Simple Purpose-built	External Processing Data Access	Simpler to build Easy to buy

Building a mobile app for both iOS and Android operating systems is known as **cross platform development**. There are a number of third-party toolkits available for creating your app. Many will convert existing code such as HTML5, JavaScript, Ruby, C++, etc. However, if your app requires sophisticated programming, a cross platform developer kit may not meet your needs.

Responsive Web Design
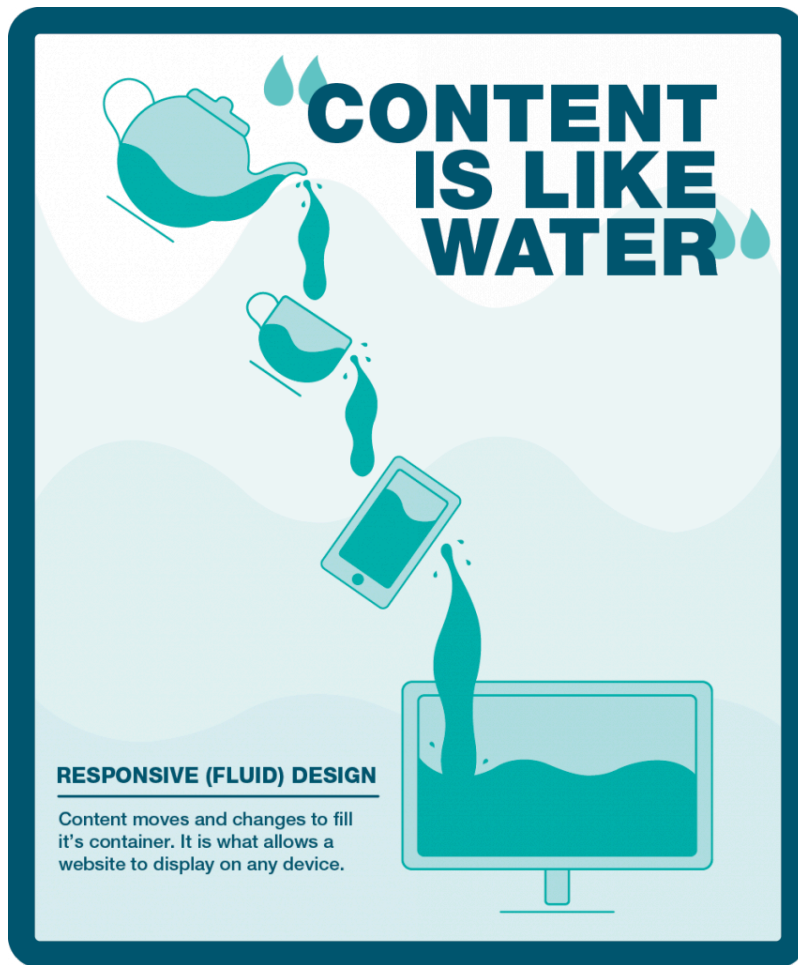
Responsive (fluid) design: content moves and changes to fill its container. It is what allows a website to display on any device.

Responsive Web Design (RWD) focuses on making web pages render well on every device, such as desktops, laptops, tablets, and smartphones. Through the concept of fluid layout, RWD automatically adjusts the content to the device on which it is being viewed. You can find out more about responsive design here.

"Chapter 10: Information Systems Development" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

7.8. PROGRAMMING

Software is created via programming, as discussed in Chapter 4. **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 developer takes the design and encodes it into a programming language which then runs on the computer. A **programming language** is an artificial language that provides a way for a developer to create programming code to communicate logic in a format that can be executed by the computer hardware. Over the past few decades, many different types of programming languages have evolved to meet a variety of needs. One way to characterize programming languages is by their "generation."

Generations of Programming Languages

Early languages were specific to the type of hardware that had to be programmed. Each type of computer hardware had a different low level programming language. In those early languages very specific instructions had to be entered line by line – a tedious process.

First generation languages were called *machine code* because programming was done in the format the machine/computer could read. So programming was done by directly setting actual ones and zeroes (the bits) in the program using binary code. Here is an example program that adds 1234 and 4321 using machine language:

```
10111001 00000000
11010010 10100001
00000100 00000000
10001001 00000000
00001110 10001011
00000000 00011110
00000000 00011110
```

```
00000000 00000010
10111001 00000000
11100001 00000011
00010000 11000011
10001001 10100011
00001110 00000100
00000010 00000000
```

Assembly language is the **second generation** language and uses English-like phrases rather than machine-code instructions, making it easier to program. An assembly language program must be run through an assembler, which converts it into machine code. Here is a sample program that adds 1234 and 4321 using assembly language.

```
MOV CX,1234
MOV DS:[0],CX
MOV CX,4321
MOV AX,DS:[0]
MOV BX,DS:[2]
ADD AX,BX
MOV DS:[4],AX
```

Third-generation languages are not specific to the type of hardware on which they run and are similar to spoken languages. Most third generation languages must be compiled. The developer writes the program in a form known generically as *source code*, then the compiler converts the source code into machine code, producing an executable file. Well-known third generation languages include BASIC, C, Python, and Java. Here is an example using BASIC:

```
A=1234
B=4321
C=A+B
END
```

Fourth generation languages are a class of programming tools that enable fast application development using intuitive interfaces and environments. Many times a fourth generation language has a very specific purpose, such as database interaction or report-writing. These tools can be used by those with very little formal training in programming and allow for the quick development of applications and/or functionality. Examples of fourth-generation languages include: Clipper, FOCUS, SQL, and SPSS.

Why would anyone want to program in a lower level language when they require so much more work? The answer is similar to why some prefer to drive manual transmission vehicles instead of automatic transmission, namely, control and efficiency. Lower level languages, such as assembly language, are much more efficient and execute much more quickly. The developer has finer control over the hardware as well. Sometimes a combination of higher and lower level languages is mixed together to get the best of both worlds. The programmer can create the overall structure and interface using a higher level language but use lower level languages for the parts of the program that are used many times, require more precision, or need greater speed.

Low-level languages	High-level languages
Machine-dependant	Machine-independent

Machine Language	Third-generation languages (C, Basics, C++, Java)	Fourth-generation languages (SQL, ABAP, ColdFusion)
Assembly Language		
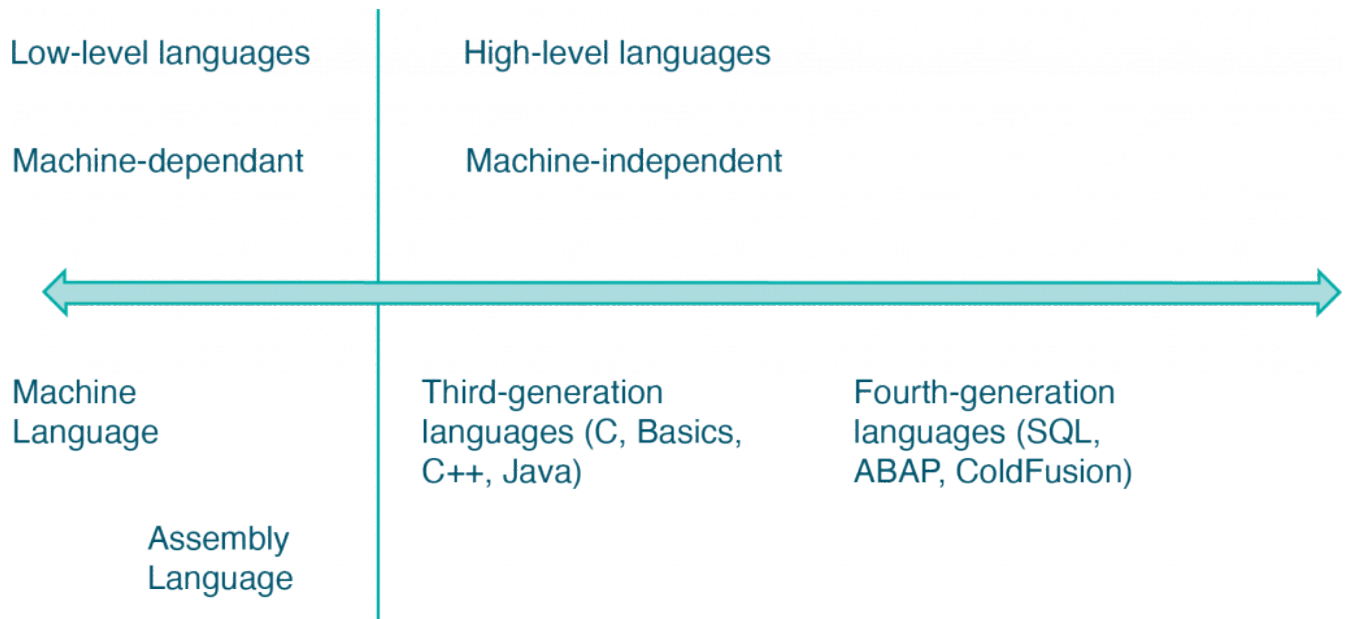
The programming language spectrum (click to enlarge).Adapted from D. Bourgeois CC-BY-NC

Programming Tools

To write a program, you need little more than a text editor and a good idea. However, to be productive you must be able to check the syntax of the code, and, in some cases, compile the code. To be more efficient at programming, additional tools, such as an Integrated Development Environment (IDE) or computer-aided software-engineering (CASE) tools can be used.

Integrated Development Environment

For most programming languages an Integrated Development Environment (IDE) can be used to develop the program. An IDE provides a variety of tools for the programmer, and usually includes:

- **Editor.** An editor is used for writing the program. Commands are automatically color coded by the IDE to identify command types. For example, a programming comment might appear in green and a programming statement might appear in black.
- **Help system.** A help system gives detailed documentation regarding the programming language.
- **Compiler/Interpreter.** The compiler/interpreter converts the programmer's source code into machine language so it can be executed/run on the computer.
- **Debugging tool.** Debugging assists the developer in locating errors and finding solutions.
- **Check-in/check-out mechanism.** This tool allows teams of programmers to work simultaneously on a program without overwriting another programmer's code.

Examples of IDEs include Microsoft's Visual Studio and Oracle's Eclipse. Visual Studio is the IDE for all of Microsoft's programming languages, including Visual Basic, Visual C++, and Visual C#. Eclipse can be used for Java, C, C++, Perl, Python, R, and many other languages.

CASE Tools

While an IDE provides several tools to assist the programmer in writing the program, the code still must be written. Computer-Aided Software Engineering (CASE) tools allow a designer to develop software with little or no programming. Instead, the CASE tool writes the code for the designer. CASE tools come in many varieties. Their goal is to generate quality code based on input created by the designer.

"Chapter 10: Information Systems Development" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

7.9. BUILD VS. BUY

When an organization decides that a new 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 software than to build it. Second, when software is purchased, it is available much more quickly than if the package is built in-house. Software can take months or years to build. A purchased package can be up and running within a few days. Third, 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 incorporated into 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 software 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 decides to buy software, it still makes sense to go through the same analysis as if it was going to be developed. This is an important decision that could have a long-term strategic impact on the organization.

Web Services

Chapter 4 discussed how the move to cloud computing has allowed software to be viewed as a service. One option, known as web services, allows companies to license functions provided by other companies instead of writing the code themselves. Web services can greatly simplify the addition of functionality to a website.

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, the company can build a Google Map directly into their application. Or a shoe company could make it easier for its retailers to sell shoes online by providing a shoe sizing 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 an application themselves but then purchase functionality from vendors to supplement their system.

7.10. IMPLEMENTATION AND MAINTENANCE

Once a new system is developed or purchased, the organization must determine the best method for implementation. Convincing a group of people to learn and use a new system can be a very difficult process. Asking employees to use new software as well as follow a new business process 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.

- **Direct cutover.** In the direct cutover implementation methodology, the organization selects a particular date to terminate the use of the old system. On that date users begin using the new system and the old system is unavailable. Direct cutover has the advantage of being very fast and the least expensive implementation method. However, this method has the most risk. 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 known as 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. Also, problems with the new software can be contained within the group and then resolved.
- **Parallel operation**. Parallel operations allow both the old and new systems to be 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**. Phased implementation provides for different functions of the new application to be gradually implemented with the corresponding functions being turned off in the old system. This approach is more conservative as it allows an organization to slowly move from one system to another.

Your choice of an implementation methodology depends on the complexity of both the old and new systems. It also depends on the degree of risk you are willing to take.

Change Management

Teamwork via Piqsels CC0 1.0 Universal Public Domain Dedication

As new systems are brought online and old systems are phased out, it becomes important to manage how change is implemented in the organization. Change should never be introduced in a vacuum. The organization should communicate proposed changes before they happen and plan to minimize the impact of the change. Communication should include how the new system will impact workflows and job processes. Employees may have concerns about their job and how their job will change post-implementation. Training should be provided so that employees are comfortable with the new system prior to going live. The change management process is a critical component of IT oversight and can help ensure buy-in from employees and the organization.

Project Outcomes

Technology represents a large investment in time and money for organizations. Information systems represent the largest portion of capital spending at most firms, and an astonishing one in three technology development projects fail to be successfully deployed (Dignan, 2007).

Why such a bad track record? Sometimes technology itself is to blame, other times it's a failure to test systems adequately, and sometimes it's a breakdown of processes and procedures used to set specifications and manage projects. Projects rarely fail for just one reason. Project post-mortems often point to a combination of technical, project management, and business decision blunders.

The most common factors include the following:

- Unrealistic or unclear project goals

- Poor project leadership and weak executive commitment
- Inaccurate estimates of needed resources
- Badly defined system requirements and allowing "feature creep" during development
- Poor reporting of the project's status
- Poor communication among customers, developers, and users
- Use of immature technology
- Unmanaged risks
- Inability to handle the project's complexity
- Sloppy development and testing practices
- Poor project management
- Stakeholder politics
- Commercial pressures (e.g., leaving inadequate time or encouraging corner-cutting)(Charette, 2005).

Managers need to understand the complexity involved in their technology investments and that achieving success rarely lies with the strength of the technology alone. Organizations can work to implement procedures to improve the overall quality of their development practices. Firms are also well served to leverage established project planning and software development methodologies that outline critical business processes and stages when executing large-scale software development projects.

Maintenance

After a new system has been introduced, it enters the maintenance 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. Documentation is key at this stage and others, so there is information to refer to on the changes made. Feedback is important as well in order to drive future development.

"Chapter 10: Information Systems Development" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

7.11. SUMMARY

Key Takeaways

- Software development is about solving business problems.
- Developing new software applications requires several steps, from the formal SDLC process to more informal processes such as agile programming or lean methodologies.
- In end-user computing, software development happens outside the information technology department.
- Conducting a feasibility analysis is important to ensure the new system will be a good investment.
- Programming languages have evolved from very low-level machine-specific languages to higher-level languages that allow a programmer to write software for a wide variety of machines.
- Most programmers work with software development tools to make the software development more efficient.
- Some companies choose to purchase software to save development costs and speed implementation.
- When implementing new software applications, there are several different types of implementation methodologies that must be considered.

Review Questions

1. What is systems development, and what are some of the factors that impact the success of systems projects?
2. Which software-development methodology would be best if an organization needed to develop a software tool for a small group of users in the marketing department? Why?
3. What is the SDLC and why is it referred to as a waterfall approach?
4. What is the result of the planning phase? What is the result of the requirements phase?
5. What should be considered in a feasibility analysis?
6. Why would an organization consider building its own software application if it is cheaper to buy one?
7. What is responsive design?
8. What are some of the considerations that must be taken into account at the implementation phase?
9. Explain some of the different ways a project can be implemented?
10. Why is the maintenance phase so important

11. Some argue that HTML is not a programming language. Doing your own research, find three arguments for why it is not a programming language and three arguments for why it is.
12. Read more about responsive design using the link given in the text. Provide the links to three websites that use responsive design and explain how they demonstrate responsive-design behavior.
13. Why do some development projects fail? What can be done to reduce the risk?

Assignment

Overview

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

7.12. KEY TERMS

Chapter 7

Agile Methodologies : A group of methodologies that utilize incremental changes with a focus on quality and attention to detail. (7.4)

Build vs. Buy Decision: 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. (7.9)

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. (7.10)

End-User Computing: Refers to systems in which nonprogrammers can create working applications. (7.4)

Implementation Methodology – Parallel Operation: The old and new system are used simultaneously for a limited period of time. (7.10)

Implementation Methodology – Direct Cutover : The organization selects a particular date that the old system is not going to be used. On that date, the old system is turned off and the new one is operational. (7.10)

Implementation Methodology – Phased Implementation: Different functions of the new application are implemented in phases, adding functionality as the phases are implemented. (7.10)

Implementation Methodology – Pilot Implementation: A subset of the organization starts using the new system before the rest of the organization. (7.10)

Joint Application Development : A methodology that involves the client or end user in the design and development of an application, through a succession of collaborative workshops called JAD sessions. (7.4)

Lean Methodology: A methodology that focuses on taking an initial idea and developing a minimum viable product (MVP). (7.4)

Maintenance: Making changes, corrections and improvement to a system already in use by a company. (7.3)

Minimum Viable Product (MVP): A working software application with just enough functionality to demonstrate the idea behind the project. (7.4)

Quality Triangle: A model that illustrates the constraints of project management: time,cost, and quality. A manager cannot change one of the constraints without impacting the others. (7.5)

Rapid Application Development: A 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. (7.4)

Systems Development Life Cycle : This methodology developed in the 1960s to manage the large software projects associated with corporate systems running on mainframes. Phases are Preliminary Analysis, Systems Analysis, Systems Design, Programming, Testing, Implementation and Maintenance. (7.3)

Web Services: When companies have the options to license functions provided by other companies instead of writing the code themselves. (7.9)

Adapted from Information Systems for Business and Beyond Glossary by Ruth Guthrie licensed under a CC-BY-3.0

7.13. KNOWLEDGE CHECK

Knowledge Check 1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1791#h5p-74

Knowledge Check 2

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1791#h5p-38

Knowledge Check 3

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1791#h5p-39

Knowledge Check 4

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1791#h5p-47

CHAPTER 8: SECURITY

Chapter Outline

Cybersecurity by Jaydeep CCO

8.1. CHAPTER INTRODUCTION

Learning Outcomes

Upon successful completion of this chapter, you will be able to:

- Discuss the impact of cybercrime in Canada;
- Describe information technologies that are used in computer crimes;
- Explain the major security threats;
- Define the information security triad;
- Discuss the information security tools used in safeguarding computers and networks; and
- Outline the process to secure yourself digitally.

Since computers and other digital devices have become essential to business, they have become increasingly targets for attacks. For a company or an individual to use a computing device with confidence, they must first be assured that the device is not compromised in any way and that all communications are secure. This chapter discusses cybercrime and its impact on Canadian organizations. It also reviews the fundamental concepts of information systems security and discusses some of the measures that can be taken to mitigate security threats. Finally, you will review a list of security precautions that individuals can take in order to secure their personal computing environment.

8.2. CYBERCRIME

Cybercrime (also referred to as computer crime) is an illegal activity that is committed with the use of a computer, or where a computer is the object of the crime. With the increase in use of digital technology by Canadians, so too is the prevalence of digital crimes and the impact of those crimes. According to Accenture's Cost of Cybercrime Survey, Canadian organizations spent $9.25 million on average resolving damage done by cyber attacks (Accenture, 2019). In addition, 21% of Canadian businesses reported that they had been impacted by a cyber security incident in 2019. However, only 12% of businesses impacted by incidents reported them to the police, stating that they could resolve them internally or through a contractor/consultant. Around a third of respondents felt the incidents were too minor to report (Bilodeau, et al., 2019).

Small and medium enterprises (SME) are most likely to face cyber threat activity that often has immediate financial or privacy implications. Canadian businesses are targeted by cyber threat actors for their data about customers, partners and suppliers, financial information and payment systems, and proprietary information. Motivations for the cybercrimes experienced by Canadian businesses vary as can be seen in the image below but ultimately result in either stealing money from a business or selling personal information for money. Cyber security incidents can also result in reputational damage, productivity loss, intellectual property theft, operational disruptions, and recovery expenses (Canadian Centre for Cyber Security, 2021).

Types of cyber security incidents that impacted businesses in Canada
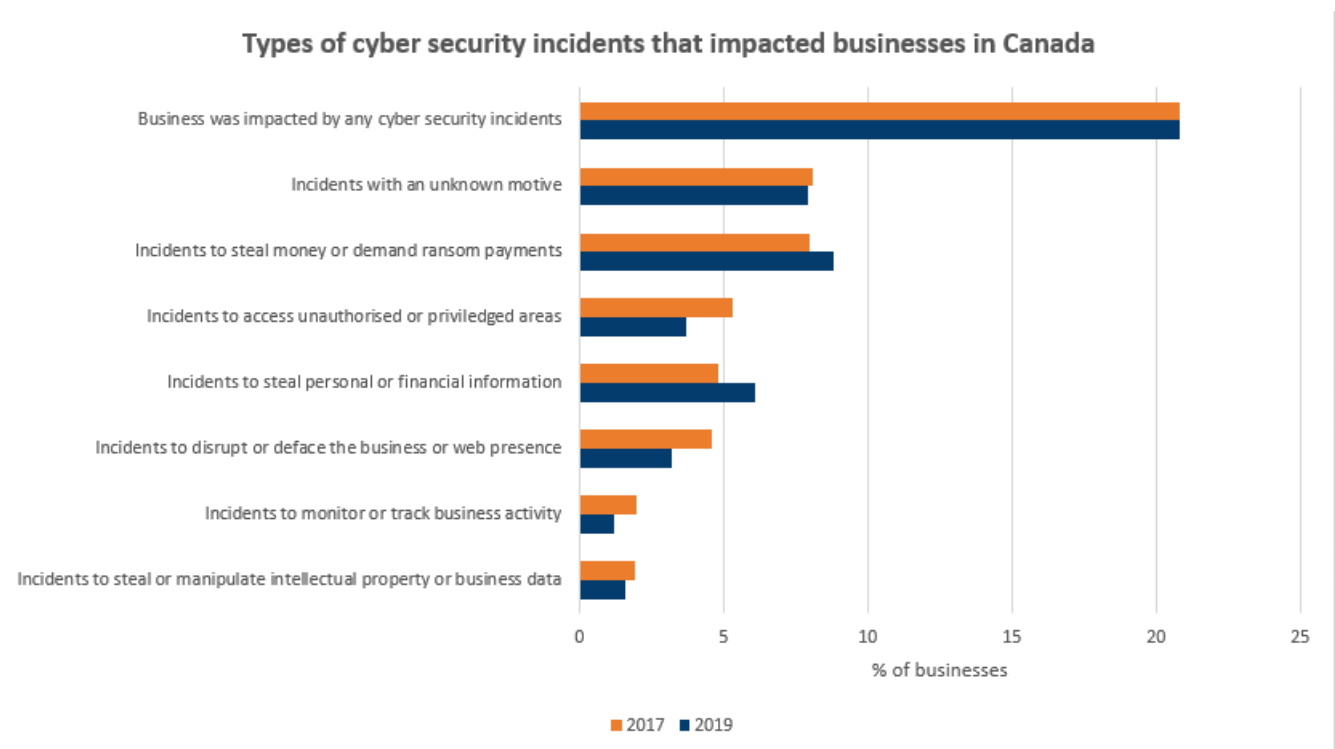
Adapted from Statistics Canada, Types of cyber security incidents that impacted businesses, Canada- October 20, 2020. This does not constitute an endorsement by Statistics Canada of this product. (click to enlarge)

Personal Information Protection

According to Canada's Personal Information Protection of Electronic Documents Act (PIPEDA) private businesses are required to safeguard personal information collected during commercial activity and report breaches to the privacy commissioner and the individuals impacted. For more information refer to the [Office of the Privacy Commission of Canada's website on privacy breaches](#) (Office of the Privacy Commissioner of Canada, 2018). It is important that businesses understand the requirements concerning collecting and storing personal information and investigate ways to safeguard it to minimize the impacts.

Types of Cybercrime

Cybercrime can be categorized based on whether a network or computer technology is the *target of the crime*, or where the technology is *used to commit a crime*. Malware and Denial of Service ("DoS") or Distributed Denial of Service ("DDoS") attacks are examples of where the target is the technology.

Technology as Target of Crime

Malware, which is a short form for malicious software, is any program that is designed to steal or destroy data and systems. Some examples of malware include viruses, worms, spyware, and ransomware.

Viruses and worms	are codes that replicate to destroy data. A virus requires a host in order to spread, such as an executable file, where a worm can spread unaided.
Spyware	is software that gathers data, usually personal, about you and sends it without your knowledge.
Ransomware	is malware that infects a computer and encrypts the data and requires payment (ransom) of the owner in order to access it again.

A **denial-of-service (DoS)** attack does exactly what the term suggests: it prevents a web server from servicing authorized users. Consider the following scenario. Dozens of computers are whirring away at an online bookmaker in the offshore gambling haven of Costa Rica. Suddenly a mass of blank incoming messages floods the company's computers, slowing operations to a trickle. No legitimate customers can get through to place their bets. A few hours later, the owner gets an e-mail that reads, "If you want your computers to stay up and running through the football season, wire $40,000 to each of 10 numbered bank accounts in Eastern Europe."

The choice of a gambling site for this example is deliberate. Many companies in the online gambling industry suffer hundreds of such attacks each year (Baker & Grow, 2004). Most gambling operations are willing to pay the ransom and return to business as usual, so denial of service to businesses in this industry has become very lucrative. Online gambling operations are good targets because they're illegal, and they cannot get help from law-enforcement authorities. However, extortionists have been known to hit other targets, including Microsoft and the Recording Industry Association of America. The problem could become more serious if they start going after e-commerce companies and others that depend on incoming orders to stay afloat.

A **DDoS** is when multiple computers send requests so that the service crashes.

Technology Used to Commit Crime

Identity theft, social engineering, hacking, phishing, spoofing, and software piracy are all examples of crimes that are facilitated with the aid of computer technology.

Identity theft is when a criminal gains access to your personal information and uses it without your knowledge.

Social engineering is when criminals lure individuals into sending them personal, confidential data that can be used in crime. For example, someone phones you, posing as a customer service representative asking for your banking log-on information.

Hacking is when someone accesses a computer without permission.

Phishing occurs when a user receives an e-mail that looks as if it is from a trusted source, such as their bank or employer. In the e-mail the user is asked to click a link and log in to a website that mimics the genuine website, then enter their ID and password. The userID and password are then captured by the attacker. See an example of a phishing email in the image below.
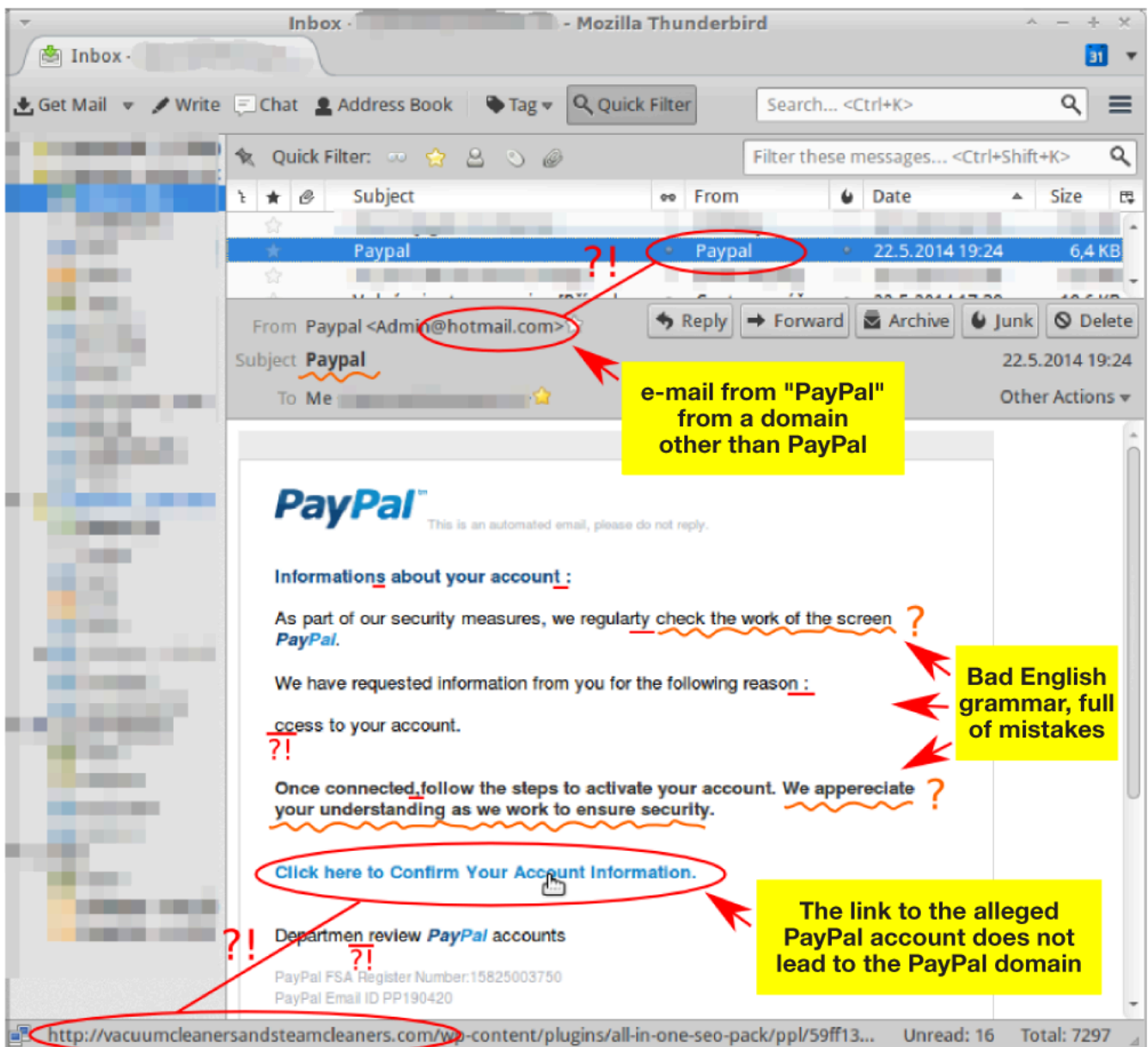
["Phishing email example"](#) with an explanation (click to enlarge). Adapted from Crysman [CC0 1.0](#)

Spoofing is a technique where culprits disguise their identities by modifying the address of the computer from which the scheme has been launched. Typically, the point is to make it look as if an incoming message has originated from an authorized source. Then, once the site's been accessed, the perpetrator can commit fraud, spy, or destroy data. You could, for example, spoof a manufacturing firm with a false sales order that seems to have come from a legitimate customer. If the spoof goes undetected, the manufacturer will incur the costs of producing and delivering products that were never ordered (and will certainly never be paid for).

Piracy

Another crime that is committed with the use of a computer is software piracy, which is the illegal copying and distribution or use of software. Technology makes it easier to create and sell intellectual property, but it also makes it easier to steal it. Since digital products can be downloaded and copied almost instantly over the Internet, it's a simple task to make perfect replicas of your favourite copyright-protected songs, movies, TV shows, and computer software, whether for personal use or further distribution. When you

steal such materials, you're cheating the countless musicians, technicians, actors, programmers, and others involved in creating and selling them. Theft cuts into sales and shrinks corporate profits, often by staggering amounts. Online piracy costs between $30 and $71 billion dollars in lost revenue in a year worldwide (Whitten, 2021).

"Online Security" by the Learning Portal is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

8.3. THE INFORMATION SECURITY TRIAD

The previous section highlighted the motivations and impact of cybercrime on Canadian businesses. It is important for companies to invest in tools, and policies to help mitigate the risk of cybercrime. The Information Security Triad or CIA Triad is a model that can be used to help in the development of security policies. It contains three main components: confidentiality, integrity and availability.

Security Triad (click to enlarge). Adapted from D. Bourgeois CC-BY-NC

Confidentiality

Protecting information means you want to be able to restrict access to those who are allowed to see it. This is sometimes referred to as NTK, (Need to Know). Everyone else should be disallowed from learning anything about its contents. This is the essence of **confidentiality**.

Integrity

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 student's 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.

Availability

Information **availability** is the third part of the CIA triad. Availability means 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 sales person may be happy to get sales numbers for the day in a report the next morning. Online retailers 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.

"Chapter 6: Information Systems Security" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

8.4. TOOLS FOR SECURITY

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. The tools can be categorized as either, authentication, prevention or detection.

Information Security Tools

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.

Something They Know

Passwords	The most common form of authentication today is the user ID and password. Authentication is done by confirming something that the user knows (their ID and password). This form of authentication is easy to compromise.
Out of Wallet (OOW) Questions	Questions that can be asked of the user to authenticate their identity. OOW questions should be easy to answer by the user but not by anyone else. This makes them ideal for the authentication process. An example might be – what is the name of your first pet?

Something They Have

Tokens	Means identifying someone by something they have, such as a key or a card. This can also be problematic as the token can be lost or stolen, making it easy to steal the identity.

Something They Are

Biometrics	This factor identifies a user through the use of a physical characteristic, such as a retinal scan, fingerprint, or facial geometry. This is much harder to compromise.

Multi-factor Identification

A more secure way to authenticate a user is through 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 it generates a new access code every sixty seconds. To log in to an information resource using the RSA device, you combine something you know, such as 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.

RSA Secure ID Token adapted from D. Bourgeois CC-BY-NC

8.5. PREVENTION

There are a number of ways to prevent unauthorized access, or loss including: access controls, encryption, firewalls, antivirus programs, and backups.

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. Two of the more common are: the Access Control List (ACL) and Role-Based Access Control (RBAC).

An information security employee can produce an **ACL** which identifies a list of users who have the capability to take specific actions with an information resource such as data files. Specific permissions are assigned to each user such as read, write, delete, or add. Only users with those permissions are allowed to perform those functions.

ACLs are simple to understand and maintain, but there are 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.

The following image shows an ACL with permissions granted to individual users. RBAC allows permissions to be assigned to roles, as shown in the middle grid, and then in the third grid each user is assigned a role. Although not modeled in the image, each user can have multiple roles such as Reader and Editor.

Access Control List

User	Read	Write	Add	Delete
jsmith	X			
rlee	X			
knguyen	X	X	X	X
mroberts	X	X		
manderson	X	X		

Role-Based Access Control

Role	Read	Write	Add	Delete
Reader	X			
Editor	X	X		
Administrator	X	X	X	X

Role Assignments

User	Role
jsmith	Reader
rlee	Reader
knguyen	Admin
mroberts	Editor
manderson	Editor
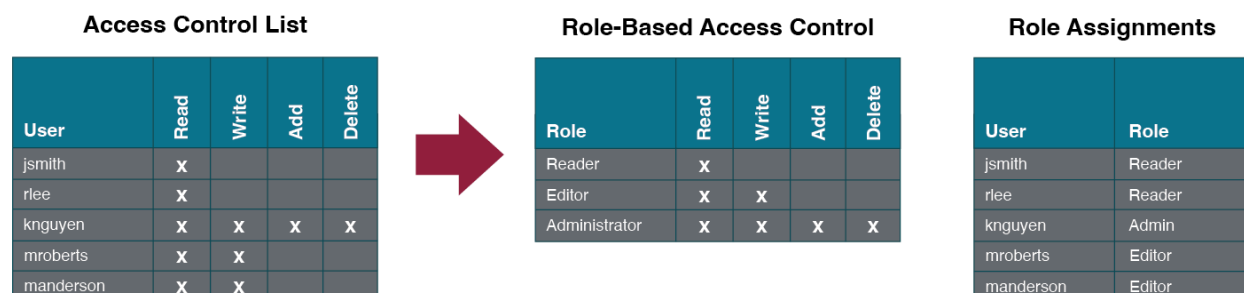
Comparison of ACL and RBAC (click to enlarge). Adapted from D. Bourgeois CC-BY-NC

Encryption

Many times an organization needs to transmit information over the Internet or transfer it on external media such as a flash drive. In

these cases, even with proper authentication and access control, it is possible for an unauthorized person to gain access to the data. **Encryption** scrambles data so that it is unreadable to those without a public key, which unlocks or decrypts the data. This is referred to as **symmetric key encryption** where both parties share the encryption key. Encryption makes information secure as the message is sent in code and appears to those without the public key as a random series of letters and numbers.

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 their 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 a message sent with the public key.

Notice in the image how the sender on the left creates a plaintext message which is then encrypted with a public key. The ciphered text is transmitted through the communication channel and the recipient uses their private key to decrypt the message and then read the plain text.

Public Key Encryption Example
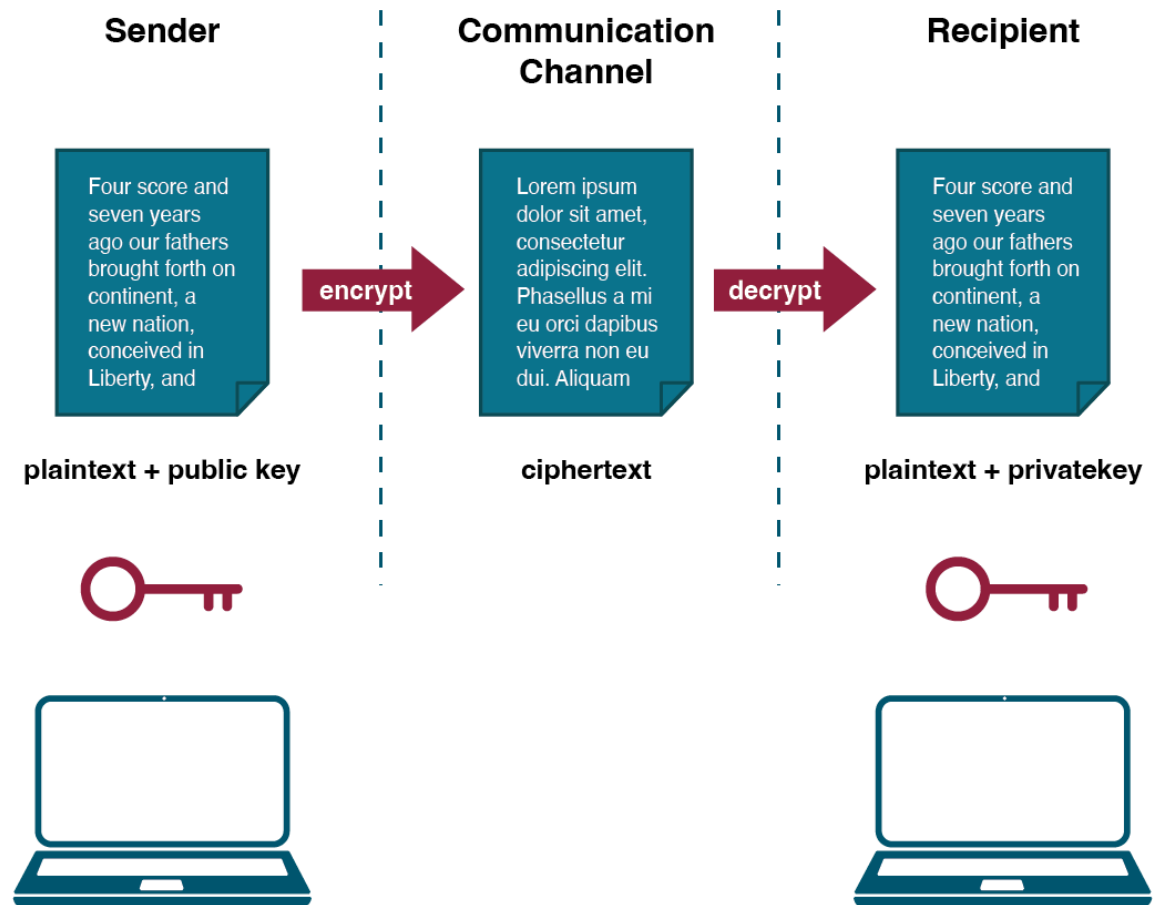
Public Key Encryption – The ciphered text is transmitted through the communication channel and the recipient uses their private key to decrypt the message and then read the plain text. (click to enlarge). Adapted from D. Bourgeois CC-BY-NC
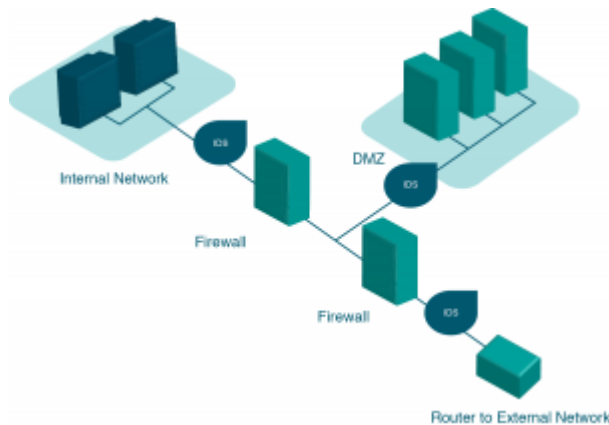
Firewalls

Network Configuration Diagram with firewalls, a router, and a DMZ (click to enlarge).Adapted from D. Bourgeois CC-BY-NC

Firewalls are another method that an organization can use for increasing security on its network. 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. One example of these rules would be preventing packets entering the local network that come from unauthorized users. A software firewall runs on the operating system and intercepts packets as they arrive at 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. A VPN allows a user who is outside of a corporate network to take a detour around the firewall and access the internal network from the outside. Through a combination of software and security measures, a VPN provides off-site access to the organization's network while ensuring overall security.

Anti-virus Programs

Antivirus programs are software that can be installed on a computer or network to detect and remove known malicious programs like viruses, and spyware. While antivirus programs provide some protection they are a reactive defense in that they must first understand what to look for.

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.

- **Full understanding of the organization's 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 to 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. Most large organizations today use data redundancy so their records are always backed up.
- **Offsite storage of backup data sets.** If all backed-up 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 destroy both the original data and the backup. It is essential the backup plan includes storing the data in an offsite location.
- **Test of data restoration**. Backups should be tested on a regular basis by having test data deleted then restored from backup. 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:

- **Uninterruptible Power Supply (UPS)**. A UPS 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 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 (SAN) and archival systems are now used by most large businesses for data backup.

8.6. DETECTION AND SECURITY POLICIES

Intrusion Detection Systems
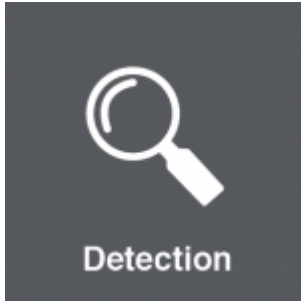
Intrusion Detection Systems (IDS) can be placed on the network for security purposes. An IDS does not add any additional security. Instead, it provides the capability to identify if the network is being attacked. An IDS can be configured to watch for specific types of activities and then alert security personnel if that activity occurs. An IDS also can log various types of traffic on the network for analysis later. It is an essential part of any good security system.

Physical Security

An organization can implement the best authentication scheme in the world, develop superior access control, and install firewalls and intrusion detection, 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 exceed acceptable ranges.
- **Employee training**. One of the most common ways thieves steal corporate information is the theft of 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 event that an employee violates a policy. A security policy should also address any governmental or industry regulations that apply to the organization. The Canadian Centre for Cyber Security has outlined Baseline Cyber Security Controls for Small and Medium Organizations.

Acceptable Use Policy

Many organizations that provide technology services to a group of constituents or the public require agreement to an Acceptable Use Policy (AUP) before those services can be accessed. This policy outlines what is allowed and what is not allowed while someone is using the organization's services. An everyday example is the terms of service that must be agreed to before using public Wi-Fi at Starbucks, McDonald's, or even a university. Acceptable use policies vary from institution to institution and can include acceptable use guidelines for social media, email, and ethical computer use.

Just as with a code of ethics, these acceptable use policies specify what is allowed and what is not allowed. Again, while some of the items listed are obvious to most, others are not so obvious:

- "Borrowing" someone else's login ID and password is prohibited.
- Using the provided access for commercial purposes, such as hosting your own business website, is not allowed.
- Sending out unsolicited email to a large group of people is prohibited.

As with codes of ethics, violations of these policies have various consequences. In most cases, such as with Wi-Fi, violating the acceptable use policy will mean that you will lose your access to the resource. While losing access to Wi-Fi at Starbucks may not have a lasting impact, a university student getting banned from the university's Wi-Fi (or possibly all network resources) could have a large impact.

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. Consider 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 6: Information Systems Security" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

8.7. INFORMATION SECURITY

As a final topic for this chapter, consider what measures each of us, as individual users, and businesses can take to secure computing technologies. There is no way to have 100% security, but there are several simple steps each individual, or business can take to be more secure.

For Businesses

A National Cyber Security Strategy was developed, as a result of the 2018 National Cyber Threat Assessment, for businesses to improve their resiliency through investment and actions in cyber security. The comprehensive strategy outlines thirteen baseline controls that should be deployed with more details on each control.

1. Develop an incident response plan
2. Keep Operating Systems and Applications up to date
3. Enable Security Software
4. Securely Configure Devices
5. Use Strong User Authentication
6. Provide Employee Awareness Training
7. Back up and Encrypt Data
8. Secure Mobile Devices
9. Implement Firewalls, VPNs and other Perimeter Defences
10. Secure Cloud and Outsourced IT Services
11. Secure Websites
12. Implement Access Control and Authorization
13. Secure Portable Media

(Government of Canada, 2020).

For Individuals

- **Keep your software up to date**. Whenever a software vendor determines that a security flaw has been found in their software, an update will be released so you can download the patch to fix the problem. You should turn on automatic updating on your computer to automate this process.
- **Install antivirus software and keep it up to date**. There are many good antivirus software packages on the market today, including some that are free.
- **Be smart about your connections.** You should be aware of your surroundings. When connecting to a Wi-Fi network in a public place, be aware that you could be at risk of being spied on by others sharing that network. It is advisable not to access your financial or personal data while attached to a Wi-Fi hotspot. You should also be aware that connecting USB flash drives to your device could also put you at risk. Do not attach an unfamiliar flash drive to your device unless you can scan it first with your security software.
- **Backup your data.** Just as organizations need to backup their data, individuals need to so as well. The same rules apply.

Namely, do it regularly and keep a copy of it in another location. One simple solution for this is to set up an account with an online backup service to automate your backups.

- **Secure your accounts with two-factor authentication**. Most e-mail and social media providers now have a two-factor authentication option. When you log in to your account from an unfamiliar computer for the first time, it sends you a text message with a code that you must enter to confirm that you are really you. This means that no one else can log in to your accounts without knowing your password and having your mobile phone with them.
- **Make your passwords long, strong, and unique**. Your personal passwords should follow the same rules that are recommended for organizations. Your passwords should be long (at least 12 random characters) and contain at least two of the following: uppercase and lowercase letters, digits, and special characters. Passwords should not include words that could be tied to your personal information, such as the name of your pet. You also should use different passwords for different accounts, so that if someone steals your password for one account, they still are locked out of your other accounts.
- **Be suspicious of strange links and attachments**. When you receive an e-mail, tweet, or Facebook post, be suspicious of any links or attachments included there. Do not click on the link directly if you are at all suspicious. Instead, if you want to access the website, find it yourself with your browser and navigate to it directly.

You can find more about these steps and many other ways to be secure with your computing by going to Get Cyber Safe.

A Note on Password Security

So why is using just a simple user ID and password not considered a secure method of authentication? It turns out that this single-factor authentication is extremely easy to compromise. Good password policies must be put in place in order to ensure that passwords cannot be compromised. Below are some of the more common policies that organizations should use.

- **Require complex passwords**. One reason passwords are compromised is that they can be easily guessed. A password should not be simple, or a word that can be found in a dictionary. Hackers first attempt to crack a password by testing every term in the dictionary. Instead, a good password policy should require the use of a minimum of eight characters, at least one upper-case letter, one special character, and one digit.

- **Change passwords regularly**. It is essential that users change their passwords on a regular basis. Also, passwords may not be reused. Users should change their passwords every sixty to ninety days, ensuring that any passwords that might have been stolen or guessed will not be able to be used against the company.
- **Train employees not to give away passwords**. One of the primary methods used to steal passwords is to simply figure them out by asking the users for their password. Pretexting occurs when an attacker calls a helpdesk or security administrator and pretends to be a particular authorized user having trouble logging in. Then, by providing some personal information about the authorized user, the attacker convinces the security person to reset the password and tell him what it is.

For Individuals adapted from "Chapter 6: Information Systems Security" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

8.8. SUMMARY

Key Takeaways

- As computing and networking resources have become more an integral part of business, they have also become a target of criminals.
- Cybercrime is an illegal activity that is committed with the use of a computer, or where a computer is the object of the crime
- The CIA triangle is composed of: confidentiality, integrity and availability. It is important to consider when developing security policies or considering security tools.
- Tools for security can be categorized as authentication, prevention or detection tools.
- Authentication can be accomplished by identifying someone through one or more of three factors: something they know, something they have, or something they are.
- Passwords are something they know, tokens are something they have, and biometrics are something they are.
- Prevention of unauthorized access, or loss can be accomplished through the use of: access controls, encryption, firewalls, antivirus programs, and backups.
- Detection can be accomplished through the use of: intrusion detection systems and physical security.
- A good information security policy lays out the guidelines for employee use of the information resources and recourse in the event that an employee violates a policy.
- There is no way to ensure 100% security, but steps can be taken to be more secure.

Review Questions

1. What are some of the risks when using technology?
2. Why is computer crime on the rise?
3. Why do companies not contact law enforcement when they experience a breach?
4. What are some different types of malware?
5. How is technology used to commit a crime?
6. Explain the difference between phishing and spoofing and provide an example of each.
7. What is the CIA triangle?

8. What are some different types of security measures that can be used to prevent crime?
9. What is role-based access control?
10. What is the purpose of encryption?
11. How are anti-virus programs and intrusion detection systems different?
12. How can a user make passwords more secure?

Assignment

Overview

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

Assignment

The business model of Facebook and Google is to collect personal information on its users, and then sell that information to advertisers in the form of targeted advertising on websites, mobile apps, and partner websites.

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. 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 Canada?

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.

8.9. KEY TERMS

Chapter 8

Access Control: To ensure that that the user can only access the information resources that are appropriate. It determines which users can authorized to read, modify, add, and/or delete information. (8.5)

Acceptable Use Policies (AUP): An acceptable usage policy or fair use policy, is a set of rules applied by the owner, creator or administrator of a network, website, or service, that restrict the ways in which the network, website or system may be used and sets guidelines as to how it should be used. (8.6)

ACL: Which identifies a list of users who have the capability to take specific actions with an information resource such as data files. Specific permissions are assigned to each user such as read, write, delete, or add. Only users with those permissions are allowed to perform those functions. (8.5)

Antivirus Programs: Are software that can be installed on a computer or network to detect and remove known malicious programs like viruses, and spyware. While antivirus programs provide some protection they are a reactive defense in that they must first understand what to look for. (8.5)

Authentication: Making sure a person is who they say they are. Three factor identification: Identifying someone: something they know, something they have, or something they are. (8.4)

Availability: That information can be accessed and modified by anyone authorized to do so in appropriate timeframe. (8.3)

Backup: The procedure for making extra copies of data in case the original is lost or damaged. (8.5)

Biometric Authentication: A type of system that relies on the unique biological characteristics of individuals to verify identity for secure access to electronic systems. Example, a fingerprint scan. (8.4)

Confidentiality: Protecting information, to be able to restrict access to only those who are allowed to see it. (8.3)

Cybercrime: (Also referred to as computer crime) is an illegal activity that is committed with the use of a computer, or where a computer is the object of the crime. (8.2)

Denial-of-Service (DoS): Attack does exactly what the term suggests: it prevents a web server from servicing authorized users. (8.2)

Employee Training: One of the most common ways thieves steal corporate information is the theft of employee laptops while employees are traveling. Employees should be trained to secure their equipment whenever they are away from the office. (8.6)

Encryption: The process of encoding data upon its transmission or storage so that only authorized individuals can read it. (8.5)

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 exceed acceptable ranges.(8.6)

Firewall: A software program or hardware device that is used to increase security on its network by blocking unwanted messages/data. . (8.5)

Hacking: When someone accesses a computer without permission. (8.2)

Identity Theft: When a criminal gains access to your personal information and uses it without your knowledge. (8.2)

Integrity: The assurance that the information being accessed has not been altered and truly represents what is intended. (8.3)

Intrusion Detection System (IDS): Works to provide the functionality to identify if the network is being attacked. (8.6)

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. (8.6)

Multifactor authentication: A security system that requires more than one method of authentication from independent categories of credentials to verify the user's identity for a login or other transaction.

Phishing: Occurs when a user receives an e-mail that looks as if it is from a trusted source, such as their bank or employer. In the e-mail the user is asked to click a link and log in to a website that mimics the genuine website, then enter their ID and password. (8.2)

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.(8.6)

Physical Security: The protection of the actual hardware and networking components that store and transmit information resources. (8.6)

Piracy: A crime that is committed with the use of a computer is software piracy, which is the illegal copying and distribution or use of software. (8.2)

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 their private key to decode it. The public key can be given to anyone who wishes to send the recipient a message.. (8.5)

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. (8.5)

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. (8.6)

Spoofing: A technique where culprits disguise their identities by modifying the address of the computer from which the scheme has been launched. Typically, the point is to make it look as if an incoming message has originated from an authorized source.(8.2)

Social Engineering: when criminals lure individuals into sending them personal, confidential data that can be used in crime. For example, someone phones you posing as a customer service representative asking for your banking log-on information. (8.2)

Symmetric Key Encryption: Where both parties share the encryption key. Encryption makes information secure as the message is sent in code and appears to those without the public key as a random series of letters and numbers.(8.5)

Universal Power Supply (UPS): A device that provides battery backup to critical components of the system, allowing they system 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 power failure. (8.5)

VPN: A virtual private network allows user who are outside of a corporate network to take a detour around the firewall and access the internal network from the outside.

Adapted from [Information Systems for Business and Beyond Glossary](#) by Ruth Guthrie licensed under a [CC-BY-3.0](#)

8.10. KNOWLEDGE CHECK

Knowledge Check 1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1793#h5p-76

Knowledge Check 2

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1793#h5p-67

Knowledge Check 3

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1793#h5p-69

CHAPTER 9: IMPACTS OF INFORMATION SYSTEMS

Chapter Outline

Photo by Simon Abrams Unsplash License

9.1. CHAPTER INTRODUCTION

Information systems have an impact far beyond the world of business. New technologies create new situations that have never had to be confronted before. One issue is how to handle the new capabilities that these devices provide to users. What new laws will be needed to protect from misuse of new technologies? How do we handle the social impacts of the new technologies? This chapter begins with a discussion of the impact of information systems have on user behaviour or ethics. This will be followed by the new legal structures being put in place focusing on intellectual property and privacy. Lastly, the chapter will explore some of the social impacts of technology use.

9.2. INFORMATION SYSTEMS ETHICS

The term **ethics** means "a set of moral principles" or "the principles of conduct governing an individual or a group (Merriam-Webster Dictionary, n.d.). Since the dawn of civilization, the study of ethics and their impact has fascinated mankind. But what do ethics have to do with information systems?

The introduction of new technology can have a profound effect on human behaviour. New technologies give us capabilities we did not have before, creating environments and situations that have not been addressed explicitly in an ethical context. Those who master new technologies gain new power, while those who cannot or do not master them may lose power. In 1913, Henry Ford implemented the first moving assembly line to create his Model T cars. While this was a great step forward technologically and economically, the assembly line reduced the value of human beings in the production process. The development of the atomic bomb concentrated unimaginable power in the hands of one government, which then had to wrestle with the decision to use it. Today's digital technologies have created new categories of ethical dilemmas.

Digital technologies have allowed us to aggregate information from multiple sources to create profiles of people. What would have taken weeks of work in the past can now be done in seconds, allowing private organizations and governments to know more about individuals than at any time in history. This information has value but also chips away at the privacy of consumers and citizens.

Facebook & Privacy

In early 2018, Facebook acknowledged a data breach affecting 87 million users. The app "thisisyourdigitallife", created by Global Science Research, informed users that they could participate in a psychological research study. About 270,000 people decided to participate in the research, but the app failed to tell users that the data of all of their friends on Facebook would be automatically captured as well. All of this data theft took place before 2014, but it did not become public until four years later.

In 2015 Facebook learned about Global Science Research's collection of data on millions of friends of the users in the research. Global Science Research agreed to delete the data, but it had already been sold to Cambridge Analytica who used it in the 2016 presidential primary campaign. The ensuing firestorm resulted in Mark Zuckerberg, CEO of Facebook, testifying before the U.S. Congress in 2018 on what happened and what Facebook would do in the future to protect users' data. Congress is working on legislation to protect user data in the future, a prime example of technology advancing faster than the laws needed to protect users. More information about this case of data privacy can be found at Facebook and Cambridge Analytica (Grigonis, 2018).

Code of Ethics

A code of ethics is one method for navigating new ethical waters. A **code of ethics** outlines a set of acceptable behaviours for a

professional or social group. Generally, it is agreed to by all members of the group. The document details different actions that are considered appropriate and inappropriate.

Code of Ethics Example

A good example of a code of ethics is the *Code of Ethics and Professional Conduct* of the Association for Computing Machinery (ACM), an organization of computing professionals that includes academics, researchers, and practitioners. In the ACM's code, you will find many straightforward ethical instructions, such as the admonition to be honest and trustworthy. Since this is also an organization of professionals that focuses on computing, there are more specific warnings that relate directly to information technology:

- No one should enter or use another's computer system, software, or data files without permission. One must always have appropriate approval before using system resources, including communication ports, file space, other system peripherals, and computer time.
- Designing or implementing systems that deliberately or inadvertently demean individuals or groups is ethically unacceptable.
- Organizational leaders are responsible for ensuring that computer systems enhance, not degrade, the quality of working life. When implementing a computer system, organizations must consider the personal and professional development, physical safety, and human dignity of all workers. Appropriate human-computer ergonomic standards should be considered in system design and in the workplace (Association for Computing Machinery, 1992).

One of the major advantages of creating a code of ethics is that it clarifies the acceptable standards of behaviour for a professional group. The varied backgrounds and experiences of the group members lead to various ideas regarding what is acceptable behaviour. While the guidelines may seem obvious, having these items detailed provides clarity and consistency. Explicitly stating standards communicates the common guidelines to everyone in a clear manner.

A code of ethics can also have some drawbacks. First, a code of ethics does not have legal authority. Breaking a code of ethics is not a crime in itself. What happens if someone violates one of the guidelines? Many codes of ethics include a section that describes how such situations will be handled.

In many cases, repeated violations of the code result in expulsion from the group. In the case of ACM: "Adherence of professionals to a code of ethics is largely a voluntary matter. However, if a member does not follow this code by engaging in gross misconduct, membership in ACM may be terminated" (Association for Computing Machinery, 1992). Expulsion from ACM may not have much of an impact on many individuals since membership in ACM is usually not a requirement for employment. However, expulsion from other organizations, such as a state bar organization or medical board, could carry a huge impact.

Another possible disadvantage of a code of ethics is that there is always a chance that important issues will arise that are not specifically addressed in the code. Technology is quickly changing and a code of ethics might not be updated often enough to keep up with all of the changes. A good code of ethics, however, is written in a broad enough fashion that it can address the ethical issues of potential changes to technology while the organization behind the code makes revisions. Finally, a code of ethics could also be a disadvantage in that it may not entirely reflect the ethics or morals of every member of the group. Organizations with a diverse membership may have internal conflicts as to what is acceptable behavior. For example, there may be a difference of opinion on the

consumption of alcoholic beverages at company events. In such cases the organization must make a choice about the importance of addressing a specific behavior in the code.

"Chapter 12: The Ethical and Legal Implications of Information Systems" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

9.3. INTELLECTUAL PROPERTY AND COPYRIGHT

The rise of information systems has resulted in rethinking how to deal with intellectual property. From the increase in patent applications swamping the government's patent office to the new laws that must be put in place to enforce copyright protection, digital technologies have impacted our behavior.

Digital technologies have driven a rise in new intellectual property claims and made it much more difficult to defend intellectual property. **Intellectual property** is defined as "property (as an idea, invention, or process) that derives from the work of the mind or intellect" (Merriam-Webster Dictionary, n.d.). This could include creations such as song lyrics, a computer program, a new type of toaster, or even a sculpture. Practically speaking, it is difficult to protect an idea. Instead, intellectual property laws are written to protect the tangible results of an idea. In other words, just coming up with a song in your head is not protected, but if you write it down, it can be protected.

Protection of intellectual property is important because it gives people an incentive to be creative. Innovators with great ideas will be more likely to pursue those ideas if they have a clear understanding of how they will benefit. The Canadian Intellectual Property Office (CIPO) is a special operating agency of Innovation, Science and Economic Development Canada. They deliver intellectual property (IP) services in Canada and educate Canadians on how to use IP more effectively. The CIPO grants patents, and registers trademarks and provides copyright protection for original works. You can learn more by taking their training modules on the CIPO website. Outside of the US and Canada, intellectual property protections vary. You can find out more about a specific country's intellectual property laws by visiting the World Intellectual Property Organization.

While protecting intellectual property is important because of the incentives it provides, it is also necessary to limit the amount of benefit that can be received and allow the results of ideas to become part of the public domain. The following sections address three of the best-known intellectual property protections: copyright, patent, and trademark.

Copyright

Copyright is the protection given to songs, computer programs, books, and other creative works. Any work that has an "author" can be copyrighted. Under the terms of copyright, the author of a work controls what can be done with the work, including:

- Who can make copies of the work.
- Who can make derivative works from the original work.
- Who can perform the work publicly.
- Who can display the work publicly.
- Who can distribute the work.

Many times a work is not owned by an individual but is instead owned by a publisher with whom the original author has an agreement. In return for the rights to the work, the publisher will market and distribute the work and then pay the original author a portion of the proceeds. Currently, copyright protection lasts for the entirety of the author's life plus 50 years after his or her death. In the case of a work that has multiple authors, the copyright will last for 50 years after the death of the last surviving author. However, the Canada-United States-Mexico Agreement will require Canada to extend the terms of copyright protection offered in the Copyright Act. There are a few exceptions to this as outlined by the Canadian Intellectual Property Office.

Fair use vs. Fair Dealing

Fair use is described in Section 107 of the United States Copyright Act, which states that the "fair use of a copyrighted work … for purposes such as criticism, comment, news reporting, teaching (including multiple copies for classroom use), scholarship or research, is not an infringement of copyright." Similarly fair dealing which is outlined in Section 29 of the Canadian Copyright Act (the 'Act') permits the use of a copyright-protected work without permission or payment as long as the use falls within one of the listed purposes in the Act, and the dealing is fair. The most important difference between fair use and fair dealing is that the list of purposes available for fair use are illustrative, while the purposes for fair dealing are exhaustive, meaning that, in theory, fair use is more flexible and is applicable to a wider variety of situations than fair dealing. To learn more about fair dealing and the six criteria: purpose, character, amount, alternatives, nature, and effect of the dealing check out the University of Alberta's page on Fair Dealing.

Unfortunately, the specific guidelines for what is considered fair use/fair dealing and what constitutes copyright violation are not well defined. Fair use/fair dealing is a well-known and respected concept and will only be challenged when copyright holders feel that the integrity or market value of their work is being threatened. Canadian copyright laws and regulations are designed to ensure that the rights of creators and other rights-holders are recognized and protected, and to promote access to copyrighted works. Canada's domestic copyright framework must also meet our international obligations and be consistent with international standards endorsed by Canada. Effective copyright protection is key to cultural expression, citizen engagement, and economic growth powered by the rapid expansion of the knowledge-based economy.

Copyright and Digital Technologies

As digital technologies have changed so has what it means to create, copy, and distribute media. In Canada, the Notice and Notice Regime is a tool established in the Copyright Act to help copyright owners deal with online copyright infringement (e.g. illegal downloading) to protect their copyright material while respecting the interests and freedom of users. Ultimately, it formalized a voluntary industry-based practice that had been in place for several years.

Therefore, when a copyright owner thinks that an Internet user might be infringing their copyright, they can send a notice of alleged infringement to the user's ISP. Notice and Notice regime requires that the ISP forward (e.g. via email) the notice of alleged infringement to the user and then inform the copyright owner once this has been done.

For example, a copyright owner identifies an internet user with a Canadian internet protocol (IP) address downloading a movie from a pirate site. Not knowing who the person is, the copyright owner can send a notice of alleged infringement to the ISP that owns the relevant IP address. The ISP must then forward the notice to its subscriber who was using that IP address at the time of the alleged infringement.

Creative Commons

In chapter 4 we explored the topic of open-source software. Open-source software has few or no copyright restrictions. The creators of the software publish their code and make their software available for others to use and distribute for free. This is great for software, but what about other forms of copyrighted works? If an artist or writer wants to make their works available, how can they go about doing so while still protecting the integrity of their work? Creative Commons is the solution to this problem.

Creative Commons is a nonprofit organization that provides legal tools for artists and authors. The tools offered make it simple to license artistic or literary work for others to use or distribute in a manner consistent with the author's intentions. Creative Commons licenses are indicated with the symbol. It is important to note that Creative Commons and public domain are not the same. When something is in the public domain, it has absolutely no restrictions on its use or distribution. Works whose copyrights have expired

are in the public domain. By using a Creative Commons license, authors can control the use of their work while still making it widely accessible. By attaching a Creative Commons license to their work, a legally binding license is created. For a full listing of the licenses and to learn much more about Creative Commons, visit their website.
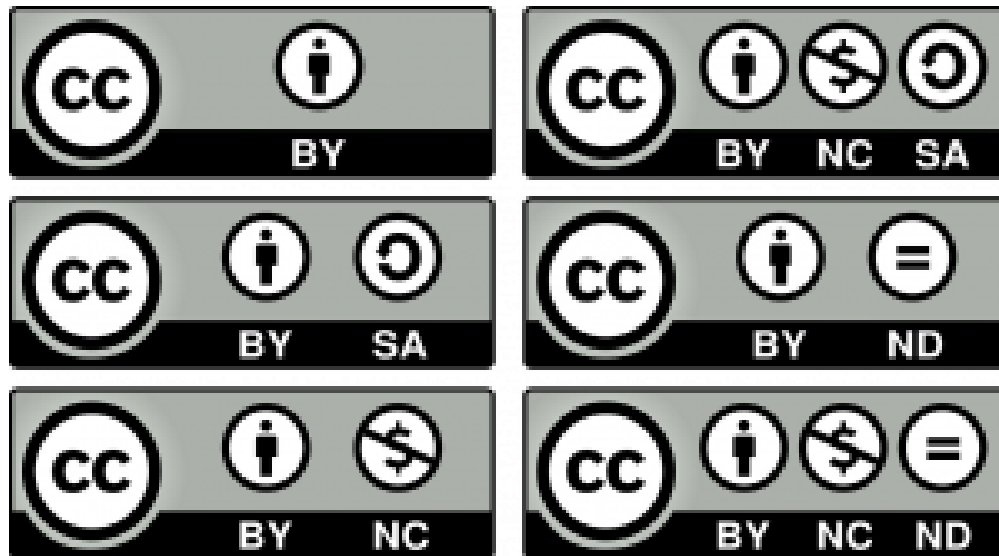
CC Licensing by Progressor on Pixabay

"Chapter 12: The Ethical and Legal Implications of Information Systems" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

9.4. PATENTS AND TRADEMARKS

Patents are another important form of intellectual property protection. A patent creates protection for someone who invents a new product or process. The definition of invention is quite broad and covers many different fields. Here are some examples of items receiving patents:

- circuit designs in semiconductors;
- prescription drug formulas;
- firearms;
- locks;
- plumbing;
- engines;
- coating processes, and
- business processes.

Through a patent, the government gives an inventor the right to stop others from making, using or selling your invention from the day the patent is granted to a maximum of 20 years after the day on which you filed your patent application. However, in exchange, one must provide a full description of the invention so that all Canadians can benefit from this advance in technology and knowledge. Patent applications are typically open to public inspection from 18 months from the filing date. Therefore, people may then read about another's invention, though they cannot make, use or sell it without the patent holder's permission.

The rights given by a Canadian patent extend throughout Canada but not to other countries. An inventor must apply for patent rights in other countries separately. Likewise, foreign patents do not protect an invention in Canada (Canadian Intellectual Property Office, 2020).

Obtaining Patent Protection

Unlike copyright, a patent is not automatically granted when someone has an interesting idea and writes it down. A patent application must be submitted to the Canadian Intellectual Property Office (CIPO). A patent will only be granted if the invention or process being submitted meets certain conditions. There are three basic criteria for patentability—novelty, utility and inventiveness:

Novelty	To be granted a patent, the invention (door lock) must be original, that is first of its kind in the world.
Utility	A valid patent cannot be obtained for something that does not work or that has no useful function. The door lock must work.
Inventiveness	To be patentable, the invention must be a new development or an improvement of an existing technology that would not have been obvious to someone working in the area of specialty. The door lock must add an improvement to the field of door locks.

What Is a Patent Troll?

The advent of digital technologies has led to a large increase in patent filings and therefore a large number of patents being granted. Once a patent is granted, it is up to the owner of the patent to enforce it. If someone is found to be using the invention without permission, the patent holder has the right to sue to force that person to stop and to collect damages.

The rise in patents has led to a new form of profiteering called **patent trolling**. A patent troll is a person or organization who gains the rights to a patent but does not actually make the invention that the patent protects. Instead, the patent troll searches for those who are illegally using the invention in some way and sues them. In many cases the infringement being alleged is questionable at best. For example, companies have been sued for using Wi-Fi or for scanning documents, technologies that have been on the market for many years.

The License on Transfer (LOT) Network is a global organization working collaboratively to reduce the risk of lawsuits from patent trolls.

Trademark

A **trademark** is a word, phrase, logo, shape or sound that identifies a source of goods or services. For example, the Nike "Swoosh," the Facebook "f", and Apple's apple (with a bite taken out of it) are all trademarked. The concept behind trademarks is to protect the consumer. Imagine going to the local shopping center to purchase a specific item from a specific store and finding that there are several stores all with the same name!

Apple Logo by D. Bourgeois CC-BY-NC

Registering your trademark with the Canadian Intellectual Property Office (CIPO) registrar protects your rights in Canada only. If one wishes to market goods or services in other countries, trademark registration must be done in that country (Canadian Intellectual Property Office, 2021).You can use CIPO's Canadian Trademarks Database to access over 140 years of Canadian trademark data. You can search and study more than 1.4 million Canadian trademarks. That includes all active and inactive marks that were cancelled, expunged, abandoned or refused after 1979.

There are two types of trademarks – an ordinary trademark and a certification trademark.

Ordinary trademark	includes words, designs, tastes, textures, moving images, mode of packaging, holograms, sounds, scents, three-dimensional shapes, colours, or a combination of these used to distinguish the goods or services of one person or organization from those of others. For example, suppose you started a courier business that you chose to call Giddy-up. You could register these words as a trademark (if you met all the legal requirements) for the service that you offer.
Certification mark	can be licensed to many people or companies for the purpose of showing that certain goods or services meet a defined standard. For example, the Woolmark design, owned by Woolmark Americas Ltd., is used on clothing and other goods.

While most any word, phrase, logo, shape, or sound can be trademarked, there are a few limitations. You cannot register a trademark if it includes the following:

- Names and surnames
- Clearly descriptive marks
- Deceptively descriptive marks
- Place of origin
- Words in other languages

To learn more go to CIPO's trademarks guide.

What are Non-fungible Tokens (NFTs) ?

Nyan Cat by Rob Bulmahn CC-BY

NFTs provide a way to limit digital items from being duplicated – making them unique. NFTs tokenize digital files by creating a digital certificate on the blockchain (more about that in Chapter 10) so that they are unique and owned and cannot be reproduced like other digital files.

While NFT's can be used to protect original works of art; they can also be linked to video's, images, lines of code or any digital asset. An NFT of digital artist Beeple's Everydays: the First 5000 days collage sold at auction for more than $69 million making it the third most expensive artwork ever sold by a living artist. Nyan Cat (see image), an iconic GIF of a cat with a Pop-Tart for a torso flying through space, sold for nearly $600,000.

9.5. PRIVACY

The term **privacy** has many definitions, but for purposes here, privacy will mean the ability to control information about oneself. The ability to maintain our privacy has eroded substantially in the past decades, due to information systems. In Canada, the [Privacy Act](#) is the law that sets out your privacy rights in your interactions with the federal government. It applies to how the government collects, uses and discloses your personal information. The Privacy Act protects your personal information that government institutions hold. The Act also gives you the right to [access your personal information](#) held by the federal government.

Personal Information (PI)

Information about a person that can be used to uniquely establish that person's identity is called **personally identifiable** information, or PI. This is a broad category that includes information such as:

- Name;
- Social Insurance Number;
- Date of birth;
- Place of birth;
- Mother's maiden name;
- Biometric records (fingerprint, face, etc.);
- Medical records;
- Educational records;
- Financial information; and
- Employment information.

The Personal Information Protection and Electronic Documents Act (PIPEDA)

Canadians are increasingly concerned about their privacy. They are choosing to do business with organizations that are sensitive to those concerns and can demonstrate they will carefully handle personal information. Organizations that collect PI are responsible to protect it. The Office of the Privacy Commissioner in Canada outlines guidelines for businesses in obtaining meaningful consent.

[The Personal Information Protection and Electronic Documents Act (PIPEDA)](#) is Canada's federal private sector privacy law and it requires individuals to understand the nature, purpose and consequences of what they are consenting to. In order for consent to be considered valid, or meaningful, organizations must inform individuals of their privacy practices in a comprehensive and understandable manner. This means that organizations must provide information about their privacy management practices in a form that is readily accessible to those interested individuals who wish to read it. It outlines the ground rules for how businesses must handle personal information for commercial activities. The Office of the Privacy Commissioner of Canada (OPC) has prepared a [guide](#) to help organizations understand and meet their obligations under PIPEDA.

Fair Information Principles

Businesses must follow the ten fair information principles to protect personal information. By following these principles, a business will contribute to building customer trust in their business and in the digital economy. The principles are:

1.   Accountability
2.   Identifying purposes
3.   Consent
4.   Limiting collection
5.   Limiting use, disclosure and retention
6.   Accuracy
7.   Safeguards
8.   Openness
9.   Individual access
10.   Challenging compliance

People have the right to access their personal information held by an organization. They also have the right to challenge its accuracy. Personal information can only be used for the purposes for which it was collected. If an organization is going to use it for another purpose, it must obtain consent again. Personal information must be protected by appropriate safeguards (Office of the Privacy Commissioner of Canada, 2019).

Personal Information Protection Statutes

In addition to PIPEDA, there are a number of statutes in Canada that apply to the protection of PI (personal information). Many of the provinces have their own laws that may override or expand on federal legislation.

- **Provinces** of Alberta, British Columbia and Quebec each have legislation that is similar to PIPEDA, which applies to the protection of PI by private sector organizations within these provinces;
- **Canadian jurisdiction** has legislation governing the protection of PI by government bodies/institutions; and
- **Provinces** have legislation that applies to the protection of personal health information by certain types of custodians, such as doctors and hospitals. For example, Ontario has the Personal Health Information Protection Act (PHIPA). To learn more check your health privacy rights in Ontario.

What is a Cookie?

Website cookies are small files sent by websites to users' computers, usually without knowledge or specific consent. Cookies can be used to personalize a website, remember users' preferences, and retain products in electronic shopping carts. Regulators are concerned about cookies because they can also be used to track online behaviour, activities and interests, and can be accessed by third parties (Bennett et al., 2020). Canada's anti-spam legislation (CASL) is the federal law dealing with cookies, spam, and other electronic threats. It is meant to protect Canadians while ensuring that businesses can continue to compete in the global marketplace.

"Chapter 12: The Ethical and Legal Implications of Information Systems" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

9.6. DIGITAL DIVIDE

In addition to privacy and security, there are some additional factors to consider when using technology. The digital divide, censorship, and work-life balance are all social impacts of using technology.

As the internet and its applications continue to permeate our world, the concern around access grows. The **digital divide** is the separation between those who have access to global networks and those who do not. The digital divide can occur between countries, regions, or even neighbourhoods. In many North American cities, there are pockets with little or no Internet access, while just a few miles away high-speed broadband is common. In Canada, the geographic disparity is prevalent.

According to Canada's Public Policy Forum (June 2014) the territories within Northern Canada have been technologically divided compared to the rest of the country. This is largely due to economic and geographical obstacles creating challenges to having high speed internet connections. Low digital literacy rates, lack of access to technology, and the distance and sparsely populated towns have all contributed to these challenges (Canada's Public Policy Forum, 2014). Furthermore, the Centre of Excellence in Next Generation Networks (CENGN) reports that 30% of Canada's economy is represented by rural and remote communities. Meanwhile, only 46% of rural households have access to high-speed internet, creating barriers in services such as e-learning, e-health, and staying connected (CENGN, 2021)

A New Understanding of the Digital Divide

In 2006, web-usability consultant Jakob Nielsen wrote an article that got to the heart of our understanding of this problem. In his article, he breaks the digital divide up into three stages: the economic divide, the usability divide, and the empowerment divide (Nielsen, 2006).

Economic divide	This is what many call the digital divide. The economic divide is the idea that some people can afford to have a computer and Internet access while others cannot.
Usability divide	Many people lack the digital literacy skills required to use technology. For those who can use a computer, accessing all the benefits of having one can sometimes be beyond their understanding.
Empowerment divide	Empowerment is the most difficult to solve. It is concerned with how we use technology to empower ourselves. Some users do not understand the power that digital technologies can give them. Many people will limit what they can do online by accepting the basic, default settings of their computer and not work to understand how they can truly be empowered.

Understanding the digital divide using these three stages provides a more nuanced view of how we can work to alleviate it. More work needs to be done to address the second and third stages of the digital divide for a more holistic solution.

Refining the Digital Divide

The Miniwatts Marketing Group, host of Internet World Stats sought in 2018 to further clarify the meaning of the digital divide by acknowledging that the divide is more than just who does or does not have access to the Internet. The group sees the following concerns.

Social mobility.	Lack of computer education works to the disadvantage of children with lower socioeconomic status.
Democracy.	Greater Internet use can lead to healthier democracies, especially in election participation.
Economic growth.	Greater Internet use in developing countries could provide a shortcut to economic advancement. Using the latest technology could give companies in these countries a competitive advantage (Miniwatts Marketing Group, 2018).

Bridging the Digital Divide in Canada

So, what can be done to help alleviate the digital divide in Canada? Like many other countries, Canada continues to propose and implement various solutions to close the digital gap among the population. Here are a few of them:

- **Broadband as a basic service** – In December 2016, the Canadian Radio-television and Telecommunications Commission (the Canadian federal regulating agency for broadcasting and communications) ruled that broadband internet is a basic service. This means that in addition to telephone services, access to broadband internet at a minimum speed is an essential service broadcast providers must offer; however, the pricing of access to the internet is still being addressed.
- **Connecting Canadians** – is a government-run program to improve broadband network access. According to the plan, all Canadians will have access with a minimum quality of 5 mbps download speed and 1 Mbps upload speed.
- **Public access** – providing access in public locations such as libraries.
- **Improve digital literacy** – improving digital literacy among Canadians begins with educating children on using technology efficiently and safely.

Digital Literacy Programs

- Through Innovation, Science, and Economic Development Canada, the Canadian federal government has committed $17.6 million to support learning opportunities for Canadians in digital literacy under the Digital Literacy Exchange Program.
- Media Smarts , Canada's Centre for Digital and Media Literacy, also provides training programs for Canadian educators to support learning opportunities for youth.

9.7. OTHER SOCIAL IMPACTS

Internet Censorship

Despite the internet being founded on the basis of openness, internet censorship is widespread. **Internet censorship** is the control of information accessible on the internet by governments and businesses. The primary reasons for government-mandated censorship are political, religious or cultural. A censor might take a range of steps to stop the publication of information, to prevent access to that information by disrupting the link between the user and the publisher, or to directly prevent users from accessing that information. The key point is to stop information from being disseminated.

Internet censorship takes two main forms: user-side and publisher-side. In **user-side censorship**, the censor disrupts the link between the user and the publisher. The interruption can be made at various points in the process between a user typing an address into their browser and being served a site on their screen. Users may see a variety of different error messages, depending on what the censor wants them to know.

Publisher-side censorship is where websites refuse to offer services to a certain class of users. There is increasing use of publisher-side censorship from site owners who want to block users of anonymizing systems (like Tor-see more below). Individuals using anonymized software prevents a website owner from knowing where their visitors are coming from and basic information about them.

Tor Web Browser

Tor, short for The Onion Router is a free internet browser software that allows users to be anonymous while using the web. The intention of the software is to protect the privacy of the user. In some countries the use of Tor is blocked. Tor has been known to be used by individuals engaged in criminal activities as well as people looking for privacy.

Telecommuting & Remote Work

Technology is becoming ubiquitous and in many cases it is allowing individuals the opportunity to work from anywhere, removing the boundary between work and life. **Telecommuting** (or telework) and remote work refer to work performed at a remote location (home or other space) by an electronic connection and can encompass a variety of employment types, from gig assignments to part-time contract work to traditional full-time employment. Telecommuting and remote work are often used interchangeably, but there is a slight difference. Telecommuting might assume that an employee may be required to come to an office some of the time, whereas remote work assumes the employee does not reside close to the business.

Today's businesses have a toolkit of technical solutions to set up working relationships with employees far and wide through voice, computer, video connections, and offsite work-sharing spaces. Coworkers can share files on a remote network server or the cloud, and managers can use nontraditional methods to monitor activity and performance. Many employers and employees had to

make significant changes to their workforce operations and pivot to remote work environments due to the COVID-19 pandemic. Although there were tremendous challenges at first, many employees became comfortable with their new workspaces away from their traditional offices. It is likely that some form of remote work will continue in many industries as it has been seen to provide many benefits.

First, it is a powerful recruiting tool for people who want to balance their work and personal lives. It allows employees to work a more flexible schedule to care for children or older relatives while maintaining a career and earning income. Individuals with ability challenges also prefer the flexibility that telecommuting affords them. Telecommuting also reduces the hours that employees spend travelling to and from the job. Remote workers can continue to do their jobs despite weather conditions that impede travel, and they are not exposed to sick coworkers and may take fewer sick days. Lastly, workers may enjoy higher productivity without the distractions of a traditional office setting, like water-cooler gossip and long lunches.

Despite the benefits of remote work, there are some concerns as well. One major disadvantage of remote work is related to loneliness and feelings of isolation. Corporate culture is not easy to convey over distance, and it is harder to collaborate. The likelihood of miscommunication increases when everything must be transmitted electronically or virtually. It is also more difficult for employers to monitor some kinds of work-related progress when an employee is working remotely. As well, some employees have found negative impacts to their productivity due to distractions in their home, or do to the lack of a proper home office with which to work from. The remote worker may also have qualms about privacy when his or her personal life inevitably intersects with the workday (as when a family member walks into the room or the dog barks during a conference call). To learn more about the future of work, check out this [paper by the Information and Communications Technology Council.](#)

9.8. SUMMARY

Key Takeaways

- Today's digital technologies have created new categories of ethical dilemmas.
- Ethics are moral principles of conduct, and a code of ethics outlines a set of acceptable behaviors for a professional or social group.
- Intellectual property protections include: copyrights, patents, and trademarks.
- Privacy is the ability to control information about oneself. There are a number of laws in Canada to protect a person's privacy and their personal information (PI).
- The digital divide is the separation between those who have access to global networks and those who do not. There are many initiatives underway in Canada to aid in providing internet access to everyone.
- Internet censorship is the control or suppression of the publishing of, or access to information on the internet.
- Telecommuting and remote work on the rise and come with benefits as well as concerns.

Review Questions

1. What does the term information systems ethics mean?
2. What is a code of ethics? What is one advantage and one disadvantage of a code of ethics?
3. What does the term intellectual property mean? Give an example.
4. What protections are provided by a copyright? How do you obtain one?
5. What is fair dealing?
6. What protections are provided by a patent? How do you obtain one?
7. What does a trademark protect? How do you obtain one?
8. What does the term personally identifiable information mean?
9. What protections are provided in Canada with respect to privacy?
10. What does the term *digital divide* mean?
11. What are Jakob Nielsen's three stages of the digital divide?

222 | 9.8. SUMMARY

Exercises

Overview

This assignment will help you to understand the digital divide and its implications .

Assignment

In this assignment, you will complete an activity to assess where you fall on the digital divide, and discuss ways to help close the digital gap in Canada.

Complete the short activity and answer the following questions:

1. Discuss your results with the class (if you feel comfortable).
2. What are some of the situations that impact your results on the digital divide assessment?
3. What are some of the ways in which the digital divide can be reduced in Canada? Do some research and share your solutions. Be sure to provide references to the resources you use.

9.9. KEY TERMS

Chapter 9

Canadian Intellectual Property Office (CIPO): A patent will only be granted if the invention or process being submitted meets certain conditions.(9.4)

Code of Ethics or Professional Conduct: Is a document that outlines a set of acceptable behaviors for a professional or social group; generally, it is agreed to by all members of the group. (9.2)

Copyright: The protection given to songs, computer programs, books, and other creative works. Any work that has an "author" can be copyrighted. (9.3)

Copyright Act: To help copyright owners deal with online copyright infringement (e.g. illegal downloading) so that they can protect their copyright material while respecting the interests and freedom of users. (9.3)

Creative Commons: A nonprofit organization that provides legal tools for artists and authors. The tools offered make it simple to license artistic or literary work for others to use or distribute in a manner consistent with the author's intentions. Creative Commons copyrights allow for less restrictive rules than traditional copyright. (9.3)

Digital Divide: The gap between demographics and regions that have access to modern information and communications technology, and those that don't or have restricted access. Newly defined stages of the digital divide defined by Jakob Nielsen include the economic divide, the usability divide and the empowerment divide. (9.6)

Ethics: A set of moral principles or the principles of conduct governing an individual or a group. (9.2)

Ethical System: A set of moral principles" or "the principles of conduct governing an individual or a group. (9.2)

Fair Use: A limitation on copyright law that allows for the use of protected works without prior authorization in specific cases. (9.3)

Intellectual Property (IP): A n idea, invention, or process that derives from the work of the mind or intellect is assigned to designated owners by law. (9.3)

Internet Censorship: is the control of information accessible on the internet by governments and businesses. (9.7)

License on Transfer (LOT): Network is a global organization working collaboratively to reduce the risk of lawsuits from patent trolls.(9.4)

Non-fungible Tokens (NFT's): tokenize digital files by creating a digital certificate on the blockchain so that they are unique and owned and cannot be reproduced like other digital files.

Patent: Set of exclusive rights granted by a sovereign state to an inventor or assignee for a limited period of time in exchange for detailed public disclosure of an invention. (9.4)

Patent Trolling. A patent troll is a person or organization who gains the rights to a patent but does not actually make the invention

that the patent protects. Instead, the patent troll searches for those who are illegally using the invention in some way and sues them. (9.4)

Personally Identifiable Information (PI): Information about a person that can be used to uniquely establish that person's identity (9.5)

Privacy: The ability to control information about oneself. (9.5)

Telecommuting: (or telework) and remote work refer to work performed at a remote location (home or other space) by virtue of an electronic connection and can encompass a variety of employment types. (9.7)

Trademark: A word, phrase, logo, shape or sound that identifies a source of goods or services. (9.4)

Website Cookies: Small files sent by websites to users' computers, usually without knowledge or specific consent. Cookies can be used to personalize a website, remember users' preferences, and retain products in electronic shopping carts. (9.5)

Adapted from Information Systems for Business and Beyond Glossary by Ruth Guthrie licensed under a CC-BY-3.0

9.10. KNOWLEDGE CHECK

Knowledge Check 1

Words to use: Public Domain, Fair Use, Copyright, Intellectual Property, Creative Commons

> *An interactive H5P element has been excluded from this version of the text. You can view it online here:*
> *https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1795#h5p-48*

Knowledge Check 2

> *An interactive H5P element has been excluded from this version of the text. You can view it online here:*
> *https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1795#h5p-70*

Knowledge Check 3

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1795#h5p-65

CHAPTER 10: E-BUSINESS

Chapter Outline

Photo by Igor Miske Unsplash License

10.1. CHAPTER INTRODUCTION

Learning Outcomes

Upon successful completion of this chapter, you will be able to:

- Define e-business and e-commerce and explain the difference between them;
- Describe the advantages and disadvantages of e-commerce;
- Outline the business-to-consumer e-commerce cycle;
- List the major categories of e-business;
- Summarize the major models of e-commerce;
- Discuss the different technologies used for e-commerce;
- Define Blockchain technology and
- Explain social commerce and New Retail and the reasons for its increasing popularity.

As we learned in chapter 6, the internet has had a massive impact on the way we communicate and how businesses operate. Businesses have found new ways to reach customers, expand markets, and transact more efficiently in digital formats. Changes in technology have allowed new business models to flourish while also making it difficult for some industries to keep pace. In general, electronic business has created a revolution in business practices. However, if organizations are going to take advantage of electronic technologies, they must take a strategic perspective. Corporate strategy must align with the company's e-commerce strategy. In this chapter, we will discuss definitions of electronic business and categories of e-commerce, as well as discussing the trends in e-commerce.

10.2. DEFINITIONS

E-Business & E-Commerce

Electronic business or e-business, in a broad sense, is the use of computer networks to improve organizational performance. Increasing profitability, gaining market share, improving customer service, and delivering products faster are some of the organizational performance gains possible by doing business electronically. E-business is more than ordering goods online, it involves all aspects of an organization's electronic interactions with its stakeholders.

E-business includes activities such as establishing a webpage to support investor relations or communicating electronically with employees. It involves the use of information technology to enhance communications and transactions with all of an organization's stakeholders. Such stakeholders include: customers, suppliers, government regulators, financial institutions, managers, employees, and the public at large. E-business involves several major components: business intelligence (BI), customer relationship management (CRM), supply chain management (SCM), enterprise resource planning (ERP), e-commerce, conducting electronic transactions within the firm, collaboration, and online activities among businesses.

E-business involves several major components: business intelligence (BI), customer relationship management (CRM), supply chain management (SCM), enterprise resource planning (ERP), e-commerce, conducting electronic transactions within the firm, collaboration, and online activities among businesses. Adapted from Components of E-Business by Matthew Pauley CC-BY-NC-SA

E-business and e-commerce are often used interchangeably, but they are not the same thing. E-commerce is the marketing, selling, and buying of goods and services online. It generates revenue, while e-business does not. The facilitation of commerce on a website, such as the ability for customers to order products online, to get questions answered about products, and for the company to introduce new products and ideas is considered e-commerce. E-business refers to all aspects of operating an online business while e-commerce refers specifically to the transaction of goods and services.

The history of e-commerce begins with the first ever online sale on August 11, 1994. A man sold a CD by Sting to his friend through his website NetMarket, an American retail platform. This is the first example of a consumer purchasing a product from a business through the internet. Since then, e-commerce has evolved to make products easier to discover and purchase through online retailers and marketplaces. Independent freelancers, small businesses, and large corporations have all benefited from e-commerce, which enables them to sell their goods and services at a scale that was not possible with traditional offline retail.

E-Commerce in Canada

E-commerce activity in Canada proliferated during the COVID-19 pandemic as restrictions for in-person shopping were put in place. Overall retail sales declined by about 18%, but e-commerce sales nearly doubled at 99.3%. As can be seen in the graph below, sales dramatically increased in April of 2020 at the peak of the pandemic. E-commerce grew in all retail sub-sectors, but the greatest gains were experienced in non-essential items. Many businesses had to shift their models and increase their web presence in order to support online selling (Aston et al., 2020, July 24). To see more on Canadian's online shopping habits, see this infographic from Statistics Canada.

Adapted from Statistics Canada, Indexed monthly retail e-commerce sales vs. in-store sales, Canada- July 24, 2020. This does not constitute an endorsement by Statistics Canada of this product. (click to enlarge)
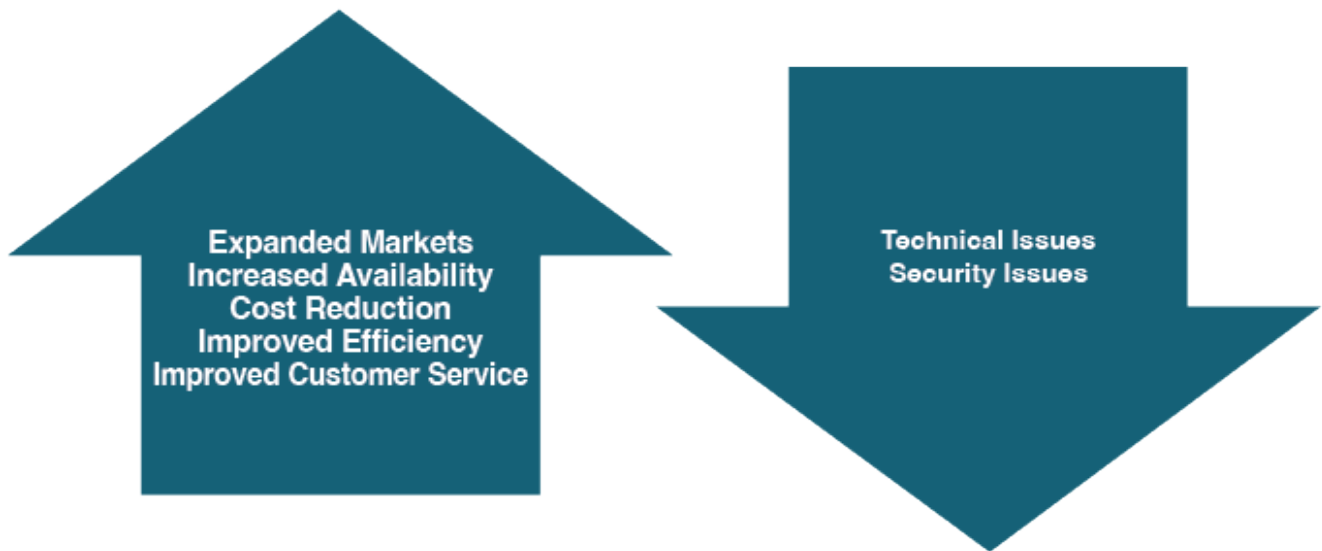
10.3. E-COMMERCE ADVANTAGES AND DISADVANTAGES

It is important to understand the advantages and disadvantages of this model compared to traditional brick-and-mortar businesses. Businesses need to understand their customers and their needs as well as the value of this model.

E-Commerce Advantages & Disadvantages (click to enlarge).

Advantages

Expanded Markets

Businesses with an online presence are not limited to servicing customers in their immediate geographic area only, and can broaden their market to serve customers at greater distances, even globally. The business would be limited only by shipping methods and costs and would need to consider this in their setup.

Increased Availability

Online operations allow businesses to interact and transact with customers all day every day, and are no longer limited to traditional bricks and mortar operating hours. This makes it easy for customers to make their purchases at a time that is convenient for them. As well, the automation of the online site means that a business can expand operating hours without necessarily increasing labour costs. As well, there are no limitations on shelf space making it possible to expand product offerings.

Reduce Costs

There are many ways that online technology can be utilized by businesses to reduce costs. For a traditional brick and mortar business,

by moving online they can save on all of the infrastructure costs of having a physical presence, such as rent, utilities, and maintenance. As well, since online businesses are not limited to shelf space, they can provide expanded product offerings to their customers without the added costs of stocking in store. For businesses that manufacture goods they can use an online site to transact directly with their customers and remove any need for a retailer (intermediary). The elimination of an intermediary is referred to as disintermediation. An example of this is Dell Direct. As well, instead of drawing employees from their local area, organizations can now hire people from the global labor pool. This allows organizations to pay a lower labor cost for the same work based on the prevailing wage in different countries.

Improved Efficiency

When processes are done online or digitally as opposed to more traditional approaches like paper based, the business benefits through efficiency. For example, online ordering allows customers to create accounts and enter in their own information which can reduce errors and speed processes like ordering and payment. This allows the business to track their customers and their shopping habits which can benefit them in the future.

Improved Customer Service

Customers are able to connect with businesses online in different ways which can improve customer satisfaction. Some businesses even have chatbots that allow customers to ask questions and receive immediate answers based on similar questions asked before. As well, customers can leave reviews and have the opportunity to provide feedback to businesses online about their satisfaction with their products and services. Some businesses have made the online return process fairly simple by automating the process and allowing customers to print return labels and drop in the mail.

The amount of data collected digitally on customers as they are interacting with the website is extremely valuable as well. This information can be used to help encourage further purchases or to help target new customers. Many sites use algorithms to suggest similar products when purchasing online to upsell the customer.

While e-commerce provides a number of advantages there are also some disadvantages with this method of doing business.

Disadvantages

Technical & Accessibility issues

Around the world customers may still experience bandwidth issues that prevent them from being able to efficiently interact with businesses online. Bandwidth and access issues will not be a problem in the future as more infrastructure is built.

Security & Privacy Issues

Customers may still be wary about shopping online especially when large privacy breaches have been well publicized. According to the Canadian Internet Use Survey looking at the online shopping habits of Canadians in 2020, for those Canadians who don't shop online, close to a quarter stated that it is due to security and privacy reasons (Statistics Canada, 2021, June 22).

Establishing Customer Trust & Satisfaction

Trust is about believing that someone will do what they say and that they will not intentionally do something to hurt you. Trust

in business is essential and it is easier to establish in the physical world as customers receive cues from the environment as well as body language from the sales staff. In the online environment, businesses can help build trust by ensuring customers have a good experience by making their online platform easy to navigate and use. Their website presentation should also be high quality and free from errors. They can also provide reviews on other customers experiences.

Fake Reviews

Since online reviews of a company's products and services have been found to generate online sales, the prevalence of fake reviews has proliferated. According to estimates, 4% of all online reviews are fake which equates to an impact on global online spending of $152 billion. Fake reviews are often created by bots which allows companies to leverage security systems to filter and remove this type of activity. Removing fake reviews is important for a company's authenticity and helps to build and maintain customer trust (Marciano, 2021, August 10).

To build trust, businesses should also make sure the product or service meets the customers expectations. Customers may be dissatisfied especially when ordering products online if the product is not reliable, or different than expected. Meaning that the display and description of the product on the website is not what they received. Online retailers should provide a complete and realistic description of the product and its benefits—with high-quality pictures and perhaps even demonstration videos if possible, appropriate, and affordable—along with product availability and likely ship dates. Customers should be notified by e-mail of order acceptance, and the anticipated delivery date with phone and e-mail contacts for any needed assistance.

10.4. ONLINE STRATEGY

Every business needs to consider the extent of their online presence. There are two key factors to be considered when considering an online strategy:

1. **How many existing or potential customers are likely to do business online?**
   If a significant portion of a company's customers are internet users, and the search cost for the product or service are reasonably, even moderately high, then an organization should have a considerable online presence; otherwise, it is missing an opportunity to inform and interact with its customers. If a company does not have a website, then there is the risk that potential customers will flow to competitors who have a web presence.

2. **What is the information intensity of the product?**
   An information-intense product is one that requires considerable information to describe it completely. The two parameters, number of customers on the web and product information intensity, can be combined to provide a straightforward model (see Exhibit 1) for determining which companies should be using the internet. Organizations falling in the top right quadrant are prime candidates because many of their customers have internet access and their products have a high information content. Firms in the other quadrants, particularly the low-low quadrant, have less need to invest in a website.
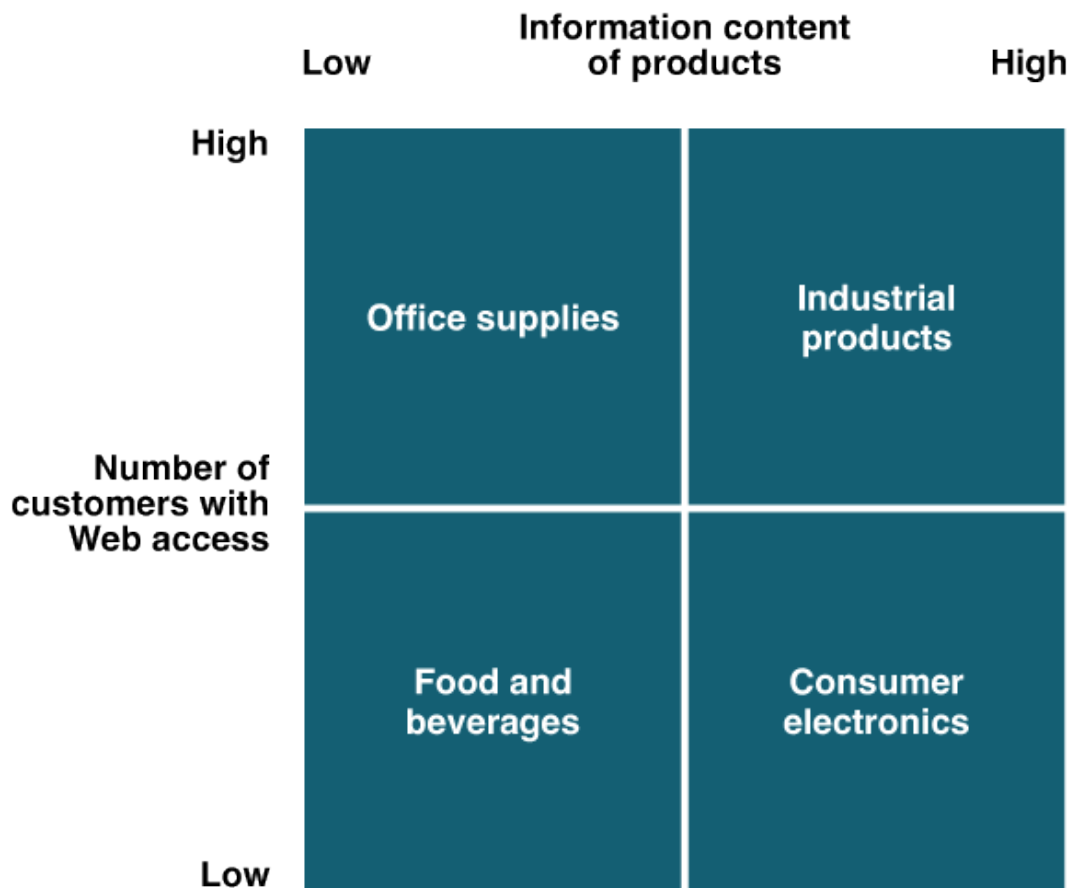
"Internet Presence Grid" (click to enlarge) adapted from Richard T. Watson CC-BY

Strategic Challenges

Now that we have explored how businesses are leveraging the internet to sell their products and services and the benefits and concerns, it is important to understand the strategic challenges of doing so. Companies often face three critical strategic challenges:

Demand Risk	Sharply changing demand or the collapse of markets poses a significant risk for many firms. The web can be used to diversify a business by taking new products to new markets.
Innovation Risk	Not being adaptable, which can lead to stagnation, and ultimately failure to remain competitive. Businesses need to be open to new ideas, and these ideas can come from customers. The internet allows communication with customers for this purpose.
Inefficiency risk	Failure to match competitors' unit costs–inefficiency risk. The internet can help reduce operating costs, such as information distribution.

10.5. TYPES OF E-COMMERCE

Every internet business is either pure-play, or brick-and-click. A **pure-play** business, such as Amazon and Well.ca, has an online presence only and uses the capabilities of the internet to create a new business. **Brick-and-click** businesses, such as Indigo and Canadian Tire, combine a physical presence with an online presence. These businesses use the Internet to supplement their existing businesses (Krishnamurthy, 2003).

There are several different types of e-commerce that can describe almost every transaction that takes place between consumers and businesses.
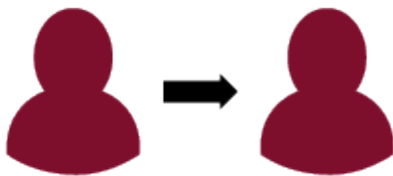

Types of e-Commerce

Business to Business (B2B)	When a business sells a good or service to another business. For example, a business that sells software-as-a-service for other businesses to use, or Staples selling office supplies. This is the largest form of e-commerce
Business to Consumer (B2C)	When a business sells a good or service to an individual consumer. For example, when you buy a pair of shoes from an online retailer like Nike.
Consumer to Consumer (C2C)	When a consumer sells a good or service to another consumer. The most well known C2C is eBay, but there are many other online market providers as well, like Kijijii or Craigslist. Peer-to-peer (P2P) are also a form of consumer to consumer. See more about P2P below.
Consumer to Business (C2B)	When a consumer sells their own products or services to a business or organization. For example, an influencer offers exposure to their online audience in exchange for a fee, or a photographer licenses their photo for a business to use.

e-Commerce can also involve the government.

Business to Government (B2G)	Defined as e-commerce transactions with the government. The internet is used for procurement, filing taxes, licensing procedures, business registrations, and other government-related operations. This is an insignificant segment of e-commerce in terms of volume, but it is growing.
Consumer to Government (C2G)	Defined as e-commerce transactions between the government and individuals. This would involve licenses and registrations, and paying taxes.

M-Commerce

Mobile e-commerce (m-commerce) refers to the purchase of goods and services through wireless technology, such as cell phones and handheld devices. M-commerce is growing fast with an estimated 73% of all e-commerce sales being done via a mobile device (Loesche & Richter, 2018, March 6). This can be attributed to the fact that many people now own smartphones, and they are using them all the time. This has made it convenient to be able to leverage this technology to shop online.

Growth in M-Commerce

M-commerce transactions continue to grow as a result of the following:

- The **number of global mobile users is steadily increasing** every year, resulting in an increased demand for mobile websites and applications.
- The **rapid adoption of e-commerce** means that evolving customers are looking for more options across more devices.
- **Improved technology** has given mobile devices advanced capabilities and faster internet access enabling m-commerce to be available on even the most affordable devices.
- **Broadband technology** and **lowering data costs** mean more consumers have access to m-commerce even on affordable devices and data plans.
- Mobile users are looking for **instant gratification** online; this includes their online shopping needs. Increase in m-commerce for fast food, fresh produce and basic household items have been driven by this need for customers to get what they need when and where they want it.

Benefits of M-Commerce

Access	Gaining access to the internet through mobile is easier and more affordable than desktop options. The falling costs of data and improved internet access on mobile mean more and more users have access to the internet via mobile than any other device.
Convenience	Mobile phones are always with us and being constantly connected enhances the benefits of anytime, anywhere use with no need to plug in to or log in to computers wherever they are situated.
Costs	Mobile devices are more affordable than computers and offer multiple uses reducing the need for an additional computer. Calls, messaging services, social media and news content are just a few of the reasons consumers would prefer to use a single device making mobile phones the obvious choice
Ease of use	Mobile phones are relatively easy and simple to use, and there is no need for a particularly digitally skilled consumer. They allow consumers to make instant purchases with little technical skill.
Mobile Payment	Security around online payments remains the biggest barrier to e-commerce. Mobile payments allow alternative options for transactions via mobile currencies, mobile wallets and alternative mobile only payment methods. Such easy and secure payment options make mobile the preferred choice for many users.
Rich Content	Advances in mobile processing power means content can be easily accessed on mobile web browsers and mobile applications. Rich media allows brands to better demonstrate a product's key features, share testimonials, and showcase the use/look of the product or service.

Peer to Peer (P2P)

Peer-to-peer is a form of e-commerce comprised of an online platform that connects individuals looking to transact with one another. Some examples of P2P are Etsy, Uber, Airbnb and TaskRabbit.

10.6. E-COMMERCE MODELS

An **e-commerce business model** is the method that a business uses to generate revenue online. E-commerce can take on a variety of forms involving different transactional relationships between businesses and consumers.

Retail	The sale of a product by a business directly to a customer without any intermediary.
Wholesale	The sale of products in bulk, often to a retailer that then sells them directly to consumers.
Dropshipping	The sale of a product, which is manufactured and shipped to the consumer by a third party.
Crowdfunding	The collection of money from consumers in advance of a product being available in order to raise the startup capital necessary to bring it to market. Example: Kickstarter
Subscription	The automatic recurring purchase of a product or service on a regular basis until the subscriber chooses to cancel. Examples: newspaper subscriptions, music streaming sites (Spotify)
Transaction Brokers	Companies who facilitate a transaction and take a portion of the revenue. Example AirBnb, EventBrite

As well e-commerce can involve different objects being exchanged as part of these transactions.

Physical products	Any tangible good that requires inventory to be replenished and orders to be physically shipped to customers as sales are made.
Digital products	Downloadable digital goods, templates, and courses, or media that must be purchased for consumption or licensed for use. For example, maybe you take a digital course online through LinkedIn Learning.
Services	A skill or set of skills provided in exchange for compensation. The service provider's time can be purchased for a fee.

The Business to Consumer Cycle

In the B2C e-commerce cycle a customer visits a website and peruses the products offered. They choose a product and place an order which then gets added to their online shopping cart. Once they have completed their selection, they navigate to their shopping cart and choose a shipping address and make a payment. Payment options are explored in detail later in the chapter.

On the other end, the business fulfills the order and prepares it for shipping. The order is then shipped, and the customer is notified of this step. The customer can follow up with customer service if there are any issues with the order or shipment. The customer is also sometimes asked to provide a review of the product so that future potential customers can benefit from this experience. If a customer is unhappy with their product, they can reach out to customer service and explore their options. Some companies, like Amazon, allow customers to return their orders online, and a return label is automatically created for printing. The customer simply has to package the item and return it via Canada Post or another shipping company.

10.7. E-COMMERCE TECHNOLOGY

Adapted from image by 200degrees Pixabay License (re-coloured)

An **e-commerce platform** is a way to build and create an online experience that allows a company to make sales and fulfill orders. While most people think an e-commerce platform is just a tool that provides a list of products and accepts payments online, a true e-commerce platform is much more than that. It is a complete business command center that controls everything from inventory to marketing. It should support basic requirements such as custom styling, search engine optimization, credit card processing, promotions, catalog management, analytics, product browsing, checkout, and order management. Some examples of e-commerce platforms are Shopify, Wix and BigCommerce.

To make an online store accessible to the public it requires a hosting solution. **Hosting** stores information on a server, which allows internet users to visit a company's site and view all of the content. Every website is hosted somewhere, meaning it has dedicated server space from a provider. Some e-commerce platforms have hosting built in, while others require self-hosting or open-source hosting.

Hosted	Some ecommerce website builders offer a hosted platform. Building on a hosted ecommerce platform provides freedom to focus on the business, and not the technology management of the site.
Self-hosted	Self-hosted platforms require companies to use their own server space or pay to rent space from a hosting provider. This makes ongoing website management complex, as you're responsible for updates, maintenance, and bug fixes. This requires a lot of internal resources that you could otherwise allocate elsewhere. Self-hosted platforms are typically open source, and you use a third party to host your website data. Third-party sourcing options charge fees for their services, and these costs quickly add up. Many times, these hosting services use tiered pricing structures, so those on the lowest plans don't get much in the way of customer support. This can leave you hanging at really important times, like traffic boosts after unexpected press coverage.

Instead of going with an e-commerce platform, businesses can also hire a full-service web developer to provide design, programming, support, hosting, search engine optimization, and more. Any combination of the services can be selected. Having the developer perform all the services would be the most expensive alternative. The ultimate cost for a website will be a function of its size, complexity, and the level of design. No two projects will cost the same. Part of the process of building a website, however, should be conducting some research and talking with website designers. The Internet offers a variety of sources on how to determine how much a website should cost. WebFX.com offers a historical perspective on website costs, a cost calculator to find out how much a web project would cost, and examples of specific web design and website development projects with cost figures (WebFx, 2022).

Search Engine Optimization

It is important when creating a website to consider **search engine optimization (SEO)**. Search Engine Optimization (SEO) refers to the techniques that help a website rank high in organic search results (such as on Google and other search engines). There are the two types of listings that appear when using a search engine: organic search and paid search. SEO aims to make a website more visible to people looking for specific information or a particular product or service via search engine. SEO falls under the umbrella of **Search Engine Marketing(**SEM). SEM is a form of internet marketing that involves the promotion of websites by increasing their visibility in search engine result pages primarily through paid advertising.

Payment Methods

Security, privacy, and trust are most important when considering the payment function. Without this transaction, there is no e-commerce, so it is imperative that businesses take the necessary steps to reduce customer concerns about shopping online. It is also important for merchants to offer multiple payment methods to provide flexibility and ensure customers complete their purchase. See the following types of payment methods. Credit cards are by far the most popular payment method for online transactions.

Electronic Payment

E-payment is any payment done electronically. This form of payment includes debit cards, credit cards, gift cards, e-transfers, email payments, mobile wallets, and cryptocurrency.

e-Transfers

Electronic transfer or e-transfer is the ability to send money from your bank account held at a Canadian financial institution

through the [Interac Corporation](#). With e-transfers the sender logs-on to their bank account and chooses a recipient to send money to. The recipient's email or phone number is provided for notification of the transfer. A security question can be added so that only the recipient with the correct password can process the transaction. The popularity of e-transfers is growing with 57 percent of the country's population registering for the service by the end of 2018. Most e-transfers happen on mobile phones (Interact Corporation, 2021, May 15).

E-Mail based methods (PayPal)

PayPal is a form of an email based payment method where members are able to send money to any registered person. Registration requires the user to set up an account with their e-mail address. A notification is sent to those individuals who are to receive funds but are not registered. PayPal accounts are tied to the registrants credit card or bank account. Paypal also has a mobile application that can be used for contactless payment through the use of QR codes.

Mobile Wallets

A mobile wallet is an application on your mobile device that stores your payment information to allow for contactless payments. It is like a regular wallet where you keep your credit, debit or prepaid cards. You can use your mobile wallet when shopping in-person or online. Your financial institution or the merchant may set limits on how much money you can spend using a mobile wallet. There are concerns about how financial information is stored on mobile wallets, and what happens if you were to lose your phone. To learn more about Mobile Wallets and the safety of them, go to the information page by the [Financial Consumer Agency of Canada](#). Some examples of mobile wallets in Canada are: Apple Pay, Google Pay, Samsung Pay.

[“What's the Best Ecommerce Platform for Your Business? Here's How to Evaluate Your Options”](#) by Alexandra Sheehan Shopfy Blog is licensed under a [Creative Commons Attribution 4.0 License](#) unless otherwise noted.

10.8. BLOCKCHAIN AND BITCOIN

Blockchain

Blockchain is a peer-to-peer network which provides an open, distributed record of transactions between two parties. A peer-to-peer (P2P) network is one where there is no server between the two nodes trying to communicate. Essentially, this means that each node acts as a server and a client.

Supporters see blockchain as a tool to simplify all types of transactions: payments, contracts, etc. Motivation comes from the desire to remove the middleman (lawyer, banker, broker) from transactions, making them more efficient and readily available across the internet. Blockchain is already being used to track products through supply chains. Blockchain is considered a foundational technology, potentially creating new foundations in economics and social systems. There are numerous concerns about Blockchain and its adoption. Consider the following:

- **Speed of adoption**. Initially there is a great deal of enthusiasm by a small group. However, adoption on a larger scale can take a great number of years even decades for a worldwide acceptance of a new method of doing business.
- **Governance**. The banking sector, both in individual countries (Bank of Canada and U. S. Federal Reserve System) and the world at large (the International Monetary Fund-IMF), controls financial transactions. One purpose of these organizations is an attempt to avoid banking and financial systems collapse. Blockchain will result in the governance of financial transactions shifting away from these government-controlled institutions.
- **Smart contracts**. The smart contract will re-shape how businesses interact. It is possible for blockchain to automatically send payment to a vendor the instant the product is delivered to the customer. Such "self-executing" contracts are already taking place in banking and venture capital funding (Iansiti & Lakhani, 2017, January).

Many are forecasting some universal form of payment or value transfer for business transactions. Blockchain and Bitcoin are being used to transform banking in various locations around the world.

Bitcoin

Bitcoin is a form of digital currency sometimes referred to as a cryptocurrency which is a new form of money that is tradable throughout the world. It operates without the involvement of central banks or a clearinghouse and runs as a P2P network. Bitcoins can be transferred between individuals or between businesses to pay for goods and services, all without the use of a bank, so the fees for that exchange are lower. Bitcoins do have value and, as such, are subject to taxation just as with cash in your local currency. Records for transactions are recorded in the blockchain.

Advantages of Using Bitcoin

Some of the advantages of using Bitcoin over another online payment network, such as PayPal, or even your bank, are:

- It can be used in any country without the need for currency conversion;
- Sending money to a business or individual costs less per transaction;
- There are no limits to the number of transactions you can initiate each month;
- Your account cannot be frozen or suspended;
- Transactions are irreversible, unlike PayPal payments; and
- You can keep Bitcoins in a digital wallet that is accessible from your phone, tablet, or computer.

Several of these advantages exist because there is no central governing authority, as there is with a bank. Of course, that may also be a disadvantage. Bitcoin is still considered "experimental," even by the organization itself, so be aware that there are also risks involved in accepting Bitcoins in place of cash. Bitcoin began trading in 2009.

Another potential advantage is that the fee to transfer Bitcoins from one person or business to another is unrelated to the amount being transferred. Unlike other payment networks that charge a percentage of the transaction value, Bitcoin charges based on the ability to reverse the transaction – the easier to cancel, the lower the fee.

That is, a Bitcoin transaction takes an average of 10 minutes to be resolved – 90 minutes at the most. During that process, there are confirmations that occur that the transfer of Bitcoins is occurring. The fewer the number of confirmations requested – you can request zero – the lower the fee to send coins; there is never a fee to receive Bitcoins. But you can also request as many as 36 confirmations to be absolutely sure that once the Bitcoins are in your account, they cannot leave without your permission.

This can be especially useful when selling expensive goods. On some payment networks, a buyer can claim to have an issue with an order and almost immediately receive a refund, even without your input. This would not happen with Bitcoins – once the payment is in your account, it is yours to keep.

Tanzania Bitcoin Project

A major bitcoin project is underway in Tanzania. Business transactions in this East African country are fraught with many challenges such as counterfeit currency and a 28% transaction fee on individuals who do not have a bank account. Seventy percent of the country's population fall into this category. Benjamin Fernandes, a Tanzanian and 2017 graduate of Stanford Graduate School of Business, is co-founder of NALA, a Tanzanian firm working to bring cryptocurrency to a country where 96% of the population have access to mobile devices. NALA's goal is to provide low cost transactions to all of the country's citizens through cryptocurrency (Fernandes, 2017, October 20). You can read more of this cryptocurrency venture in this article in TechCrunch.

"Chapter 6: Information Systems Security" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

"What is Bitcoin?" By Shopify Business Encyclopedia is licensed under a Creative Commons Attribution 4.0 License unless otherwise noted.

10.9. TRENDS

Social Commerce

Social factors—our attitudes, values, ethics, and lifestyles—influence what, how, where, and when people purchase products or services. However, they can be difficult to predict, define, and measure making the job of marketing more challenging. Social networks are changing that as customers are providing larges amounts of information about themselves and their preferences online for digital advertisers to mine and collect.

Online **social networks** provide a platform for people to connect with each other and share information. Facebook, Instagram, Twitter, LinkedIn and TikTok are all examples of online social networks that allow for the exchange of information. These platforms are valuable to the users, but can also be valuable for businesses. They provide insight into customer behaviour that can help direct business strategy, and also be used to market goods and services. According to Gartner, 74% of consumers rely on social networks to guide purchase decisions (Gartner UK Ltd Tamesis, 2010, July 26).

This is referred to as **social commerce** where online social networks are utilized to promote the sale of goods and services. Social commerce provides a means for interactive shopping, including reviews, ratings, and social shopping websites where you can chat with merchant personnel or with friends while you are shopping.

Benefits of Social Commerce

Just like m-commerce, there are certain benefits that s-commerce has over traditional e-commerce. These include:

Audience Growth	As of January 2017, over 2.7 billion people were on social media. This is more than a third of the global population. This number is also up over 20% from 2016. A tremendous growth, with little sign of slowing down (Chaffey, 2017). One of the most important considerations for any e-commerce business is how to reach and sell to its target customer audience, and from these statistics it is safe to say that a large proportion of any brand's market is on social media.
Higher Search Ranking	Using social media for s-commerce increases traffic to your website which will influence your ranking on search engine results. It also allows your audience to engage with a product, like or share it, and to reach an even larger audience.
Authentic Engagement	The most significant benefit of using social media for s-commerce is the engagement and reach that businesses can get whenever they share content. By appearing in followers' updates or feeds on a regular basis, you're participating in a powerful branding opportunity. Operating on social media encourages users to connect with a business through two-way communication. This allows customers to not only engage with your business on a commercial level, but it also gives them the opportunity to use social media as an efficient customer service channel where it's possible to solve problems. Social media word-of-mouth (sharing/ reposting) helps with audience building, as well as increased engagement and website traffic.
Customer Loyalty	S-commerce is not purely focused on selling but uses the social platforms to help the business build relationships with potential and existing customers. Such relationships can deepen trust and loyalty between consumers and the brand. This in turn creates happy, satisfied customers, who will likely be customers who make repeat purchases, i.e. a loyal customer.
Analytics	Social media platforms make it easy to track, measure and evaluate conversions that happen through s-commerce. Facebook, Twitter, Instagram, Pinterest and LinkedIn all offer built-in analytics tools for measuring traffic, clickthrough, fans/followers, likes, sentiment and actual conversions coming via the social platform. This is a huge benefit for monitoring your ROI.

Social Media Marketing

As more and more people around the planet become connected through social media, the influence of these channels continues to grow. In response, organizations allocate more promotion budgets to social media. This makes sense when social media strategies align with broader marketing strategies in support of corporate objectives.

When used effectively, social media marketing can generate a lot of buzz without a lot of expense. There are still costs associated with content creation, but the proliferation of online content creators and hungry media outlets means that on social media, content tends to be cheap. The 24-7 cycle of global social media requires eyes, brains and analytical tools to stay on top of everything happening, but never before has it been so easy to tap into, listen and learn from individuals and communities interacting with your product or brand. It is undoubtedly exciting for your brand to become a trending topic among these networks, but it is important to remember social media attention can easily veer into positive or negative territory. Absolute control of the message is virtually impossible with social media. Managing consumer perceptions requires attention and perseverance.

Because many people share immense amounts of information about themselves through social media, increasingly marketers can use this information to deliver highly targeted messages and offers. Navigational click-stream data from social media and other websites is another source of valuable information about consumer behaviour, what makes them tick, and how they do or don't choose to engage with your brand. At the same time, firms must be prepared to address increasingly complex cybersecurity and data privacy challenges.

New Retail

New Retail is a term that was coined by Alibaba's Jack Ma, which is defined as an "integrated retail delivery model where offline, online, logistics, and data, converge to enhance customer experience (Medium Predict, 2021, May 8)." Essentially, this means that the boundary between offline and online commerce disappears. A way that an online store can create a physical presence is through a pop-up shop, or creating a partnership with other retailers where physical displays are set up. Companies can digitize their supply chain by offering the ability to buy online and pick up in store. Some companies have also explored the options of using digital ordering within physical stores for products that customers would like to see and touch. New retail is really about leveraging technology to make the process of shopping seamless whether you are in-store or online.

10.10. SUMMARY

Key Takeaways

- E-business and e-commerce are not synonymous terms. E-business consists of several major components, one of which is e-commerce.
- Every Internet business is either pure-play (an Internet presence only) or brick-and-click (having both a physical and an online presence).
- The seven major types of e-commerce are B2B, B2C, C2C, B2G, C2B, m-commerce, and P2P.
- An e-commerce business model is the method that a business uses to generate revenue online. Some models are very simple; others are more complicated. New business models are being introduced all the time.
- Different technologies can be used for e-commerce including all-in-one e-commerce platforms, and digital payments systems.
- Blockchain which is a digital distributed record of transactions is being leveraged for bitcoin which is a cryptocurrency that can be used for digital payment.
- Social media platforms are popular tools for marketers to promote products and services and glean valuable customer data.
- New Retail blurs the line between off-line and on-line commerce to improve the customer experience.

Review Questions

1. What is e-commerce and how is it different from e-business?
2. What are some popular e-commerce sites in Canada?
3. What is the business to business e-Commerce cycle?
4. List and describe some advantages and disadvantages of e-commerce.
5. Outline some models for business to business e-commerce.
6. What is mobile commerce and what is it being used for?
7. Provide some different forms of electronic payment. Why are electronic payment systems on the rise?
8. What is social commerce and why do you think this works?
9. What are some e-commerce innovations? Where do you see e-commerce heading?

10.   What does New Retail mean?

Assignment

Overview

This assignment is designed to help you understand e-commerce trends.

Assignment

In this assignment you will explore some trends and innovations in e-commerce. Focus on the theme of ***blurring the lines between offline and online.*** Complete the following questions in a separate document.

Choose an e-commerce application or innovation that interests you. Share a quick video, or link, or picture that provides some context of the technology. Answer the following questions:

1.   What is the application/innovation? How does it work?
2.   What are the benefits? How does this impact business?
3.   What are the concerns?
4.   Would you use it?

10.11 KEY TERMS

Chapter 10

Bitcoin: A form of digital currency sometimes referred to as a cryptocurrency which is a new form of money that is tradable throughout the world. (10.8)

Blockchain: A peer-to-peer network which provides an open, distributed record of transactions between two parties. (10.8)

Brick-and-Click Businesses: Such as Indigo and Canadian Tire, combine a physical presence with an online presence. These businesses use the Internet to supplement their existing businesses.(10.5)

E-Commerce Business Model: The method that a business uses to generate revenue online. E-commerce can take on a variety of forms involving different transactional relationships between businesses and consumers.(10.6)

E-Commerce Platform: A way to build and create an online experience that allows a company to make sales and fulfill orders. (10.7)

E-payment: Any payment done electronically. This form of payment includes debit cards, credit cards, gift cards, e-transfers, email payments, mobile wallets, and cryptocurrency. (10.7)

Electronic Business or E-Business : The use of computer networks to improve organizational performance. Increasing profitability, gaining market share, improving customer service, and delivering products faster are some of the organizational performance gains possible by doing business electronically. (10.2)

Electronic Transfer or E-Transfer: The ability to send money from your bank account held at a Canadian financial institution through the Interac Corporation. (10.7)

Fake Reviews: Often created by bots which allows companies to leverage security systems to filter and remove this type of activity. (10.3)

Hosting: Stores information on a server, which allows internet users to visit a company's site and view all of the content.(10.7)

Mobile M-Commerce (M-Commerce): Refers to the purchase of goods and services through wireless technology, such as cell phones and handheld devices. (10.5)

Mobile Wallet: An application on your mobile device that stores your payment information to allow for contactless payments. It is like a regular wallet where you keep your credit, debit or prepaid cards. (10.7)

New Retail: A term that was coined by Alibaba's Jack Ma which is defined as an "integrated retail delivery model where offline, online, logistics, and data, converge to enhance customer experience." (10.9)

Peer-to-Peer Network (P2P): One where there is no server between the two nodes trying to communicate. Essentially, this means that each node acts as a server and a client. (10.8)

Pure-Play Business: Such as Amazon and Well.ca, has an online presence only and uses the capabilities of the internet to create a new business. (10.5)

Social Commerce: Where online social networks are utilized to promote the sale of goods and services. Social commerce provides a means for interactive shopping, including reviews, ratings, and social shopping websites where you can chat with merchant personnel or with friends while you are shopping. (10.9)

Social Networks: Provide a platform for people to connect with each other and share information. Facebook, Instagram, Twitter, LinkedIn and TikTok are all examples of online social networks that allow for the exchange of information. (10.9)

Adapted from Information Systems for Business and Beyond Glossary by Ruth Guthrie licensed under a CC-BY-3.0

10.12. KNOWLEDGE CHECK

Knowledge Check 1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1797#h5p-54

Knowledge Check 2

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1797#h5p-42

Knowledge Check 3

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1797#h5p-43

CHAPTER 11: BUSINESS PROCESS SOLUTIONS

Chapter Outline

Photo by Christina Unsplash License

11.1. CHAPTER INTRODUCTION

Learning Outcomes

Upon successful completion of this chapter, you will be able to:

- Define the term business process;
- Explain how business process management and business process re-engineering work and the associated advantages and disadvantages;
- Identify the different systems needed to support business processes in an organization;
- Explain transaction processing systems, and contrast them to enterprise systems; and
- Outline how information technology combined with business processes can bring an organization competitive advantage.
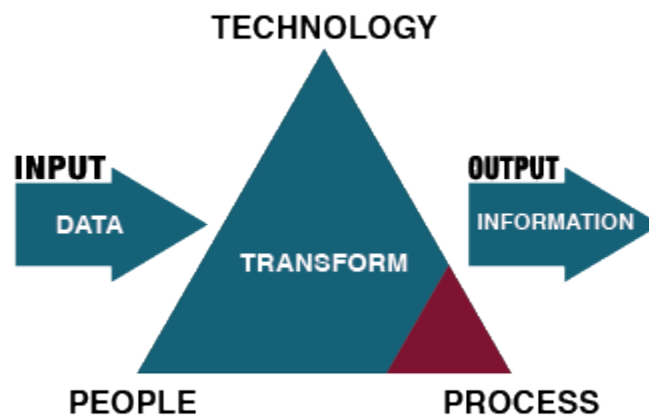
Processes are another component of information systems, but what is a process and how does it tie into information systems? This chapter explores business processes, and the strategies employed to improve them. In addition, information systems that can be utilized to automate business processes for strategic advantage are examined.

11.2. BUSINESS PROCESS

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. Processes are something that businesses go through every day in order to accomplish their mission. The better the 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). If you have worked in a business setting, you have participated in a business process. Anything from making a sandwich to building a space shuttle utilizes one or more business processes. In the context of information systems, a business process is a set of business activities performed by human actors and/or the information system to accomplish a specific outcome.

Documenting a Process

Every day each of us will perform many processes without even thinking about them such as getting ready for work, using an ATM, texting a friend, etc. As processes grow more complex, documenting them becomes necessary. It is essential for businesses to do this because it allows them to ensure control over how activities are undertaken in their organization. It also allows for standardization. For example, Tim Hortons has the same process for making coffee in all of its restaurants.

The simplest way to document a process is to just create a list. The list shows each step in the process. Each step can be checked off upon completion. A simple process such as how to create an account on Gmail might look like this:

1. Go to gmail.com.
2. Click "Create account." For myself.
3. Enter your contact information in the "Create your Google Account" form.
4. Choose your username and password.
5. Agree to User Agreement and Privacy Policy by clicking on "Submit."

For processes that are not so straightforward, documenting all of the steps 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 step 1.
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 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 responsibility 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 considered the 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 approval.
- **Communication**. When a process changes, those who implement the process need to be made aware of the changes. The document management system will notify the appropriate people when a change to a document has been approved.
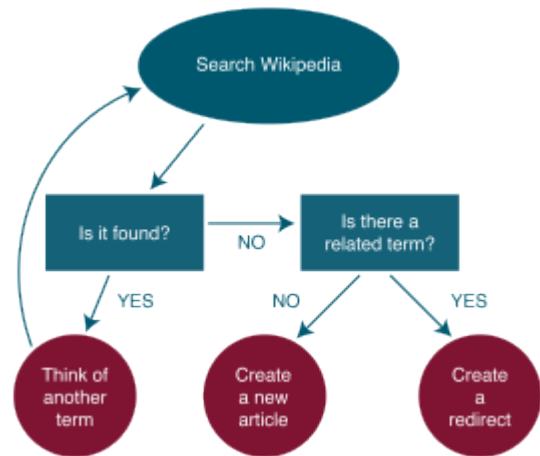
Of course, document management systems are not only used for managing business process documentation. Many other types of documents are managed in these systems, such as legal documents or design documents.

Tools for Documentation

A **diagramming tool** for documentation of business processes is a formalized visual language that provides systems analysts with the ability to describe the business processes unambiguously, to visualize the business processes for systematic understanding, and to communicate the business process for business process management. Natural languages (e.g., English) are incapable of explaining complex business processes. Diagrams have been used as tools for business process modeling in the information systems field. There have been many types of business process diagramming tools, and each of them has its own style and syntax to serve its particular purpose. The most commonly used business process diagramming tools are Business Process Modeling Notation (BPMN), Data Flow Diagram (DFD), and the Unified Modeling Language (UML).

BPMN	is an extension of the traditional flowchart method by adding more diagramming elements for descriptions of business processes. The objective of BPMN is to support business process documentation by providing intuitive notations for business rules. The flowchart style diagrams in BPMN can provide detailed specifications of business processes from start to end. However, BPMN is short of the ability of system decomposition for large information systems.
DFD	has served as a foundation of many other tools of documentation of business processes. The central concept of DFD is a top-down approach to understanding a system. The top-down approach is consistent with the system concept that views a system in a holistic manner and concerns an understanding of a system by examining the components and their interactions within the system. More importantly, while describing a business process by using DFD, the data stored is used in the process and generates data flows in the process are also defined. See an example of a DFD illustrating the integration of data and business tasks in documenting a business process below.
The Unified Modeling Language (UML)	is a general-purpose modeling tool in the field of software engineering for constructing all types of computerized systems. UML includes a set of various types of diagrams with different subjects of modeling and diversified graphics styles. The diversified diagrams in UML can provide detailed specifications for software engineering in many perspectives for construction of information systems, but could be too complicated for documenting business processes from the perspective of business process management.

11.3. 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.

Business Process Management in Retail Example

Suppose a large clothing retailer is looking to gain a competitive advantage through superior customer service. A task force is created 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 Enterprise Resource Planning (ERP) system to implement this returns policy (more on ERP systems in this chapter).

In preparation for the rollout of the system, all customer-service employees are trained, showing 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 it is determined that many women are returning their high-end dresses after wearing them once, they could implement a change to the process that limits the return period to 14 days from the original purchase date. 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.

Business Process Management

Empowering Employees

Built-in Reporting

Enforcing Best Practices

Enforcing Consistency

Business Process Management Benefits

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, it is also important to understand that 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 suggested 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 (Hammer, 1990).

Business process reengineering (BPR) 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.

Unfortunately, business process re-engineering got a bad name in many organizations. This was because it was used as an excuse for

cost cutting that really had nothing to do with BPR. For example, many companies simply used it as a reason for laying off part of their workforce. However, today many of the principles of BPR have been integrated into businesses and are considered part of good business-process management.

Reengineering the College Bookstore Example

The process of purchasing the correct textbooks in a timely manner for college classes has always been problematic. Now with online bookstores competing directly with the college bookstore for students' purchases, the college bookstore is under pressure to justify its existence. But college bookstores have one big advantage over their competitors, namely they have access to students' data. Once a student has registered for classes, the bookstore knows exactly what books that student will need for the upcoming term. To leverage this advantage and take advantage of new technologies, the bookstore wants to implement a new process that will make purchasing books through the bookstore advantageous to students. Though they may not be able to compete on price, they can provide other advantages such as reducing the time it takes to find the books and the ability to guarantee that the book is the correct one for the class. In order to do this, the bookstore will need to undertake a process redesign.

The goal of the process redesign is simple. Capture a higher percentage of students as customers of the bookstore. After diagramming the existing process and meeting with student focus groups, the bookstore comes up with a new process. In the new process the bookstore utilizes information technology to reduce the amount of work the students need to do in order to get their books. In this new process the bookstore sends the students an e-mail with a list of all the books required for their upcoming classes. By clicking a link in this e-mail the students can log into the bookstore, confirm their books, and complete the purchase. The bookstore will then deliver the books to the students. And there is an additional benefit to the faculty: Professors are no longer asked to delay start of semester assignments while students wait for books to arrive in the mail. Instead, students can be expected to promptly complete their assignments and the course proceeds on schedule.

BEFORE
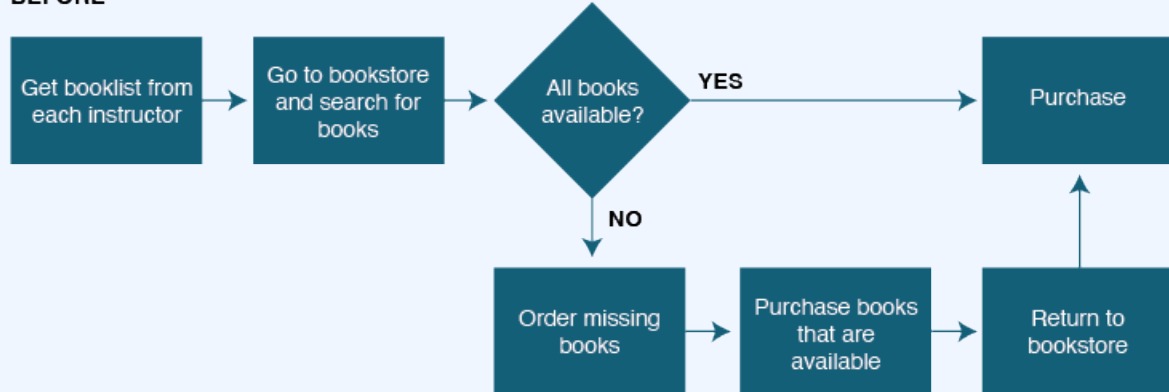
REDESIGNED
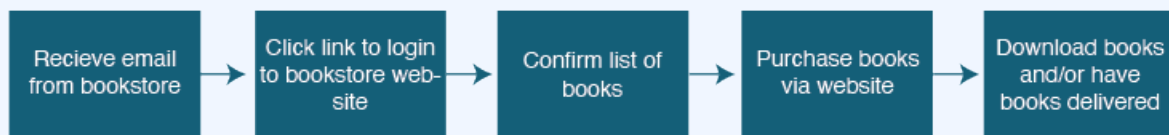
Here are the changes to this process shown as data flow diagrams:

BEFORE
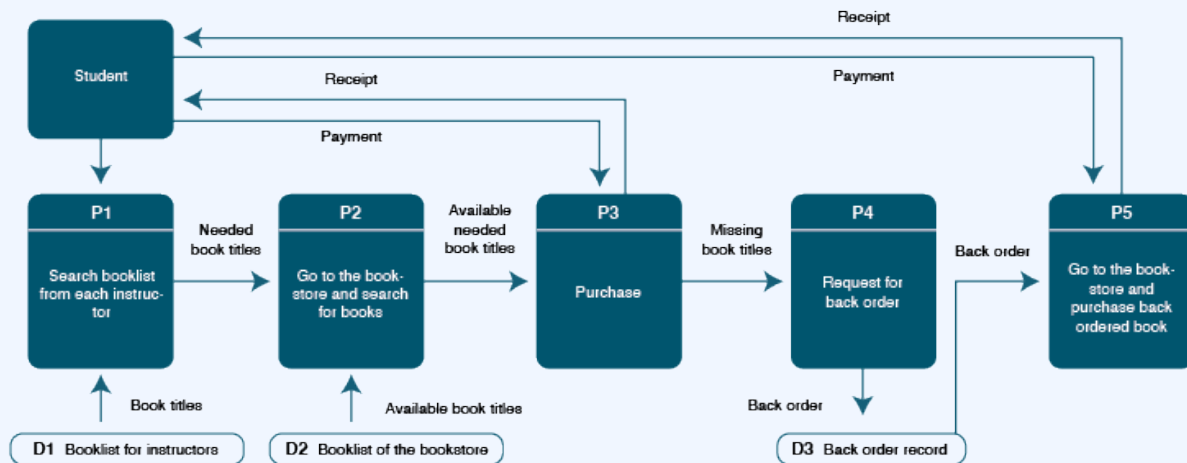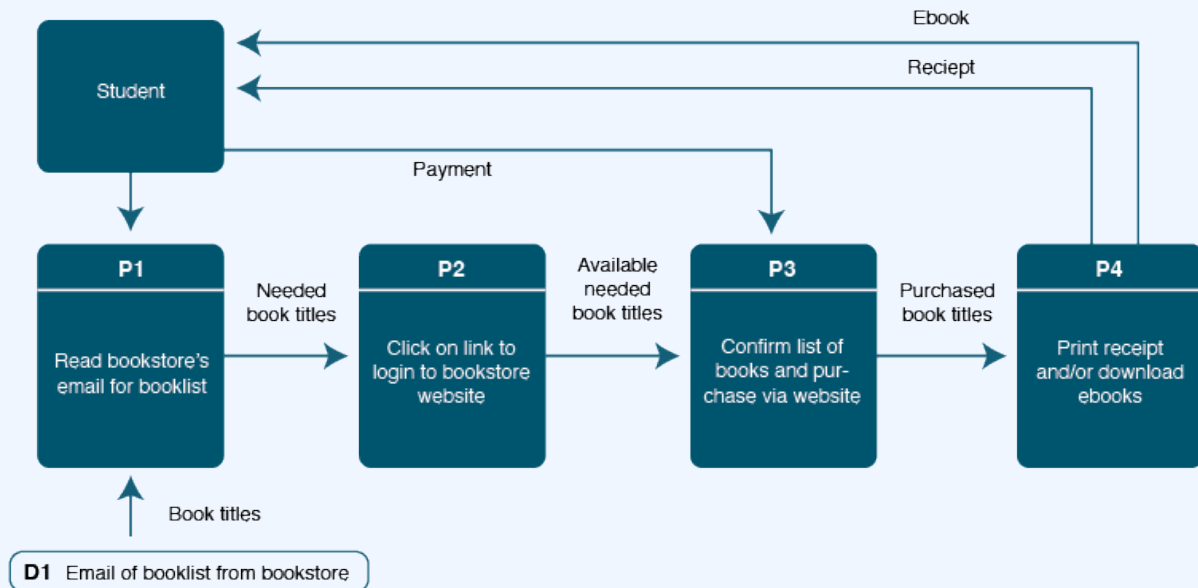
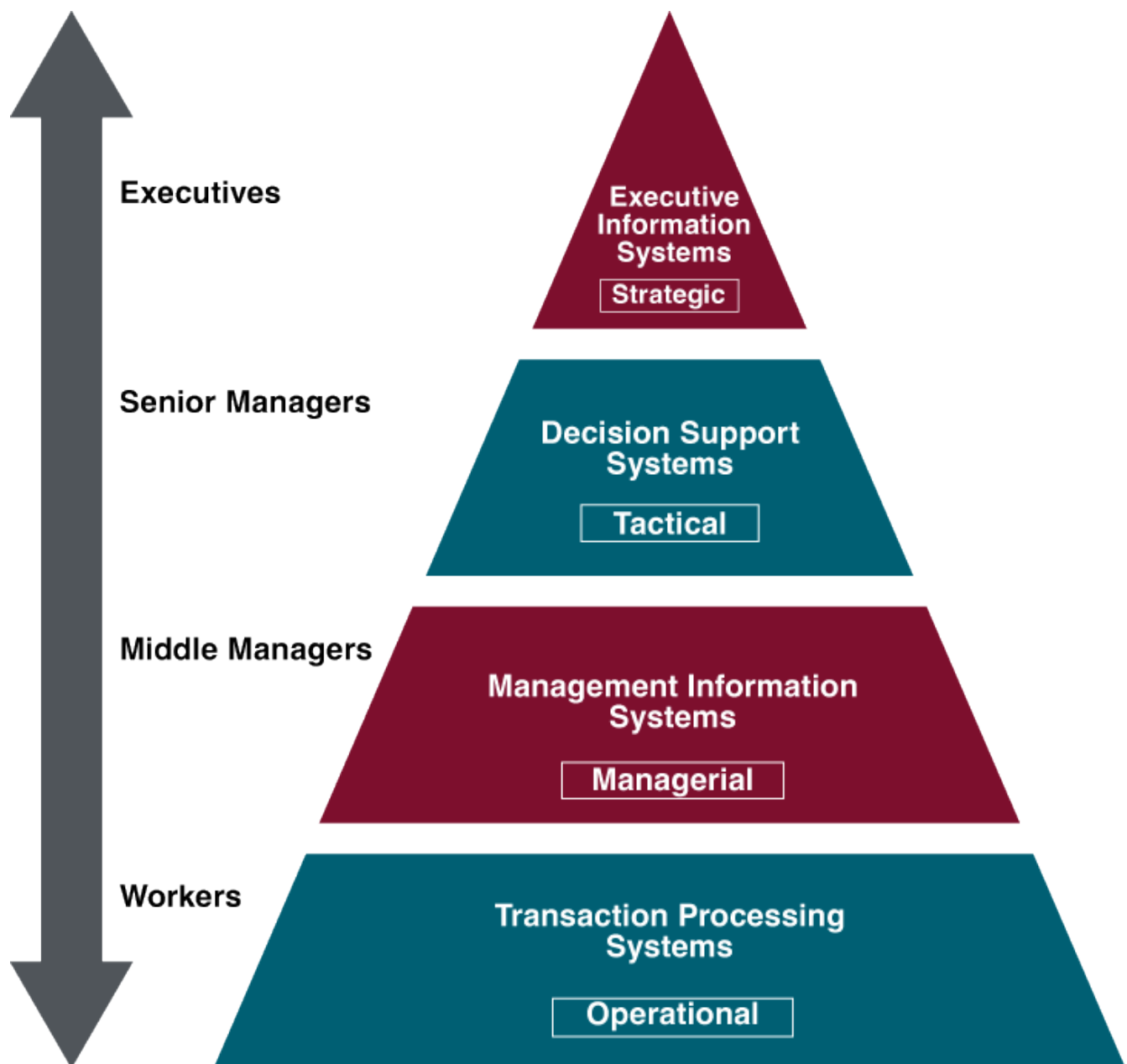Images adapted from Information Systems for Business and Beyond by D. Bourgeois CC-BY-NC

11.4. INFORMATION SYSTEMS

Now that we understand business processes and how to document them, we will explore the different systems businesses use to manage their operations. It is critical that a business understands its own internal processes before purchasing or developing a new system. Sometimes the new system is built to fit the internal processes or sometimes the system dictates how the business operates. To review the systems development process, please see Chapter 7.

There are many different ways in which systems are utilized to automate processes and transactions. Factories use information systems to automate production processes and manage inventory. Banks use a variety of systems to process transactions such as deposits, ATM withdrawals, and loan payments. Information systems are also used to process customer orders and handle billing and vendor payments. Companies typically have several types of information systems, starting with systems to process transactions. Each type of system serves a particular level of decision-making: operational, tactical, and strategic. The image below shows the relationship between transaction processing and management support systems as well as the management levels they serve. Decision support systems will be covered in the next chapter. Let's take a more detailed look at how companies and managers use transaction processing and management support systems.

Information System Types Pyramid Model (click to enlarge). Adapted from Five Level Pyramid Model by Compo CC-BY 3.0

Transaction Processing Systems

An integrated information system starts with a T**ransaction Processing System** (TPS). A TPS is a system that collects, modifies and retrieves business transaction data. Every time a consumer uses a point-of-sale system, an ATM, or a service desk, there's a transaction (some kind of business exchange) occurring, representing an event that's likely worth tracking. The cash register is the data generation workhorse of most physical retailers, and the primary source that feeds data to the TPS. But while TPS can generate a lot of bits of data, it's sometimes tough to match this data with a specific customer. For example, if you pay a retailer in cash, you're likely to remain a mystery to your merchant because your name isn't attached to your money. Grocers and retailers can tie you to cash transactions if they can convince you to use a loyalty card. Use one of these cards and you're in effect giving up information

about yourself in exchange for some kind of financial incentive. The explosion in retailer cards is directly related to each firm's desire to learn more about you and to turn you into a more loyal and satisfied customer.

The image below illustrates a transaction processing system in which the transaction is a customer's electronic payment of a bill. As you can see, transaction processing system output can consist not only of documents sent to outside parties (in this case, notification of payment received), but also of information circulated internally (in the form of reports), as well as of information entered into the database for updating.
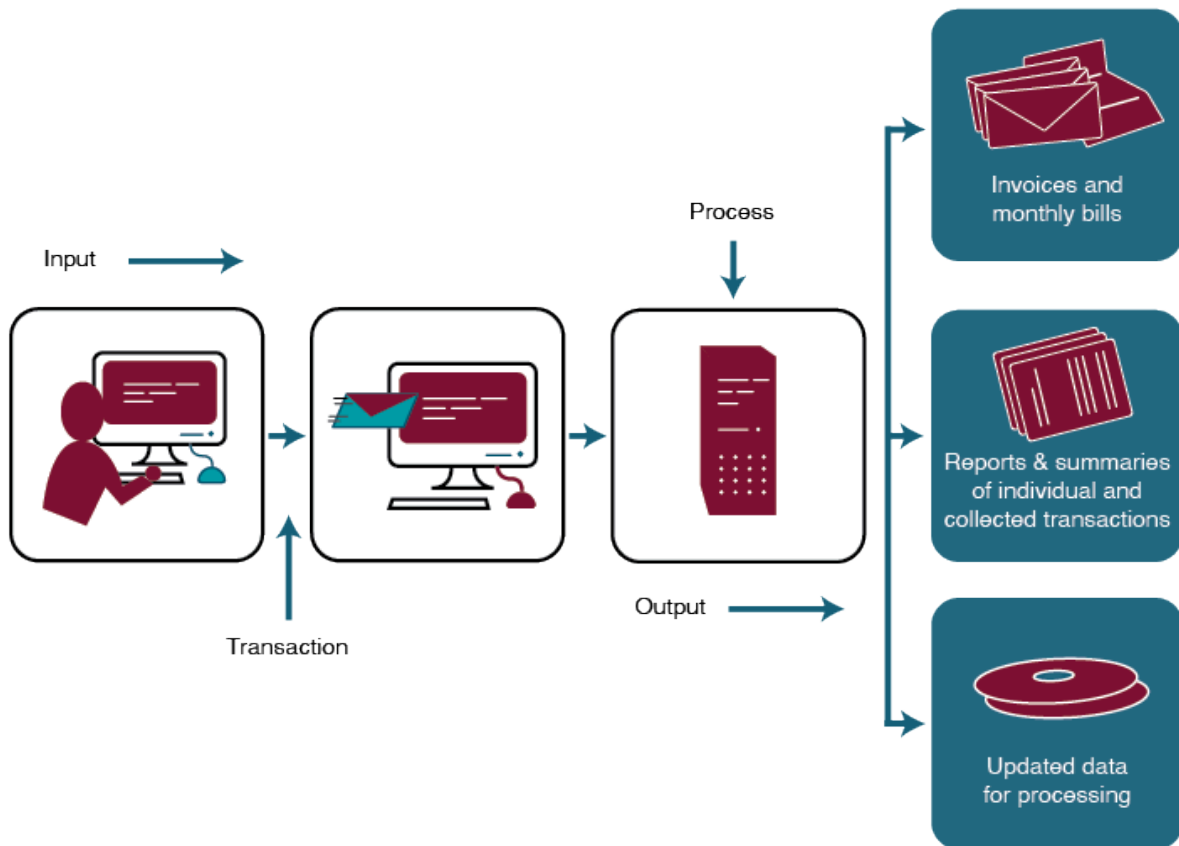
"Transaction Processing System" adapted from Matthew Pauley CC-By-NC-SA

The TPS receives raw data from internal and external sources and prepares this data for storage in a database. In fact, all the company's key data is stored in a single huge database that becomes the company's central information resource. The database management system tracks the data and allows users to query the database for the information they need. The database can be updated in two ways:

- **Batch processing** is where data is collected over some time period and processed together. Batch processing uses computer resources very efficiently and is well-suited to applications such as payroll processing that require periodic rather than continuous processing.
- **Online processing** keeps the company's data current. When you make an airline reservation, the information is entered into the airline's information system, and you quickly receive confirmation, typically through an e-mail. Online processing is more expensive than batch processing, so companies must weigh the cost versus the benefit. For example, a factory that operates

around the clock may use real-time processing for inventory and other time-sensitive requirements but process accounting data in batches overnight.

Management Information Systems

A **management information** system extracts data from a database to compile reports, such as sales analysis, inventory-level reports, and financial statements, to help managers make routine decisions. The type and form of the report depend on the information needs of a particular manager. Other systems such as decision support systems, executive information systems, and expert systems can help support non-routine decision making and they will be discussed in later chapters.

11.5. ENTERPRISE RESOURCE PLANNING

The increased use of automated systems like TPSs creates the challenge of controlling and centralizing the information generated. For instance, someone in sales creates a spreadsheet to calculate sales revenue, while someone in finance creates a different revenue document that meets the needs of their department but calculates revenue differently. The two spreadsheets report different revenue totals, but which one is correct? Who is responsible for managing all of this information?

In the 1990s, the need to bring an organization's information back under centralized control became more apparent. The Enterprise Resource Planning (ERP) system was developed to bring together an entire organization within one program. Some of the best-known ERP vendors are SAP, Microsoft, and Oracle. Here are some key points of an ERP:

- **Computer program**. The system is a computer program, which means that it has been developed with specific logic and rules behind it. It is customized and installed to work specifically for an individual organization.
- **Centralized database**. All data in an ERP system is stored in a single, central database. Centralization is key to the success of an ERP. Data entered in one part of the company can be immediately available to other parts of the company.
- **Organization-wide.** An ERP can be used to manage an entire organization's operations. 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. A firm can also mix and match components, linking software the firm has written with modules purchased from different enterprise software vendors. However, this route is more challenging from an integration perspective.
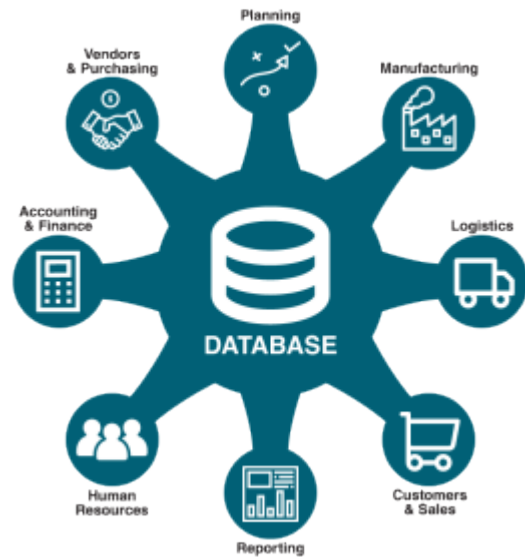
Enterprise Resource Planning System

Enterprise Resource Planning Example

An ERP system with multiple modules installed can touch many functions of the business, for example:

- **Sales.** A sales rep from Vancouver-based SnowboardCo takes an order for five thousand boards from a French sporting goods chain. The system can verify credit history, apply discounts, calculate prices (in euros), and print the order in French.
- **Inventory.** While the sales rep is on the phone with his French customer, the system immediately checks product availability, signalling that one thousand boards are ready to be shipped from the company's warehouse, the other four thousand need to be manufactured and can be delivered in two weeks from the

firm's manufacturing facility in Guangzhou, China.
- **Manufacturing.** When the customer confirms the order, the system notifies the Guangzhou factory to ramp up production for the model ordered.
- **Human Resources.** High demand across this week's orders triggers a notice to the Guangzhou hiring manager, notifying her that the firm's products are a hit and that the flood of orders coming in globally means her factory will have to hire five more workers to keep up.
- **Purchasing.** The system keeps track of raw material inventories, too. New orders trigger an automatic order with SnowboardCo's suppliers so that raw materials are on hand to meet demand.
- **Order Tracking.** The French customer can log in to track her SnowboardCo order. The system shows her other products that are available, using this as an opportunity to cross-sell additional products.
- **Decision Support.** Management sees the firm's European business is booming and plans a marketing blitz for the continent, targeting board models and styles that seem to sell better for the Alps crowd than in the Canadian market.

ERP & Business Process

An ERP system not only centralizes an organization's data but it enforces the business processes for the organization. When an ERP vendor designs a module, it has to implement the rules for the associated business processes. Best practices can be built into the ERP – a major selling point for ERP. 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. If done properly, an ERP system can bring an organization a good return on their investment. Most organizations see an overall improvement after implementing an ERP by consolidating information systems across the enterprise and using the software to enforce best practices. But for some, an ERP brings 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? A large organization may have one version of the ERP, and then acquire a subsidiary which has a more recent version. Imagine the challenge of requiring the subsidiary to change back to the earlier version.

One of the criticisms of ERP systems has been 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 customization so the ERP is unique to the organization.

There is a drawback to customizing an ERP system. Namely, 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 new ERP version. This requires someone to maintain a listing of these changes as well as re-testing 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?

Other categories of enterprise software that managers are likely to encounter include Customer Relationship Management systems,

Supply Chain Management systems, and Business intelligence systems. Business intelligence and decision support systems are explored in chapter 12.

"Chapter 8: Business Processes" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

' 9.3 Application Software " from Information Systems – A Manager's Guide to Harnessing Technology by Minnesota Libraries is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License, except where otherwise noted

11.6. ENTERPRISE SYSTEMS

Customer Relationship Management

A **Customer Relationship Management (CRM)** system manages 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. CRM systems are often used to empower employees to track and record data at nearly every point of customer contact. Someone calls for a quote? Brings a return back to a store? Writes a complaint via e-mail? A well-designed CRM system can capture all these events for subsequent analysis or for triggering follow-up events. Some ERP software systems include CRM modules. An example of a well-known CRM package is Salesforce.

Supply Chain Management

Supply Chain Management System (click to enlarge)

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. For example, if there are two suppliers, one manufacturing facility, and two distributors, then the number of links to manage = 4 (2 x 1 x 2). However, if two more suppliers are added, plus another manufacturing facility, and two more distributors, then the number of links to manage = 32 (4 x 2 x 4). Also, notice in the image above that all arrows have two heads, indicating that information flows in both directions. Suppliers are part of a business's supply chain. They provide information such as price, size, quantity, etc. to the business. In turn, the business provides information such as quantity on hand at every store to the supplier. The key to successful supply chain management is the information system.

A **Supply Chain Management (SCM) system** handles the interconnection between these links as well as the inventory of the products in their various stages of development. Much of Walmart's success has come from its ability to identify and control the supply chain for its products. They realized in the 1980s that the key to their success was information systems to manage their complex supply chain with thousands of suppliers, retail outlets, and millions of customers. They invested heavily in systems so they could communicate with their suppliers and manage the products they sell. Their success came from being able to integrate information systems to every entity (suppliers, warehouses, retail stores) through the sharing of sales and inventory data.
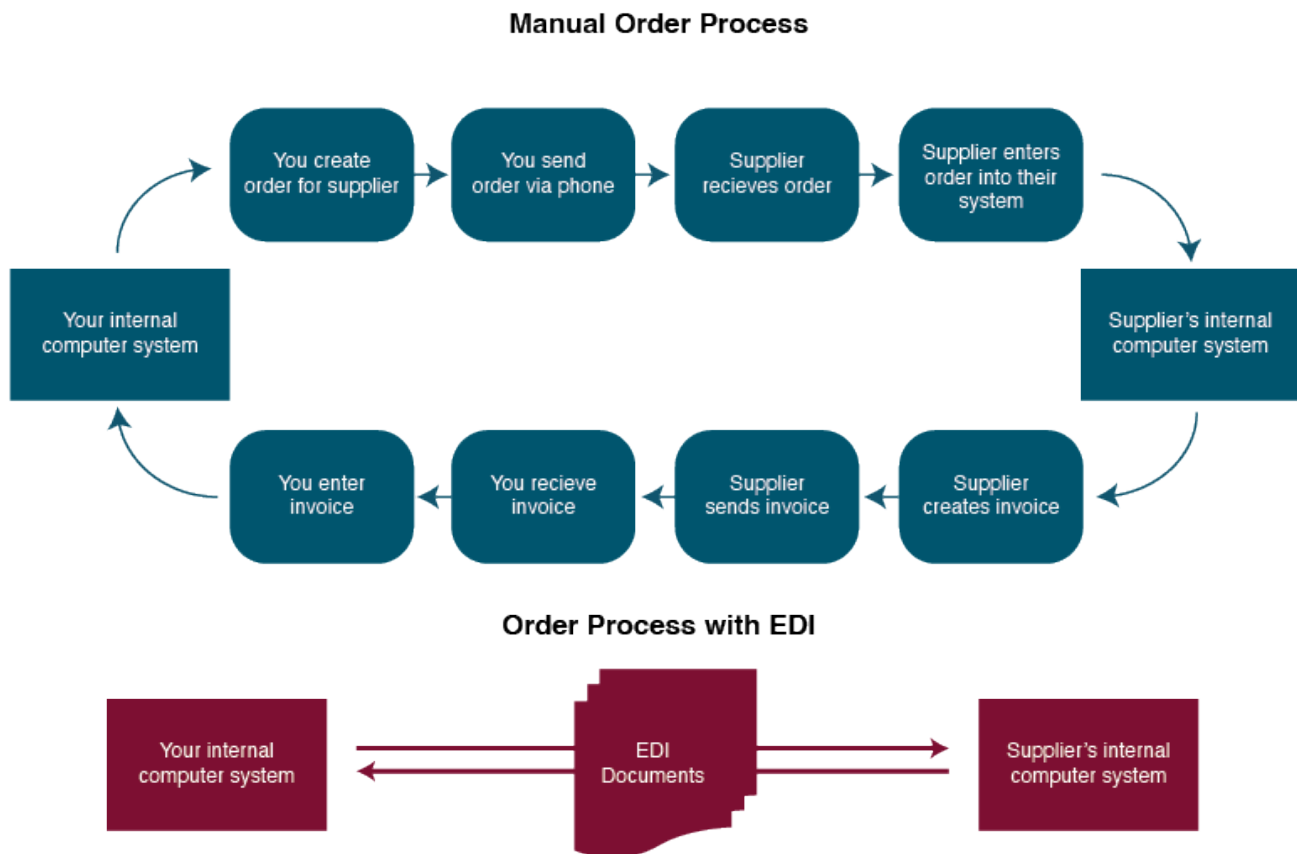
Knowledge Management

All companies accumulate knowledge over the course of their existence. Some of this knowledge is written down or saved, but

not in an organized fashion. Much of this knowledge is stored inside the heads of its employees. **Knowledge management** is the process of creating, formalizing the capture, indexing, storing, and sharing of the company's knowledge in order to benefit from the experiences and insights that the company has captured during its existence. Knowledge management systems store and streamline this process. One example of a knowledge management system is learning management systems which are used in educational institutions. Professors use the system to share educational materials with students. Desire to Learn (D2L) is one vendor in the learning management system market.

Electronic Data Interchange

Electronic Data Interchange (EDI) provides a competitive advantage through integrating the supply chain electronically. EDI can be thought of as the computer-to-computer exchange of business documents in a standard electronic format between business partners. By integrating suppliers and distributors via EDI, a company can vastly reduce the resources required to manage the relevant information. Instead of manually ordering supplies, the company can simply place an order via the computer and the products are ordered.

Manual Order Process

You create order for supplier → You send order via phone → Supplier recieves order → Supplier enters order into their system → Supplier's internal computer system → Supplier creates invoice → Supplier sends invoice → You recieve invoice → You enter invoice → Your internal computer system

Order Process with EDI

Your internal computer system ↔ EDI Documents ↔ Supplier's internal computer system

Order Processes

11.7. SUMMARY

Key Takeaways

- The advent of information technologies has had a huge impact on how organizations design, implement, and support business processes.
- From document management systems to ERP systems, information systems are tied into organizational processes.
- Using business process management, organizations can empower employees and leverage their processes for competitive advantage.
- Using business process reengineering, organizations can vastly improve their effectiveness and the quality of their products and services.
- Integrating information technology with business processes is one way that information systems can bring an organization lasting competitive advantage.
- An ERP system stores all data in a centralized database that is made accessible to all programs and departments across the organization.

Review Questions

1. What does the term business process mean?
2. What are three examples of business processes from a job you have had or an organization you have observed?
3. What is the value in documenting a business process?
4. What is business process reengineering? How is it different from incrementally improving a process?
5. What is a transaction processing system, and how is it different from an enterprise system?
6. List and describe the types of enterprise systems.
7. What components or functions are contained in an ERP system?
8. What are some benefits and concerns of an ERP system?
9. What is a supply chain and how can a supply chain management system improve a supply chain?
10. How can the internet be used to improve supply chain activities?
11. What tasks can a CRM do, and how does this impact the customer relationship?
12. Why is knowledge management a good idea?

Assignment

Overview

This assignment requires you to document a business process and discuss whether automation of this process can be beneficial .

Assignment

1. Think of a business process that you have had to perform in the past. How would you document this process? Would a diagram make more sense than a checklist? Document the process both as a checklist and as a diagram.
2. Consider whether this process could be automated and what benefits would be experienced from automation. Discuss some potential challenges with automation as well.

11.8. KEY TERMS

Chapter 11

Batch Processing is where data is collected over some time period and processed together. Batch processing uses computer resources very efficiently and is well-suited to applications such as payroll processing that require periodic rather than continuous processing.(11.4)

Business process: A collection of linked tasks which end in the delivery of a service or product to a client. (11.2)

Business Process Management (BPM): A systematic approach to making an organization's workflow more effective, more efficient and more capable of adapting to an ever changing environment. (11.3)

Business Process Reengineering (BPR): The analysis and redesign of workflows within and between enterprises in order to optimize end-to-end processes and automate non value-added tasks. (11.3)

Centralized Database: All data in an ERP system is stored in a single, central database. Centralization is key to the success of an ERP. Data entered in one part of the company can be immediately available to other parts of the company. (11.5)

Customer Relationship Management (CRM): System manages an organization's customers. (11.6)

Diagramming Tool: For documentation of business processes is a formalized visual language that provides systems analysts with the ability to describe the business processes unambiguously, to visualize the business processes for systematic understanding, and to communicate the business process for business process management.(11.2)

Document Management System: Stores and tracks documents and supports the following functions.(11.2)

Electronic Data Interchange (EDI): Provides a competitive advantage through integrating the supply chain electronically. (11.6)

Enterprise Resources Planning (ERP): A business process management program that allows an organization to use a system of integrated applications to manage the business and automate many back office functions related to technology, services and human resources. (11.5)

Knowledge Management: The process of creating, formalizing the capture, indexing, storing, and sharing of the company's knowledge in order to benefit from the experiences and insights that the company has captured during its existence. (11.6)

Management Information System: Extracts data from a database to compile reports, such as sales analysis, inventory-level reports, and financial statements, to help managers make routine decisions.(11.4)

Online Processing: Keeps the company's data current. When you make an airline reservation, the information is entered into the airline's information system, and you quickly receive confirmation, typically through an e-mail. (11.4)

Process: A series of tasks that are completed in order to accomplish a goal. (11.2)

SAP: Systems, Applications & Products in Data Processing. A German multinational software corporation that makes enterprise software to manage business operations and customer relations. (11.5)

Supply Chain Management (SCM): System handles the interconnection between these links as well as the inventory of the products in their various stages of development. (11.6)

Transaction Processing System (TPS): A TPS is a system that collects, modifies and retrieves business transaction data.(11.4)

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 considered the default.(11.2)

Adapted from Information Systems for Business and Beyond Glossary by Ruth Guthrie licensed under a CC-BY-3.0

11.9. KNOWLEDGE CHECK

Knowledge Check 1

Drop the correct action/process into the diagram

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1799#h5p-68

Knowledge Check 2

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1799#h5p-49

CHAPTER 12: DECISION SUPPORT

Chapter Outline

Photo by Carlos Muza Unsplash License

12.1. CHAPTER INTRODUCTION

Learning Outcomes

Upon successful completion of this chapter, you will be able to:

- Define big data;
- Describe the decision making process;
- Distinguish between the types of decisions by organizational level and type;
- Compare the different types of information systems used by management for decision making;
- Discuss business intelligence, and the tools available to support decision making;
- Discuss some considerations for data analysis projects;
- Define data mining and describe its role in an organization; and
- Describe the difference between a data warehouse and a data mart.

In order for a business to stay competitive, managers must make good decisions based on valuable information. Making good decisions can be challenging, especially with the constant creation of digital information. The increasing number of internet users and the amount of online activity is driving the growth in creation of digital data. The COVID-19 pandemic changed the way companies do business and moved the majority of the workforce online. These changing conditions mean that most of the data created has been done recently. In this chapter, you will explore the impact of the increasing amounts of digital data, and the tools that can make sense of it all.

12.2. BIG DATA

As mentioned previously, the rate and quantity of data that is being created is growing rapidly. According to estimates, the amount of data created, stored, and used globally over the next five years (2020-2025) is expected to reach 180 zettabytes, which is roughly enough to fill 10 million DVDs (Holst, 2021, June 7).

Every time you perform an internet search, shop online, or post a video to social media, you are contributing to the digital repository of data. Data is becoming so voluminous and complex that it is difficult for existing systems to handle and process. This is the definition of **big data**. Big data can be categorized by the three V's: Volume (size), Variety (# of data types), and Velocity (processing speed).

The Three V's of Big Data

Volume
How Big?

Variety
How Diverse?
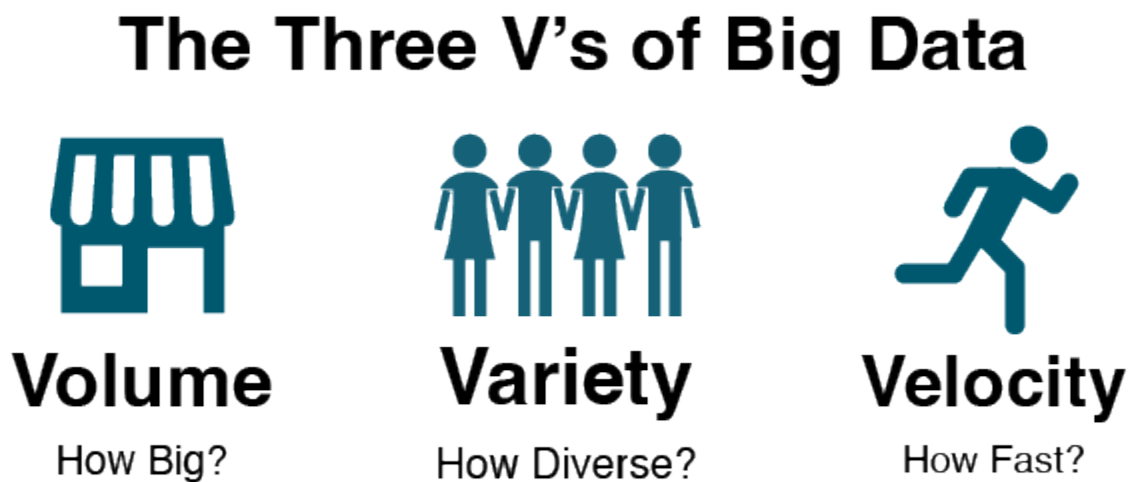
Velocity
How Fast?

Big data can be categorized by the three V's: Volume (size), Variety (# of data types), and Velocity (processing speed).

- **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, variety 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.
- **Velocity.** Big datasets can be so large in size that they can't necessarily be moved from storage to analysis; instead, they need to be 'streamed' through the analysis. 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.

For organizations, the ability to collect data has become much more cost-effective due to advances in technology. However, more data does not equal better data. As the size of data storage methods increases, the ability to use traditional techniques to identify and transform data becomes more complex. It is important to understand this concept and the consequences it has for managerial decision-making. Organizations need to consider the characteristics of data as they design processes, roles and systems to help make sense of data gathered to make informed decisions.

12.3. MANAGERIAL DECISION MAKING

Decision-making is the action or process of thinking through possible options and selecting one. It is important to recognize that managers are continually making decisions, and that the quality of their decision-making has an impact—sometimes quite significant—on the effectiveness of the organization and its stakeholders. Stakeholders are all the individuals or groups that are affected by an organization (such as customers, employees, shareholders, etc.).

Members of the top management team regularly make decisions that affect the future of the organization and all its stakeholders, such as deciding whether to pursue a new technology or product line. A good decision can enable the organization to thrive and survive long-term, while a poor decision can lead a business into bankruptcy. Managers at lower levels of the organization generally have a smaller impact on the organization's survival, but can still have a tremendous impact on their department and its workers. Poor decision-making by lower-level managers is unlikely to drive the entire firm out of existence, but it can lead to many adverse outcomes. Therefore, increasing effectiveness in decision making is critical, and using a model can help.

The Decision-Making Process

Decision makers should use a systematic process for making decisions. The decision-making process can be broken down into a series of six steps, as follows:

1. Recognize that a decision needs to be made.
2. Generate multiple alternatives.
3. Analyze the alternatives.
4. Select an alternative.
5. Implement the selected alternative.
6. Evaluate its effectiveness.

While these steps may seem straightforward, individuals often skip steps or spend too little time on some steps. In fact, sometimes people will refuse to acknowledge a problem (Step 1) because they aren't sure how to address it.
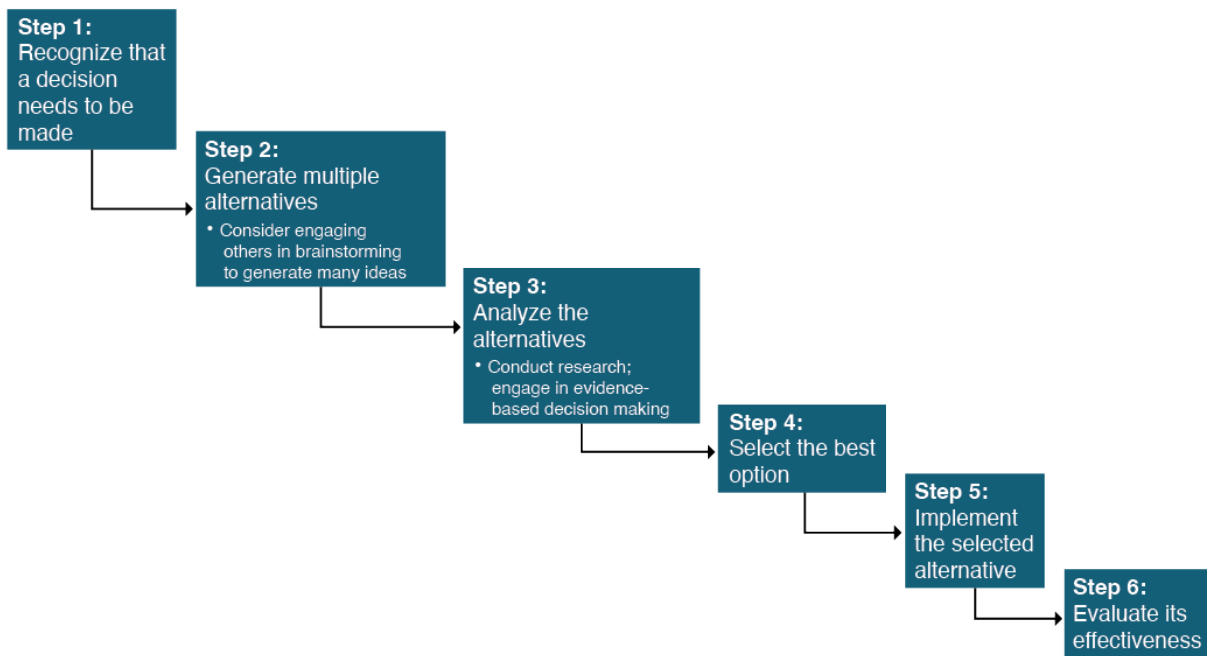
The Decision-Making Process (click to enlarge). Adapted from Open Stax, Rice University CC-BY 4.0

"2.1 Overview of Managerial Decision-Making" from Principles of Management by Open Stax is licensed under Creative Commons Attribution 4.0 License
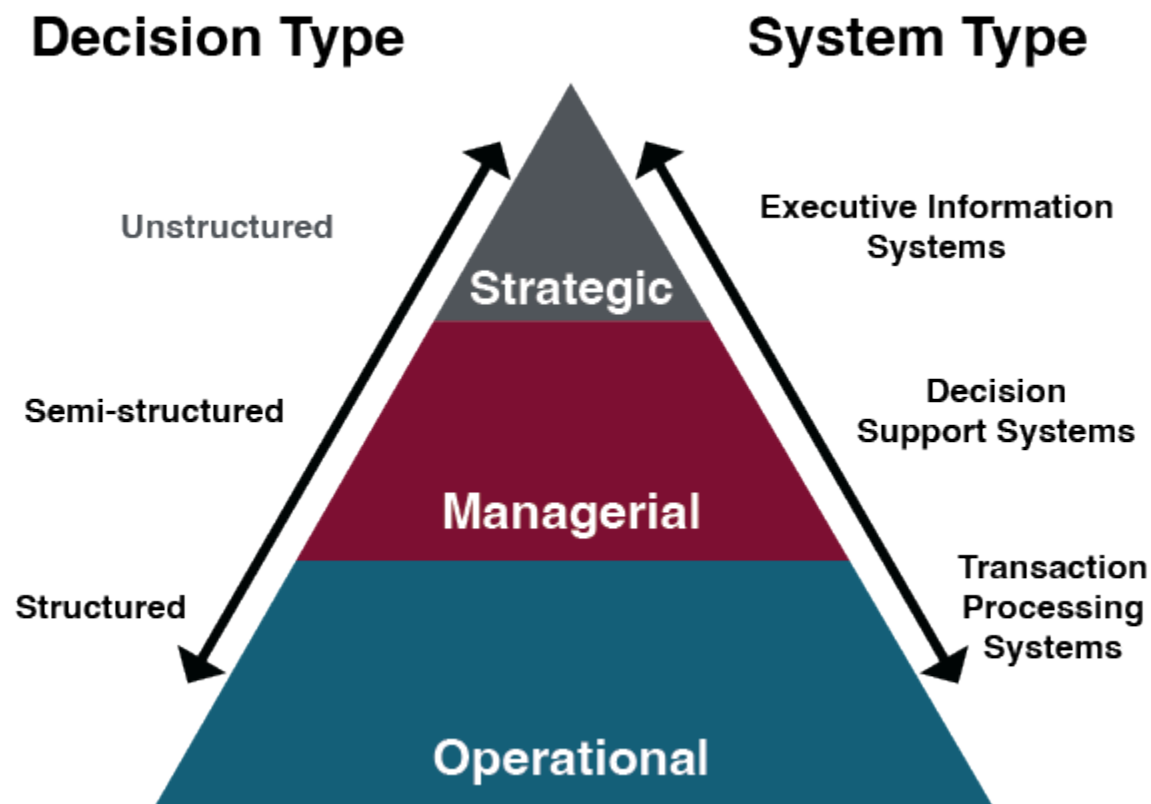
12.4. DECISION TYPES

An organization has a wide variety of decisions to make, ranging from highly structured decisions to unstructured decisions. A **structured decision** is one that is made quite often, and one in which the decision is based directly on the inputs. With structured decisions, once you know the necessary information you also know the decision that needs to be made. For example, inventory reorder levels can be structured decisions. Once your inventory of widgets gets below a specific threshold, there is a need to order more. Processes like this, based on structured decisions, are good candidates for automation. They can also be referred to as programmed decisions.

For programmed decisions, managers often develop **heuristics**, or mental shortcuts, to help reach a decision. For example, the retail store manager may not know how busy the store will be the week of a big sale, but might routinely increase staff by 30% every time there is a big sale (because this has been fairly effective in the past). Heuristics are efficient—they save time for the decision maker by generating an adequate solution quickly. Heuristics don't necessarily yield the optimal solution, but a good solution. Heuristics are often used for programmed decisions, because experience in making the decision over and over helps the decision maker know what to expect and how to react. Programmed decision-making can also be taught fairly easily to another person.

In contrast, an **unstructured decision** or non programmed decision involves a lot of unknowns. They are generally based on criteria that are not well-defined, and information is more likely to be ambiguous or incomplete. The decision maker may need to exercise some thoughtful judgment and creative thinking to reach a good solution. An information system can support these types of decisions by providing the decision makers with information gathering tools and collaborative capabilities. An example of an unstructured decision might be dealing with a labor issue or setting policy for the implementation of a new technology.

A **semi-structured decision** is one in which most of the factors needed for making the decision are known but human experience and other outside factors may still impact the decision. A good example of a semi-structured decision is the hiring process. Part of the decision is structured (years of experience, education, etc.) and part of the decision is based on human experience (for example: social skills, problem solving skills etc.) Take a look at how companies are trying to program this decision and use algorithms. Semi-structured and unstructured decisions are more challenging and systems may not be able to assist in the process fully. However, advances in artificial intelligence (explored in Chapter 13) are helping to change this.

Decision Type   System Type

Unstructured

Strategic — Executive Information Systems

Semi-structured

Managerial — Decision Support Systems

Structured

Operational — Transaction Processing Systems

Decision Type and System Type Pyramid (click to enlarge).

Decisions can also be classified into three categories based on the level at which they occur.

Strategic decisions set the course of an organization. Tactical/Managerial decisions are decisions about how things will get done. Finally, **operational decisions** refer to decisions that employees make each day to make the organization run. For example, think about the restaurant that routinely offers a free dessert when a customer complaint is received. The owner of the restaurant made a strategic decision to have great customer service. The manager of the restaurant implemented the free dessert policy as a way to handle customer complaints, which is a tactical decision. Finally, the servers at the restaurant are making individual decisions each day by evaluating whether each customer complaint received is legitimate and warrants a free dessert. Different information systems are used at each level of the company structure to support the different decision types. We explored transaction processing systems in Chapter 11.

Level of Decision	Examples of Decision	Who Typically Makes Decisions
Strategic Decisions	Should we merge with another company? Should we pursue a new product line? Should we downsize our organization?	Top Management Teams, CEOs, and Boards of Directors
Tactical Decisions	What should we do to help facilitate employees from the two companies working together? How should we market the new product line? Who should be let go when we downsize?	Managers
Operational Decisions	How often should I communicate with my new coworkers? What should I say to customers about our new product? How will I balance my new work demands?	Employees throughout the organization

12.5. DECISION SUPPORT SYSTEMS

A decision support system (DSS) helps managers make decisions using interactive computer models that describe real-world processes. These systems are designed to take inputs regarding a known (or partially-known) decision making process and provide the information necessary to make a decision. The DSS uses data from the internal database but looks for specific data that relate to the problems at hand. DSSs generally assist a management level person in the decision-making process. It is a tool for answering "what if" questions about what would happen if the manager made certain changes. With models, the manager enters into the computer the values that describe a particular situation, and the program computes the results. A DSS can be looked at as a tool for competitive advantage because it can give an organization a mechanism to make wise decisions about products and innovations.

DSS's can come in many different formats. A nicely designed spreadsheet that allows for input of specific variables and then calculates required outputs could be considered a DSS. A manager could create a spreadsheet to show the amount of overtime required if the number of workers increases or decreases. Another DSS might be one that assists in determining which products a company should develop. Input into the system could include market research on the product, competitor information, and product development costs. The system would then analyze these inputs based on the specific rules and concepts programmed into it. The system would report its results with recommendations and/or key indicators to be used in making a decision. Companies can use a predictive analytics program to improve their inventory management system and use big data to target customer segments for new products and line extensions.

Common DSS Analysis Techniques

The following are common analysis techniques in a decision support system.

What if analysis	Outlines the impact of a change in a variable or assumption on the model.
Sensitivity Analysis	Outlines the impact when one variable is changed repeatedly.
Goal Seek Analysis	Goal seeking analysis-finds the inputs necessary to achieve a goal
Optimization Analysis	Optimization analysis -finds the optimum value for a target variable by repeatedly changing other variables

Executive Information Systems

Although similar to a DSS, an **executive information system** (EIS) is customized for executives. These systems provide specific information for strategic decisions. For example, a CEO's EIS may include special spreadsheets that present financial data comparing the company to its principal competitors and graphs showing current economic and industry trends.

Most EIS's have a business intelligence (BI) dashboard. A BI dashboard is a tool that shows all of an organization's key metrics and performance indicators on one screen. This makes it easy for management to quickly see how the company is performing and address any outliers or negative trends while also being able to identify positive trends. It also provides a consolidated overview with the ability to drill down or filter when needed. During the COVID pandemic many dashboards were created to track the virus as well as vaccine rates. One example is the GIS Hub provided by Esri Canada that shares all information about the pandemic.

Expert Systems

An **expert system** gives managers advice similar to what they would get from a human consultant. Artificial intelligence enables computers to reason and learn to solve problems in much the same way humans do, using what-if reasoning. Although they are expensive and difficult to create, expert systems are finding their way into more companies as more applications are found. Lower-end expert systems can even run on mobile devices. Top-of-the-line systems help airlines appropriately deploy aircraft and crews, critical to the carriers' efficient operations. The cost of hiring enough people to do these ongoing analytical tasks would be prohibitively expensive. Expert systems have also been used to help explore for oil, schedule employee work shifts, and diagnose illnesses. Some expert systems take the place of human experts, whereas others assist them. For more information on expert systems see Chapter 13.


12.6. BUSINESS INTELLIGENCE & DATA ANALYTICS

With the rise of Big Data and a myriad of new tools and techniques at their disposal, businesses are learning how to use information to their advantage. The term **business intelligence** describes the process that organizations take to collect and analyze data in the hopes of obtaining a competitive advantage. Business intelligence is really an organizational process as much as it is a set of technologies. Besides using their own data, stored in data warehouses (more on this later), firms often purchase information from data brokers to get a big-picture understanding of their industries and the economy. The results of analysis can drive organizational strategies and provide competitive advantage.

Data Brokers

Data brokers collect and sell data based on online activity. Digital marketing company WebFX estimates that there are more than 4,000 data brokers worldwide. Digital marketers use this information to help direct their advertising and product development efforts. The data broker market in Canada is flourishing due to less safeguards on personal information (McClelland, 2021, August 27).

All the terminology around business intelligence can be confusing, as often the terms are used interchangeably. What is the difference between business intelligence, data science and data analytics? Much like information technology and information systems, the terms are differentiated on the components involved. In the data world, the components consist of engineering, analysis, and communication. Combining the terms in different ways will yield various 'areas of focus'.

Data Engineering	Refers to the design, creation, and structure of data and datasets.
Data Analysis	Refers to the techniques used to refine and manipulate data into information.
Data Communication	Is defined as the flow of data from a source(s) to the user.
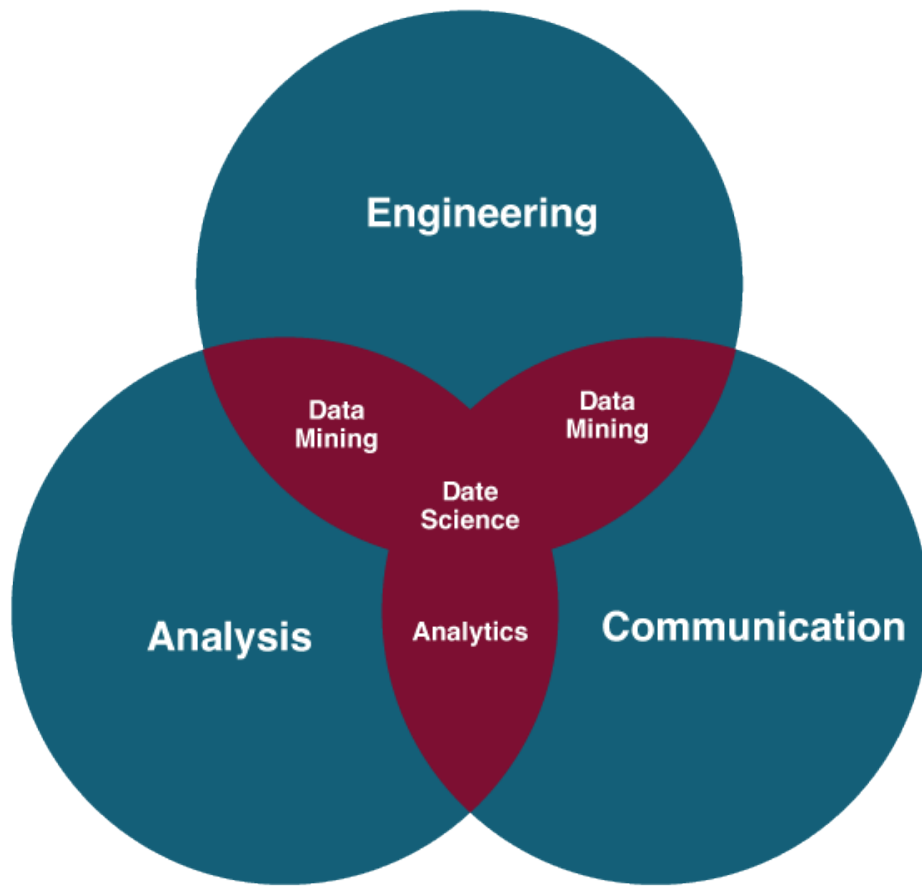
Venn Diagram of Data Engineering, Analysis and Communication.

Data Science

Combining all three areas (engineering, communication and analysis) results in the field of data science. **Data Science** is the analysis of large data sets to find new knowledge. The field of data science is constantly changing, and data scientists are on the cutting edge of work in areas such as artificial intelligence and neural networks. While a data scientist does many different things, their focus is generally on analyzing large data sets using various programming methods and software tools to create new knowledge for their organization. For example, data scientists look at building new models and algorithms to extract data in different ways. Data scientists are skilled in machine learning.

Data Analytics

Combining analysis and communication results in data analytics. **Data analytics** looks at the past data to try and understand what happened and can also make predictions for the future. Data analytics is focused on finding answers to questions by analyzing trends and creating visual representations, like dashboards whereas data science is a broad concept that focuses on figuring out the questions that should be asked of the data. Whereas business intelligence focuses on what happened in the past up until now. It helps to identify trends in the past, and data analysis can look to the future. To learn more about the history of business intelligence and its evolution see this see this infographic.

Data Analytics Types

Analytics is a very broad term, but no matter the type of data, or size of data you are using, generally all analytics can be categorized in four ways: describe, diagnose, predict, and prescribe. These four categories range from summarizing historical information to providing insight for the future by investigating the data and attempting to answer the following questions:

Descriptive Analytics	What happened?
Diagnostic Analytics	Why did it happen?
Predictive Analytics	What might happen?
Prescriptive Analytics	What to do next?

Calculating some summary statistics such as mean, median, mode and standard deviation is an example of **descriptive analytics**. Similarly matching, or creating a scatter plot diagram are examples of **diagnostic techniques** that can help identify outliers. **Predictive** techniques involve using regression analysis and attempts to find similarities between historical data sets to be able to forecast into the future. Lastly, **prescriptive** analytics involve using decision support systems, machine learning and artificial intelligence to analyze the information and recommend a course of action. Multiple predictions are generated and an optimized solution is recommended. For example, if you use a GPS on a long road trip, you may have experienced 'dynamic route updates', or the suggestion of new alternate routes that may be quicker due to slowing traffic or an accident.

12.7. DATA ANALYSIS PROJECTS

Data analysis projects should start with a clear vision with business-focused objectives. When senior executives can see objectives illustrated in potential payoff, they will be able to champion the effort, and having an executive champion is a key success factor. Focusing on business issues will also drive technology choice, with the firm better able to focus on products that best fit its needs. Once a firm has business goals and hoped-for payoffs clearly defined, it can address the broader issues needed to design, develop, deploy, and maintain its system. Data analysis projects should consider the following:

Data relevance	What data is needed to meet our current and future goals?
Data sourcing	Where can this data be obtained from? Is it available via our internal systems? Via third-party data aggregators? Via suppliers or sales partners? Do we need to set up new systems, surveys, and other collection efforts to acquire the data we need?
Data quantity	How much data is needed?
Data quality	Can our data be trusted as accurate? Is it clean, complete, and reasonably free of errors? How can the data be made more accurate and valuable for analysis? Will we need to 'scrub,' calculate, and consolidate data so that it can be used?
Data hosting	Where will the systems be housed? What are the hardware and networking requirements for the effort?
Data governance	What rules and processes are needed to manage data from its creation through its retirement? Are there operational issues (backup, disaster recovery)? Legal issues? Privacy issues? How should the firm handle security and access?

Data Governance

Data governance is essential in organizations to ensure that the data being used is reliable. **Data governance** is really the commitment by an organization to ensuring data and information meet the characteristics of being valuable in order for the organization to meet its objectives. This can include strategies, processes and standards. An issue occurs when information is not valuable and cannot be relied on. Bad data can be due to duplication or incomplete information stored. As well, there are issues when legacy systems try to communicate with each other.

Legacy systems are outdated information systems that were not designed to share data, aren't compatible with newer technologies, and aren't aligned with the organization's current business needs. The problem can be made worse by mergers and acquisitions, especially if a company depends on operational systems that are incompatible with its partner. The elimination of incompatible systems is not just a technical issue. A company might be under an extended agreement with different vendors or outsourcers, and breaking a contract or invoking an escape clause can be costly.

Another problem when turning data into information is that most transactional databases are not set up to be simultaneously accessed for reporting and analysis. When a customer buys something from a cash register, that action may post a sales record and deduct an item from the firm's inventory. In most TPS systems, requests made to the database can usually be performed pretty quickly—the system adds or modifies the few records involved and it's done—in and out in a flash. But if a manager asks a database to analyze historical sales trends showing the most and least profitable products over time, they may be asking a computer to look at thousands of transaction records, comparing results, and neatly ordering findings. That's not a quick in-and-out task, and it may very well require significant processing to come up with the request. Do this against the very databases you're using to record your transactions, and you might grind your computers to a halt.

12.8. ANALYSIS AND REPORTING TOOLS

The idea behind analysis tools that allow queries and reporting is to present users with a subset of requested data, selected, sorted, ordered, calculated, and compared, as needed. Managers use these tools to see and explore what's happening inside their organizations. **Canned reports** provide regular summaries of information in a predetermined format. They're often developed by information systems staff and formats can be difficult to alter. By contrast, **ad hoc reporting tools** allow users to dive in and create their own reports, selecting fields, ranges, and other parameters to build their own reports on the fly.

A subcategory of reporting tools is referred to as O**nline Analytical Processing** (OLAP)(pronounced "oh-lap"). Data used in OLAP reporting is usually sourced from standard relational databases, but it's calculated and summarized in advance, across multiple dimensions, with the data stored in a special database called a **data cube.** This extra setup step makes OLAP fast (sometimes one thousand times faster than performing comparable queries against conventional relational databases). Given this kind of speed boost, it's not surprising that data cubes for OLAP access are often part of a firm's data mart and data warehouse efforts.

A manager using an OLAP tool can quickly explore and compare data across multiple factors such as time, geography, product lines, and so on. In fact, OLAP users often talk about how they can "slice and dice" their data, "drilling down" inside the data to uncover new insights. And while conventional reports are usually presented as a summarized list of information, OLAP results look more like a spreadsheet, with the various dimensions of analysis in rows and columns, with summary values at the intersection.

Data Visualization


Charts and Graphs by Wallusy via Pixabay

Data visualization is the graphical representation of information and data. These graphical representations (such as charts, graphs, and maps) can quickly summarize data in a way that is more intuitive and can lead to new insights and understandings. Just as a

picture of a landscape can convey much more than a paragraph of text attempting to describe it, graphical representation of data can quickly make meaning of large amounts of data. Many times, visualizing data is the first step towards a deeper analysis and understanding of the data collected by an organization. Examples of data visualization software include **Tableau** and **Google Data Studio**.

Dashboards are a type of data visualization that provide a heads-up display of critical indicators, letting managers get a graphical glance at key performance metrics. Some tools may allow data to be exported into spreadsheets. Even the lowly spreadsheet can be a powerful tool for modelling "what if" scenarios and creating additional reports. However, if data can be easily exported, then it can potentially leave the firm dangerously exposed, raising privacy, security, legal, and competitive concerns.

Data Mining
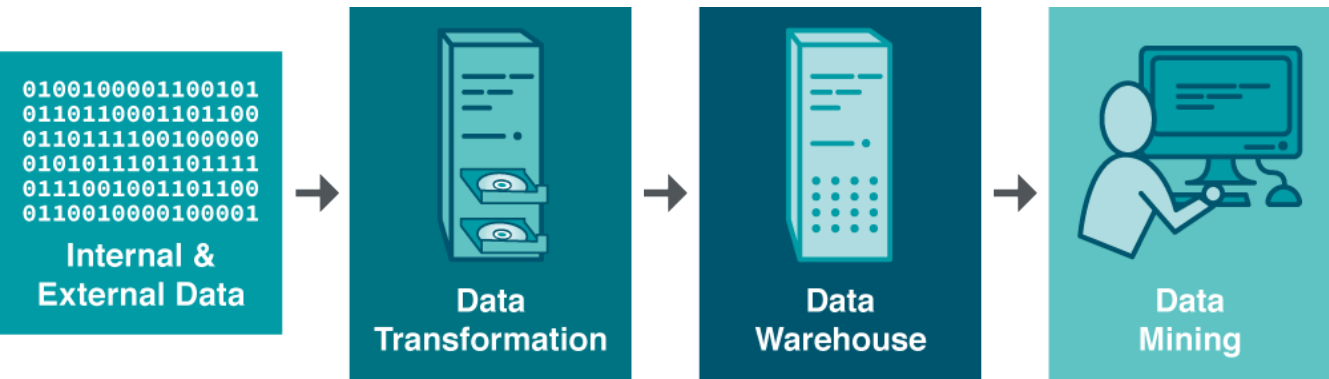
Data mining is the process of analyzing data to find previously unknown and interesting trends, patterns, and associations in order to make decisions. Click to enlarge. Data Mining Process adapted from Matthew Pauley CC-BY-NC-SA 4.0

While reporting tools can help users explore data, modern data sets can be so large that it might be impossible for humans to spot underlying trends. That's where data mining can help. **Data mining** is the process of analyzing data to find previously unknown and interesting trends, patterns, and associations in order to make decisions. Generally, data mining is accomplished through automated means against extremely large data sets, such as a data warehouse. Some of the key areas where businesses are leveraging data mining include the following:

Customer segmentation	Figuring out which customers are likely to be the most valuable to a firm.
Marketing and promotion targeting	Identifying which customers will respond to which offers at which price at what time.
Market basket analysis	Determining which products customers buy together, and how an organization can use this information to cross-sell more products or services.
Collaborative filtering	Personalizing an individual customer's experience based on the trends and preferences identified across similar customers.
Customer churn	Determining which customers are likely to leave, and what tactics can help the firm avoid unwanted defections.
Fraud detection	Uncovering patterns consistent with criminal activity.
Financial modeling	Building trading systems to capitalize on historical trends.
Hiring and promotion	Identifying characteristics consistent with employee success in the firm's various roles.

Model Considerations

For data mining to work, two critical conditions need to be present:

1. **Clean and consistent data.** Deceive your systems with bad data and your models are worthless. It is important that the data that is input into the system is accurate and consistent
2. **Data should reflect current and future trends.** As well historical consistency should be considered. Computer-driven investment models can be very effective when the market behaves as it has in the past. But models are blind when faced with extreme and unusual events that never occurred in the data used to build the model.

Data mining presents a host of other perils, as well. It's possible to <u>over-engineer</u> a model, building it with so many variables that the solution arrived at might only work on the subset of data you've used to create it. You might also be looking at a random but meaningless statistical fluke. One way to test to see if you're looking at a random occurrence in the numbers is to divide your data, building your model with one portion of the data, and using another portion to verify your results. This is the approach Netflix has used to test results achieved by teams in the <u>Netflix Prize</u>, the firm's million-dollar contest for improving the predictive accuracy of its movie recommendation engine. Finally, sometimes a pattern is uncovered but determining the best choice for a response is less clear. First findings don't always reveal an optimal course of action.

Skills Required

These modelling considerations highlight the importance of recruiting a data mining and business analytics team that possesses three critical skills:

Information technology	For understanding how to pull together data, and for selecting analysis tools.
Statistics	For building models and interpreting the strength and validity of results.
Business knowledge	For helping set system goals, requirements, and offering deeper insight into what the data really says about the firm's operating environment.

Miss one of these key functions and your team could make some major mistakes.


12.9. DATA REPOSITORIES

Data Warehouse

Since running analytics against transactional data can bog down a system, and since most organizations need to combine and reformat data from multiple sources, firms typically need to create separate data repositories for their reporting and analytics work—a kind of staging area from which to turn that data into information. Two terms you'll hear for these kinds of repositories are data warehouse and data mart.

A **data warehouse** is a set of databases designed to support decision making in an organization. It is structured for fast online queries and exploration. Data warehouses may extract, and aggregate enormous amounts of data from many different operational systems. The concept of the data warehouse is simple: extract data from one or more of the organization's databases and load it into the data warehouse (which is itself another database) for storage and analysis. However, the execution of this concept is not that simple. A data warehouse should be designed so that it meets the following criteria:

- **It uses non-operational data**. This means that the data warehouse is using a copy of data from the active databases that the company uses in its day-to-day operations, so the data warehouse must pull data from the existing databases on a regular, scheduled basis.
- **The data is time-variant.** This means that whenever data is loaded into the data warehouse, it receives a time stamp, which allows for comparisons between different time periods.
- **The data is standardized.** Because the data in a data warehouse usually comes from several different sources, it is possible that the data does not use the same definitions or units. For example, each database uses its own format for dates (e.g., mm/dd/yy, or dd/mm/yy, or yy/mm/dd, etc.). In order for the data warehouse to match up dates, a standard date format would have to be agreed upon and all data loaded into the data warehouse would have to be converted to use this standard format. This process is called extraction-transformation-load (ETL).

There are two primary schools of thought when designing a data warehouse: bottom-up and top-down. The bottom-up approach starts by creating small data warehouses, called data marts. **A data mart** is a database focused on addressing the concerns of a specific problem (e.g., increasing customer retention, improving product quality) or business unit (e.g., marketing, engineering). As these data marts are created, they can be combined into a larger data warehouse. The top- down approach suggests that we should start by creating an enterprise-wide data warehouse and then, as specific business needs are identified, create smaller data marts from the data warehouse.
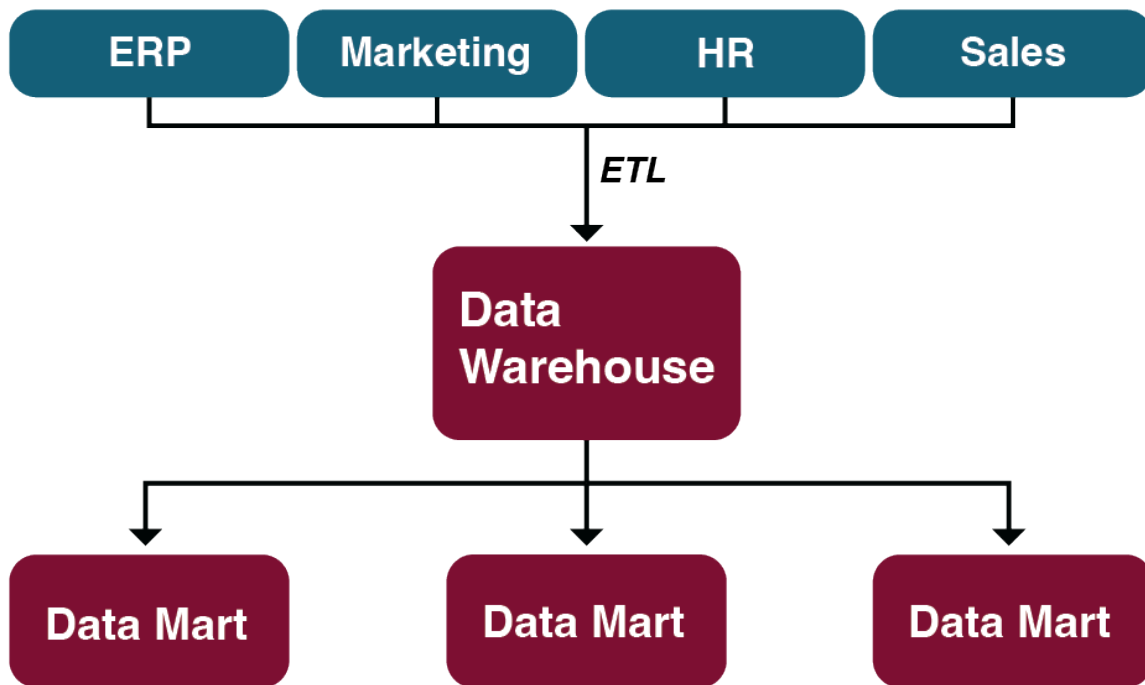
Data Warehouse adapted from D. Bourgeois CC-BY-NC

Benefits of Data Warehouses

Organizations find data warehouses quite beneficial for a number of reasons:

- The process of developing a data warehouse forces an organization to **better understand the data** that it is currently collecting and, equally important, what data is not being collected.
- A data warehouse provides a **centralized view** of all data being collected across the enterprise and provides a means for determining data that is inconsistent.
- Once all data is identified as consistent, an organization can generate "**one version of the truth**". This is important when the company wants to report consistent statistics about itself, such as revenue or number of employees.
- By having a data warehouse, **snapshots of data** can be taken over time. This creates a historical record of data, which allows for an analysis of trends.
- A data warehouse provides **tools** to combine data, which can provide new information and analysis.

Privacy Concerns

The increasing power of data mining has caused concerns for many, especially in the area of privacy. In today's digital world, it is becoming easier than ever to take data from disparate sources and combine them to do new forms of analysis. In fact, a whole industry has sprung up around this technology: data brokers. These firms combine publicly accessible data with information obtained from the government and other sources to create vast warehouses of data about people and companies that they can then sell. Privacy protections were explored in Chapter 9.

12.10. SUMMARY

Key Takeaways

- Big data is voluminous and complex and difficult for systems to process and analyze.
- Big data is categorized by the three V's: Volume (size), Variety (# of data types), and Velocity (processing speed).
- Decision makers should use a systematic process for making decisions.
- An organization has a wide variety of decisions to make, ranging from highly structured decisions to unstructured decisions.
- A decision support system (DSS) helps managers make decisions using interactive computer models that describe real-world processes. An executive information system (EIS) is customized for an individual executive.
- An expert system gives managers advice similar to what they would get from a human consultant.
- Business intelligence describes the process that organizations take to collect and analyze data in the hopes of obtaining a competitive advantage. It is an organizational process as well as technology.
- Data Science is the analysis of large data sets to find new knowledge, and data analytics looks at the past data to try and understand what happened and can also make predictions for the future.
- Legacy systems often limit data utilization because they were not designed to share data, aren't compatible with newer technologies, and aren't aligned with the firm's current business needs.
- Most transactional databases aren't set up to be simultaneously accessed for reporting and analysis. In order to run analytics the data must first be ported to a data warehouse or data mart.
- There are many different ways to present data findings. Data visualization is the graphical representation of information and data.
- A data warehouse is a set of databases designed to support decision making in an organization and a data mart is a database focused on addressing the concerns of a specific problem or business unit.
- Data privacy is huge concern today, especially with the growth in the amount of digital data being created and stored.

Review Questions

1. What are the benefits and concerns of big data?
2. What are some typical problems faced by businesses? Can these problems be helped by systems?

3. List and describe the phases of the decision making process.
4. What is the difference between a structured, semi-structured, and unstructured decision?
5. What is data analytics, and why are many companies using it?
6. What is the difference between business intelligence, data analytics and data science?
7. What are some of the tools used to convert data into information?
8. What is the difference between canned reports and ad hoc reporting?
9. How do reports created by OLAP differ from most conventional reports?
10. List the key areas where businesses are leveraging data mining.
11. For data mining to work, what two critical data-related conditions must be present?
12. List the three critical skills a competent business analytics team should possess.
13. What is the difference between a data mart and data warehouse?

Assignment

Overview

This assignment provides the opportunity to work with the pivot table function in Excel to summarize data for analysis.

Assignment

1. Go to the Intro to PivotTables tutorial on GCF LearnFree.org download the practice workbook, and work through the tutorial.
2. How can the pivot table function be used to support decision-making?
3. What are some other questions that can be asked of this data?
4. Create a visualization based on your question for the data.

Share your findings and visualization with the class.

12.11. KEY TERMS

Chapter 12

AD Hoc Reporting Tools: allow users to dive in and create their own reports, selecting fields, ranges, and other parameters to build their own reports on the fly..(12.8)

Big Data: Big data can be categorized by the three V's: Volume (size), Variety (# of data types), and Velocity (processing speed). (12.2)

Business Intelligence: Describes the process that organizations take to collect and analyze data in the hopes of obtaining a competitive advantage. (12.6)

Canned Reports: Provide regular summaries of information in a predetermined format. They're often developed by information systems staff and formats can be difficult to alter.(12.8)

Data Analytics: Looks at the past data to try and understand what happened and can also make predictions for the future.(12.6)

Data Governance: The commitment by an organization to ensuring data and information meet the characteristics of being valuable in order for the organization to meet its objectives.(12.7)

Data Mart: Database focused on addressing the concerns of a specific problem (e.g., increasing customer retention, improving product quality) or business unit (e.g., marketing, engineering).(12.9)

Data Mining: The process of analyzing data to find previously unknown and interesting trends, patterns, and associations in order to make decisions.(12.8)

Data Science: The analysis of large data sets to find new knowledge. The field of data science is constantly changing, and data scientists are on the cutting edge of work in areas such as artificial intelligence and neural networks. (12.6)

Data Warehouse: Set of databases designed to support decision making in an organization. It is structured for fast online queries and exploration. Data warehouses may extract, and aggregate enormous amounts of data from many different operational systems.(12.9)

Data Visualization: The graphical representation of information and data. These graphical representations (such as charts, graphs, and maps) can quickly summarize data in a way that is more intuitive and can lead to new insights and understandings. (12.8)

Dashboards: Type of data visualization that provide a heads-up display of critical indicators, letting managers get a graphical glance at key performance metrics. Some tools may allow data to be exported into spreadsheets. (12.8)

Decision-Making: The action or process of thinking through possible options and selecting one. (12.3)

Decision Support Systems: A computer program application that analyzes business data and presents it so that users can make business decisions more easily. (12.5)

Executive Information System (EIS):Customized for executives. These systems provide specific information for strategic decisions. For example, a CEO's EIS may include special spreadsheets that present financial data comparing the company to its principal competitors and graphs showing current economic and industry trends.(12.5)

Expert System: Gives managers advice similar to what they would get from a human consultant. (12.5)

Legacy Systems: Are outdated information systems that were not designed to share data, aren't compatible with newer technologies, and aren't aligned with the organization's current business needs.(12.7)

Online Analytical Processing: (OLAP)(pronounced "oh-lap"). Data used in OLAP reporting is usually sourced from standard relational databases, but it's calculated and summarized in advance, across multiple dimensions, with the data stored in a special database called a data cube. (12.8)

Operational Decisions: Refer to decisions that employees make each day to make the organization run. For example, think about the restaurant that routinely offers a free dessert when a customer complaint is received. (12.4)

Semi-Structured Decision: one in which most of the factors needed for making the decision are known but human experience and other outside factors may still impact the decision (12.4)

Strategic Decisions: Set the course of an organization. Tactical/Managerial decisions are decisions about how things will get done. (12.4)

Structured Decision: One that is made quite often, and one in which the decision is based directly on the inputs.(12.3)

Unstructured Decision: Or non programmed decision involves a lot of unknowns.(12.4)

Adapted from [Information Systems for Business and Beyond Glossary](#) by Ruth Guthrie licensed under a [CC-BY-3.0](#)

12.12. KNOWLEDGE CHECK

Knowledge Check 1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1801#h5p-59

Knowledge Check 2

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1801#h5p-60

Knowledge Check 3

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=1801#h5p-78

CHAPTER 13: EMERGING TECHNOLOGY

Chapter Outline

Photo by geralt Pixabay Pixabay License

13.1. INTRODUCTION

Learning Outcomes

Upon successful completion of this chapter, you will be able to:

- Define Artificial Intelligence;
- Discuss the history of artificial intelligence;
- Compare machines, humans and AI;
- Distinguish between the types of AI and learning methods;
- Differenitate between the types of extended reality;
- List some of the emerging technology trends and their impact on business;

Information systems have evolved at a rapid pace ever since their introduction in the 1950s. Today devices that you can hold in one hand are more powerful than the computers used to land a man on the moon in 1969. The last 10 years has seen the proliferation of intelligent devices, devices that can process information and make suggestions or provide responses. How does Netflix seem to know what types of programs or movies we like? How does Amazon post product displays to our account that sparks our interest? How does YouTube seem to provide video feeds that align with what we have previously watched and protect younger viewers from harmful content? This is achieved through artificial intelligence using algorithms and machine learning.

Artificial intelligence, the ability of a computer or machine to think and learn, and mimic human behaviour is changing the way companies do business. AI uses software algorithms to simulate human intelligence processes such as reasoning and speaking within computers and other IoT devices. AI simulates human intelligence processes through robotics, intelligent agents, expert systems, algorithms, and natural-language processing.

This chapter will provide an introduction to artificial intelligence and provide some examples of how businesses are leveraging this technology. It will also explore other types of emerging technology. **Emerging technology** includes new technology and technology that is continuously evolving.

13.2. AI EVOLUTION

To understand where the development of intelligent systems is heading, it is important to explore it's evolution. One of the first articles discussing the possibility of intelligent machines dates back to 1950, when Claude Shannon published Programming a Computer for Playing Chess which discuss the development of a chess playing program (Reynoso, 2021, May 25).

Around the same time, Alan Turing, a young British mathematician, explored the possibility of artificial intelligence in his 1950 paper, Computing Machinery and Intelligence in which he discussed how to build intelligent machines and how to test their intelligence.

The Turing Test: Can Machines Think?

The Turing Test (referred to as the Imitation Game) attempts to differentiate humans and machines. In the test, a human judge asks a human and a machine questions. If the judge cannot reliably tell the difference between the machine and the human (imitating human behaviour), the machine is said to have passed the test, and therefore have the ability to think. There have been criticisms of the test, and Turing responded to some. He stated that he did not intend for the test to measure the presence of "consciousness" or "understanding", as he did not believe this was relevant to the issues that he was addressing. The test is still referred to today.

The first official usage of the term "AI" was in 1956, at which point AI systems were used mainly to solve simple mathematical problems that were too tedious for humans. From 1957 to 1974, AI flourished. Computers could store more information and became faster, cheaper, and more accessible. Machine learning algorithms also improved and people got better at knowing which algorithm to apply to their problem. Early demonstrations such as Newell and Simon's *General Problem Solver* and Joseph Weizenbaum's *ELIZA* showed promise toward the goals of problem solving and the interpretation of spoken language respectively.

In the 1980's expert systems, which mimicked the decision making process of a human expert were introduced. The Japanese government heavily funded expert systems and other AI related endeavors as part of their *Fifth Generation Computer Project* (FGCP).

In 1997, reigning world chess champion and grand master Gary Kasparov was defeated by IBM's *Deep Blue*, a chess playing computer

program. In the same year, speech recognition software, developed by Dragon Systems, was implemented on *Windows*. Even human emotion was fair game as evidenced by Kismet, a robot developed by Cynthia Breazeal that could recognize and display emotions.

In 2011, IBM's Watson competed against two "Jeopardy!" winners, Ken Jennings and Brad Rutter, and emerged victorious. In 2014, a Chatbot named Eugene Goostman becomes the first computer that passed the Turing Test developed by Alan Turing himself. In 2017, Google's *Alpha Go* was able to defeat Chinese Go champion Ke Jie.

See some of these major events in the evolution of AI in the timeline below.

> *An interactive H5P element has been excluded from this version of the text. You can view it online here:*
> *https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=3412#h5p-80*

"Module 1: Introduction to Artificial Intelligence" from Thriving in the Age of Artificial Intelligence by the Faculty of Engineering and Applied Science at Ontario Tech University under a Creative Commons Attribution license, unless otherwise noted.

"The History of Artificial Intelligence" by Rockwell Anyoha, Harvard University SITN Boston is licensed under CC BY-NC-SA 4.0

13.3. MACHINES, AI & HUMANS

Current development of intelligent machines is focused on mimicking human behavior to perform complex tasks. Applications of AI are proliferating, and being integrated into our every day lives. Explore the examples in the activity below. Which of these examples of everyday technology incorporate AI?

📰 *One or more interactive elements has been excluded from this version of the text. You can view them online here:*
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=3422

[Activity: Using AI](#) from [Thriving in the Age of Artificial Intelligence](#) by the Faculty of Engineering and Applied Science at Ontario Tech University under a [Creative Commons Attribution license](#).

Machines vs AI

Machines and AI systems may appear to be the same, but their systems and mode of operation are vastly different.

- Machines that incorporate AI are typically capable of analyzing data, and they appear to "make decisions", similar to humans.
- Regular machines simply execute a series of commands and are unable to improve based on the data they receive.

Example: Machine vs AI

A great example of the difference between machines and AI systems is the platform [Grammarly](#) versus your typical spell check. While a spelling checker is able to correct your spelling, grammar, and punctuation, Grammarly can do all that, as well as check for issues in sentence structure, misused words, and more through the power of AI.

A key distinction between a computer following the code vs an AI system executing this is that with AI, the algorithm would become smarter as more data is entered and the number of errors would decrease over time. AI models are created through **algorithms**, which are a set of rules or processes to solve a specific problem or task (de Ponteves, 2019).

Example: Algorithm

Imagine you were given some numbers and were tasked with developing an algorithm that sorts the numbers from lowest to highest. What would be the set of steps that you would need to follow to accomplish this task?

One solution would probably be to first define the range of numbers and set some criteria for the computer to follow. Next, write a specific set of instructions on how you would like to order the numbers. For example, you may want the computer to sort the numbers lowest to highest. If there are several datasets, sometimes a **loop,** which is a part of code that allows a command to run again and again would be used to ensure the computer completes the command over and over until all datasets are sorted. The algorithm would then execute the commands one by one and any errors would be attributed to a mistake in the code.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=3422#h5p-79

AI vs Humans

The disctinction between AI and simple machines has been made, but how is AI different from humans? AI and Humans are different in a number of ways. Apart from humans being biological, live organisms, a key difference is the type and level of intelligence we possess (Vadapalli, 2020, September 15). We are able to make decisions based on our intelligence, emotions, self-awareness, and creativity, whereas most machines simply perform tasks based on code written by programmers. The main goal behind the advancement of machines and computers is to make these systems more efficient and "smarter" to support humans, which is now being accomplished through AI.

However, tasks that involve emotional intelligence or intuition cannot be automated. A machine will make decisions based on facts and statistical data but cannot, for example, recognize emotions, and thus would not be able to make rational decisions. AI lacks the "Human Factor". The table below compares natural (human) and artifical intellignece for a range of different abilities on a scale of acheivement (low to high).

(Stair & Reynolds, 2017)

Ability	Natural	Artificial
Creativity and imagination	high	low
Learn from experience	high	med
Use sensors	high	med
Adapt to new situations	high	med
Perform complex calculations	high	high
Transfer information	high	high
Perform calculations accurately and efficiently	high	high

"Module 1: Introduction to Artificial Intelligence" from Thriving in the Age of Artificial Intelligence by the Faculty of Engineering and Applied Science at Ontario Tech University under a Creative Commons Attribution license, unless otherwise noted.

13.4. TYPES OF AI

AI systems are different from humans and machines, and the degree of variation helps classify the different types of AI. AI can be classified based on ability and functionality. There are three categories of AI based on ability: narrow AI, general AI and super AI.

Types of AI: Based on Ability
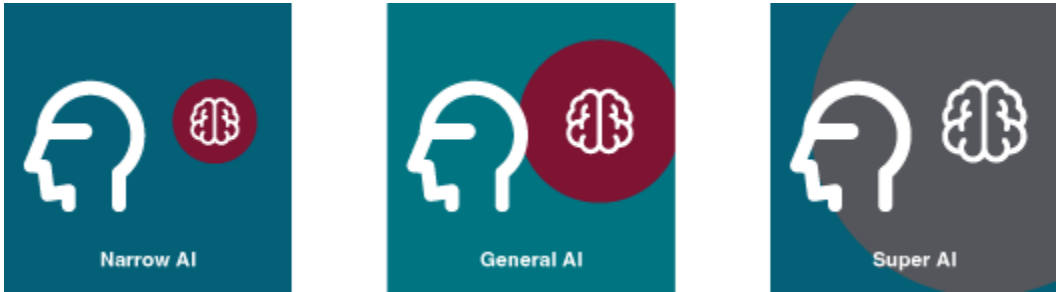
Types of Artificial Intelligence Based on Ability

Artificial Narrow Intelligence (A.N.I)	A form of weak AI refers to a computer's ability to perform a single task well. This is the type of AI we see today. Natural language processing used in smart assistants like Siri and Google are examples of narrow AI.
Artificial General Intelligence (A.G.I)	A form of strong AI that mimics human intelligence. It means that machines have the ability to apply what they have learned across different tasks, take in new information, and apply reason.
Artificial Super Intelligence (A.S.I)	A form of supernatural AI that exceeds human capabilities.

Despite having developed complex machines and applications such as Siri, Alexa, or other virtual assistants, all AI systems that currently exist are classified as A.N.I. According to a consensus among researchers, A.G.I and A.S.I are still decades away (Dilmegani, 2021, Aug 11).

Example: Chatbots

Chatbots and virtual assistants (i.e. Siri and Alexa) are computer programs that use AI and natural language processing (NLP) to understand customer questions and automate responses to them, simulating human conversation (Ibm.com, n.d.). These bots are cloud-based and able to gather information, such as user preferences or browsing history, to provide solutions that are specific to each individual. Chatbots improve the individual customer experience as the Cloud is able to provide personalized and relevant information.

In the hospitality industry, Best Western, in collaboration with IBM Watson Advertising, managed to use AI and NLP to create a more personalized customer experience for those looking to book Best Western hotels for their holidays. Specifically, "Conversations", an AI-powered advertising model from IBM, was used to provide one-on-one connections and recommend options based on the user's intent (Ibm.com, 2021). For example, Conversations was able to provide users with ads containing information on their destination and other tips and tricks!

Types of AI: Based on Functionality

AI can also be categorized based on functionality: reactive machines, limited memory, theory of mind, and self-awareness.
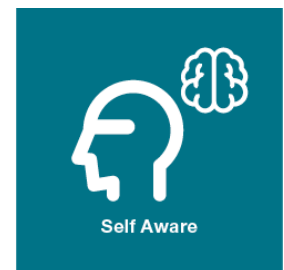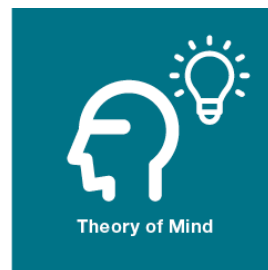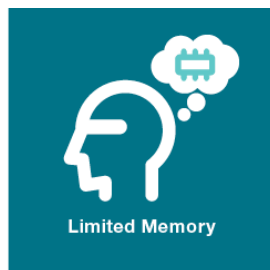
Categories of Artificial Intelligence Based on functionality include reactive machines, limited memory, theory of mind and self-awareness.

Reactive Machines	AI that conducts tasks for specific objectives. It is the first step of any AI system where no learning takes place. An example of this type of AI is Deep Blue the IBM program that beat chess champion Garry Kasparov.
Limited Memory	It is the ability of AI to use past experience and information to make predictions.
Theory of Mind	AI with the awareness that others have their own beliefs, objectives, and intentions. This type of AI is not yet developed and will be able to distinguish and understand emotion.
Self-Aware	AI with the sense of self and consciousness. This type of AI is not yet developed.

"Module 1: Introduction to Artificial Intelligence" from Thriving in the Age of Artificial Intelligence by the Faculty of Engineering and Applied Science at Ontario Tech University under a Creative Commons Attribution license, unless otherwise noted.

13.5. MACHINE LEARNING AND DEEP LEARNING

Now that you understand how AI systems differ from humans and machines and their evolutionary arc, the next question is how they work? Intelligent systems are created through **machine learning** and **deep Learning** techniques. These techniques are used to train, test, and validate AI models that can be implemented into different systems to automate simple tasks, process massive amounts of data and even develop new products. Let's look at the relationship between artificial Intelligence, machine Learning, and Deep Learning, as illustrated in the image below. It is important to understand the relationship between these terms as they are similar and can be confusing.
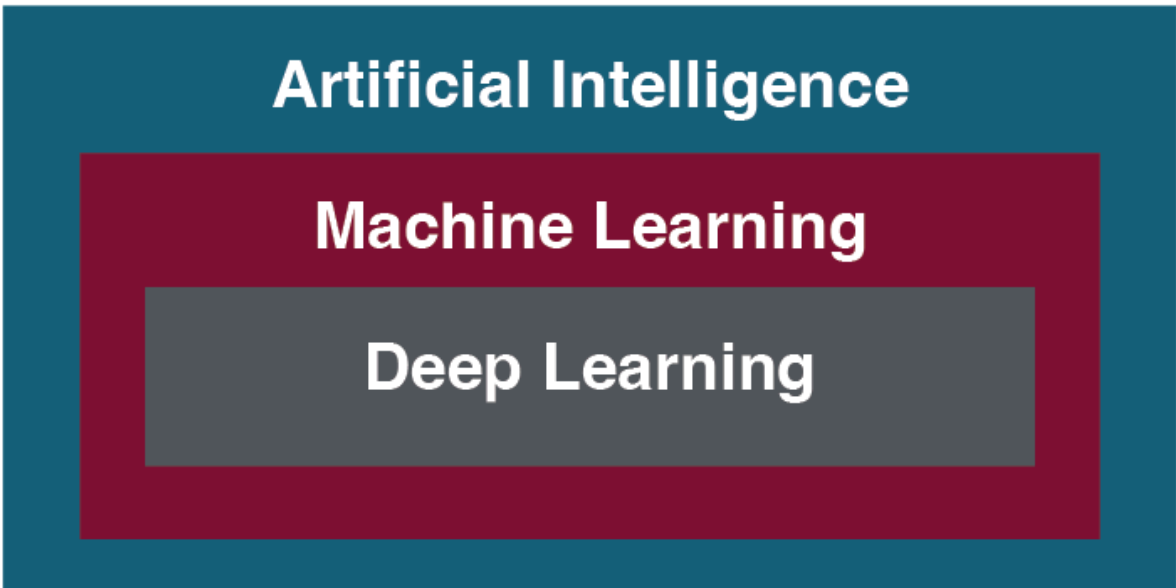
Relationship between AI, Machine Learning and Deep Learning

Artificial Intelligence	Refers to a machine mimicking human behaviour.
Machine Learning	A technique in which a computer is able to solve problems using sets of data.
Deep Learning:	A subset of Machine Learning – Deep Learning refers to when computers are able to solve more complex problems that cannot be solved using the traditional Machine Learning method (IBM Cloud Education, 202,0 June 3).

Machine Learning

Machine learning is a technique that is used by an AI system to analyze data, find patterns and make decisions automatically or with minimal human support. Machine Learning enables a system to sort, organize, and analyze data in order to draw important

conclusions and make predictions. Machine learning techniques can be subdivided into three categories: supervised learning, unsupervised learning, and reinforcement learning.

Supervised Learning	The form of Machine Learning in which data is labelled and categorized into groups by humans such as fruits and vegetables or engineers and doctors. Algorithms are used to classify data based on labels. Techniques can include decision trees, neural networks, and regression.
Unsupervised Learning	The form of Machine Learning in which a machine is given unlabelled data and must find its own connections through analysis, clustering, and identifying patterns.
Reinforcement learning	The trial and error-based machine learning method is used in which a machine learns from mistakes and improves upon them. Uses unlabeled data and learns through a series of trial-and-error actions.

Supervised learning is typically used to create algorithms where the model must learn how the inputs affect the outputs. Therefore, these models are used in instances like predicting the prices of houses, image classification, and even weather prediction.

AI systems created through **unsupervised learning** algorithms are given unlabelled data and like the human brain, the model is expected to connect information together, sort of like detecting patterns within data sets. The data given to the machine is unorganized, and the machine does the work of drawing inferences and conclusions from existing data points to sort it out into groups or clusters.

Example: Supervised and Unsupervised Learning

If a company wants to create a new marketing campaign for a particular product line, they may look at data from past marketing campaigns to see which of their consumers responded most favorably. Once the analysis is done, a machine learning model is created that can be used to identify these new customers. It is called "supervised" learning because we are directing (supervising) the analysis toward a result (in our example: consumers who respond favourably).

If a retailer wants to understand the purchasing patterns of its customers, an unsupervised learning model can be developed to find out which products are most often purchased together or how to group their customers by purchase history. This is called "unsupervised" learning because no specific outcome is expected.

Machine learning models can form the core of logistics and supply chain solutions in terms of optimizing the product packet size, delivery vehicle selection, delivery route selection, and delivery time computation. For instance DHL uses Amazon's Kiva robotics (improve speed, accuracy) for network management.

Reinforcement learning is similar to how humans learn: they learn from mistakes. Systems created using reinforcement learning become smarter as more data is collected, and the machine learns from any mistakes it makes. In this type of algorithm, no supervision is involved as it is based on a reward or goal-driven system where the machine is rewarded (assigned positive values) for desired behaviours and punished (assigned negative values) for undesired ones. Therefore, this algorithm is optimal for use in instances where a very specific behaviour needs to be automatically determined.

Example: Reinforcement Learning

Fanuc, a Japanese industry-based robotics company, has been leading with its innovation in this field – it is working actively to develop reinforcement learning in its own robots. They use reinforcement training so that the robots can train themselves on how to pick an object from one box and place it into another box. They use this process for different tasks, and as a result, they can build robots that can complete complex tasks more quickly than humans (Sharma, 2020).

"FANUC robots" by Mixabest CC-BY-SA 3.0

Deep Learning

Deep Learning is a subfield of Machine Learning and is another technique in which a machine is trained with massive datasets. However, there is significantly less human work involved. In **Deep Learning**, the model can extract features and classify the data itself instead of having a human identify the features. We can view Deep Learning as an intelligent technique that uses multiple layers of a computing system known as Artificial Neural Networks to categorize information within a data set. Much like the neural pathways in a brain, scientists and engineers created a web of connected paths for electrical messages, which are called **Artificial Neural Networks (A.N.N)**. These neural networks function similarly to the neurons that fire electrical impulses within the brain, which then send messages to and from the brain in living organisms to accomplish tasks. The data in A.N.Ns are activated and sent to other layers through a series of mathematical calculations to simulate decision-making in computers.

Neural Networks	Algorithms that process information in a similar way to the human brain. Contain a collection of interconnected nodes.

Deep learning and neural networks have been deployed in several fields, such as computer vision, natural language processing, and speech recognition. It has been used in many healthcare applications for the diagnosis and treatment of many chronic diseases. These algorithms have the power to avoid outbreaks of illness, recognize and diagnose illnesses, and minimize running expenses for hospital management and patients. While machine learning, deep learning, and neural networks are all subsets of artificial intelligence, deep learning is actually a subset of machine learning, and neural networks are a subset of deep learning.

Deep learning can be thought of as the automation of predictive analytics. Deep learning is essentially a neural network with three or more layers which allows it to learn from a large amount of data. Deep learning is behind many artificial intelligence applications improving on automation and analytics. It is used in such applications as voice-activated electronics, self-driving cars, and credit card fraud detection. The evolution of deep learning started after the invention of neural networks, by adding more neurons and additional hidden layers to neural networks makes deep learning more cultivated. Like machine learning, deep learning is also categorized into subcategories, i.e., supervised and unsupervised.

Machine Learning vs Deep Learning

Machine learning focuses on developing algorithms that can alter themselves without human involvement to take defined data and generate a required output. Deep learning uses neural networks to learn unsupervised from unstructured or unlabeled data.

Machine learning uses algorithms to analyze data, learn from it, and make smart decisions based on the knowledge learned, while deep learning organizes the algorithms into layers to form artificial neural networks that can learn and make intelligent decisions independently.

Table: A summary of the differences between Deep Learning and Machine Learning (Jelvix, 2021)

	Deep Learning	Machine Learning
Data Requirements	Requires a large dataset	Works well with a small to a medium dataset
Hardware Requirements	May require machines with a GPU	Works with low-end machines
Training Time	Longer training times (ranging from a few hours to weeks)	Shorter training times (from a few seconds to hours)
Processing Time	Faster processing times	Slower processing times
Number of Algorithms	Fewer Algorithms required	More algorithms required
Data Interpolation	Difficult	Difficulty Varies

13.6. APPLICATIONS OF AI

Autonomous Technology

One of the most widely used applications of AI is autonomous technologies. By combining software, sensors, and location technologies, devices that can operate themselves to perform specific functions are being developed. Some examples include: 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. While most drones today are used for military or civil applications, there is a growing market for personal drones.

Robots

Robots are automated machines that can execute specific tasks with very little or no human intervention and are able to accomplish tasks with both speed and precision (TechTarget, 2021, May 14). The development and deployment of robots is most common in manufacturing in the replacement of humans in repetitive tasks. Robots are also used in medicine, education, restaurants and hotels, and entertainment. Some of the most popular robots are ASIMO by Honda and Boston Dynamics robots like ATLAS. Robots can increase productivity and accuracy, but are costly. For more advantages and disadvantages, see the table below.

Photo by Phasmatisnox via Wikipedia CC-BY

Advantages	Disadvantages
- Reduction of risk. Tasks that are dangerous to humans can be done by robots (i.e. defusing bombs, travelling to space). - Error reduction and increased level of precision. - No downtime. Robots can work everyday all day. - Good at performing repetitive tasks that may otherwise injure humans - Faster decisions can be made by robots programed with artificial intelligence than humans as they are able to process complex data at a much higher speed	- Reduction in specific employment opportunities in jobs being replaced by robots - High capital investment required by organizations to utilize and maintain - Lack of creativity and emotion in the performance of tasks or decision-making processes - Reduction in human interaction - Require constant power to run and maintain

With artificial intelligence, robots will be able to independently estimate the events around them and to make decisions on actions which they're required to make for their given objective. Robots can already both record human movement skills and replicate them as machine learning improves drive efficiency and mobility (Bryndin, 2019).

Intelligent Agents

Intelligent agents process the inputs it receives, and makes decisions/takes action based on that information. Sensors allow intelligence agents to perceive their surroundings, while actuators allow them to act on that perception. A software agent, a human agent, and a robotic agent are all examples of agents, each with its own set of sensors and actuators to sense its environment and then perform actions through its actuators.

AI agents that can learn from their previous experiences or have learning capabilities are known as learning agents. Beginning by acting on basic knowledge, learning agents subsequently learn to act and adapt on their own automatically. Conversational intelligence tools are tools that have the ability to auto-record meetings, transcribe, and apply AI to speech. They can be helpful for individuals working in sales, and could possibly replace some functions performed by customer relationship management systems.

IOS 7 Siri by Kavakavins111 on Wikipedia CC-BY-SA

Siri, Alexa and Google Assistant are examples of intelligent agents that can be accessed from smartphones. These tools can allow users to open applications, send messages, make calls, play voicemails and check the weather.

Natural Language Processing (NLP)

Natural Language Processing (NLP) allows computers to extract meaning from human language. Natural Language Processing's goal by design is to read, decipher, and comprehend human language. In Natural Language Processing, humans converse with the machine which records the conversation and converts the audio to text. After that, the system analyses the data and converts it to audio. The machine then plays the audio file back in response to the human.

Algorithms use natural language processing to detect natural language rules, resulting in the conversion of unstructured language input into a format that computers can recognize. Natural Language Processing (NLP) is used in many translation applications such as Google Translate, various interactive voice response (IVR) applications found in call centres, and software tools that check for grammatical accuracy of texts, like Microsoft Word and Grammarly. Additionally, it is also used in personal assistant tools like Siri, Cortana and Alexa.

Expert Systems

Expert systems (ES) are designed to emulate the human ability to make decisions in specific contexts. An expert system, by means of a reasoning, can perform at a level comparable to or better than a human expert does within a specified area. The goal of ES is therefore to solve complex problems by following a line of reasoning that is derived from human knowledge. This reasoning is normally represented by if–then–else statements, instead of conventional procedural code. Expert systems have been reliably used

in the business world to gain competitive advantages and forecast market conditions. In a time where every decision made in the business world is critical for success; the assistance provided from an expert system can be an essential and highly reliable resource.

Expert Systems in Fraud Detection

Expert systems can be used in fraud detection. A company can establish rules for detecting fraud and then allow the system to identify fraudulent behaviour based on the set of rules created. For example, a rule can be created to look for transactions that are originating from a particular location (one that may been known for criminal activity) and are over a certain amount. Since expert systems are based on rules that are programmed, it may be easy for cybercriminals to circumvent the system. However, expert systems can still be useful as part of a larger fraud defense strategy that may also incorporate more intelligent systems (Lu, 2017, February 19).

Autonomous Technologies adapted from "Chapter 13: Trends in Information Systems" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

Expert Systems adapted from "Protecting Artificial Intelligence IPs: A Survey of Watermarking and Fingerprinting for Machine Learning" by F. Regazzoni, P. Palmieri, F. Smailbegovic, R. Cammarota, and I. Polian, licensed under CC BY 4.0

Advantages and Disadvantages of Robots adapted from "Robots with Artificial Intelligence and Spectroscopic Sight in Hi-Tech Labor Market" by Evgeniy Bryndin is licensed under a Creative Commons Attribution 4.0 License unless otherwise noted.

13.7. EXTENDED REALITY

Another category of emerging technology is **extended reality** or XR. XR is an umbrella term that covers all forms and combinations of real and virtual environments. This includes augmented reality (AR), virtual reality (VR) and a combination of the two or mixed reality (MR) (Likens, 2019, April 8).

Augmented Reality

Augmented-reality by OyundariZorigtbaatar WikiCommons CC-BY-SA

Augmented reality (AR) enhances one's view of the real world with layers of digital information added to it. With AR there is no created scenario; instead, an actual event is being altered in real-time (Moawad et al., 2020 Nov 25). Some examples of this are Snapchat lenses and the game Pokémon Go. AR is being used in e-commerce to help purchasers visualize and interact with the products before purchasing them.

IKEA Augmented Reality Game

Escape the Clutter is an AR escape room game for Snapchat developed by IKEA. In the game, a cluttered 3D room will appear on the screen. The object of the game is to remove the clutter by adding in IKEA organization solutions. The organization's products act as the 'keys' to the escape room. As users add the products, they can learn more about them and their benefits (Ikea, 2022).

Virtual Reality

Photo by Minh Pham on Unsplash

Virtual reality (VR) is a computer interaction in which a real or imagined environment is simulated. This allows users to both interact with and alter that reality within the environment. The popularity and development of virtual and augmented reality have grown due to advances in VR technology and devices based on smartphones like Google Cardboard. Some people view virtual reality as a gimmick to enhance video game playing at home, but the technology is being used in innovative ways.

One way in which businesses are leveraging VR technology is for training and education. This technology is especially valuable in high-risk industries like the military, space exploration, and medicine, where one wrong move can have disastrous consequences. It can also be helpful to simulate interview scenarios or difficult conversations, allowing users to role-play and practice in varied scenarios. VR can also simulate in-person meetings for those working remotely using avatars. Avatars are computer representations of people.

13.8. EMERGING TECHNOLOGY TRENDS

In addition to AI; a number of other emerging technologies are forecast to have an impact on how businesses operate and communicate. The following are some trends that are driving these new and innovative technologies.

Wearable

The last section explored VR technologies, which include devices that can be worn to simulate virtual environments. Technology that can be worn or '**wearables**' have been around for a long time, with applications such as hearing aids and, later, Bluetooth earpieces. Product lines have expanded to include the Smartwatch, body cameras, sports watch, and various fitness monitors and other wellness devices. Energy harvesting and haptic devices are examples of future developments in wearable technology. Energy harvesting allows body heat to be converted to solar power, and haptic devices allow one to control virtual objects. Wearable haptic devices will be integrated into clothing to help with directions or to assist individuals in navigating the virtual world (Perkoic, 2022, September 29).

Connected

As discussed in chapter 3, the **Internet of Things (IoT)** refers to devices that have been embedded into a variety of objects, including appliances, lamps, vehicles, lightbulbs, toys, thermostats, jet engines, etc. and then connecting them via Wi-Fi, BlueTooth, or LTE to the internet. Think of IoT as devices that you wouldn't normally consider being connected to the internet, and the connection is independent of human intervention. This interconnectedness or uploading of data is virtually automatic. So a PC is not an IoT, but a fitness band could be. Interconnected devices are becoming ubiquitous, meaning they are everywhere. Today, there are IoTs for monitoring traffic, air quality, soil moisture, bridge conditions, consumer electronics, autonomous vehicles, and the list seemingly never stops.

Principally, three factors have come together to give us IoT: inexpensive processors, wireless connectivity, and a new standard for addresses on the internet known as IPv6. Processors have become both smaller and cheaper in recent years, leading to their being embedded in more devices. Consider technological advancements in your vehicles. Your car can now collect data about how fast you drive, where you go, radio stations you listen to, and your driving performance, such as acceleration and braking. Insurance companies are offering discounts for the right to monitor your driving behaviour. On the positive side, imagine the benefit of being informed instantly of anticipated traffic delays each time you adjust your route to work in the morning. Benefits from IoTs are virtually everywhere. Here is a quick list.

Optimization of Processes	IoTs in manufacturing monitor a variety of conditions that impact production including temperature, humidity, and barometric pressure – all factors which require adjustment in the application of manufacturing formulas.
Component Monitoring.	IoTs are added to components in the manufacturing process, then monitored to see how each component is performing.
Home Security Systems.	IoTs make the challenge of monitoring activity inside and outside your home are now easier.
Smart Thermostats.	Remote control of home thermostats through the use of IoTs allows the homeowner to be more efficient in consumption of utilities.
Residential Lighting	IoTs provide remote control of lighting.

While there are many benefits to these constantly connected devices, the privacy and security of personal data and information should also be considered.

Collaborative
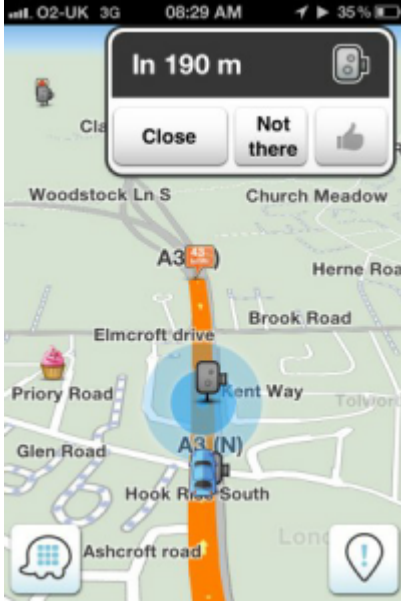
"Waze Screen Shot" (click to enlarge) by D. Bourgeois CC-BY-NC

As more people 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 your location in order to update traffic statistics. Other data can be reported actively, such as adding your 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 directs you around traffic and accidents based upon real-time reports from other users.

Super

Quantum computing a technology that applies quantum mechanics to build novel supercomputers, high-performance computers used to solve large-scale computational tasks. Quantum computers can operate at speeds that are exponentially faster than common computers and can make calculations based on the probability of an object's state before it is measured. Google demonstrated that their quantum computers can solve a problem that no classical computer could ever solve. For the third year in a row, IBM doubled its quantum computing power. Additionally, several web service providers, including Amazon, announced plans for cloud-based quantum computing services. Quantum computers can make drug development, power storage, manufacturing, and agriculture better, faster, and more sustainable. They may also unravel cybersecurity infrastructure around the world, making them a potential threat to national security. The field of quantum computing is still in its infancy, and the question of scale remains unsolved.

"Chapter 13: Trends in Information Systems" from Information Systems for Business and Beyond (2019) by David Bourgeois is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

13.9.THE FUTURE: A CAUTIONARY APPROACH?

As outlined in this chapter, applications of AI and other emerging technology are increasing rapidly. However, the advancement of these technologies also raises questions with respect to governance and regulations to its development. Concerns over ethical and privacy issues along with military development are among some issues to consider. Remember from chapter 9, **ethics** means a set of moral principles. There are several events that reiterate just how easy it is to exploit AI for unethical uses.

Example: AI and Privacy

Examples like the breaking of privacy laws by Google's DeepMind and the failure to protect Facebook users' personal data in the Facebook – Cambridge Analytica scandal generated a lot of concern about the use of AI. In both of these examples, the data stored by the AI in DeepMind and Facebook was released to third-party users without the patients' (DeepMind) or Facebook users' knowledge or consent (Sinha, 2022).

Example: ChatGPT and Ethical Implications

ChatGPT is a conversational chatbot that was launched by OpenAI in November 2022. It can be used to produce written work as well as write code by responding to prompts or instructions. Following it's release, news articles proliferated criticizing the tool over the ethical concerns of its use. Some concerns shared include the increased risk of misinformation, the ability to perpetuate bias, and its ability to impersonate individuals (Steinbeck, 2023, Jan 8). Academic institutions across the world expressed their concerns around the use of the tool for cheating. Some schools have even banned its use (Wood & Kelly, 2023, January 26).
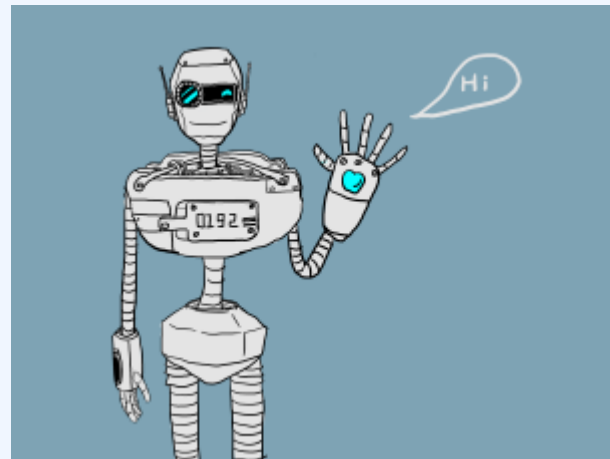

Image by scarlett_z10 Pixabay License

However, despite the setbacks, AI appears to be an exponentially growing field. Today, because of the Internet of Things, data volumes have significantly increased since almost every device we use has the ability to gather and store data such as pedometers on our phones, thermostats, and voice assistants like Alexa or Siri. To keep up with these large amounts of data, AI has been upgraded to increase processing speeds and computational capacity. Nowadays, AI systems are much more efficient, widely available, and are easily accessible in contrast to their earlier developmental stages. With the rapid growth in the development of AI, it is important to consider the ethical implications of its use.

Ethical Implications of AI

> *An interactive H5P element has been excluded from this version of the text. You can view it online here:*
> *https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=3631#h5p-82*

"Module 1: Introduction to Artificial Intelligence" & "Module 5 Societal and Ethical Impacts of AI" from Thriving in the Age of Artificial Intelligence by the Faculty of Engineering and Applied Science at Ontario Tech University under a Creative Commons Attribution license, unless otherwise noted.

13.10.SUMMARY

Key Takeaways

- Artificial intelligence (AI) is the ability of a computer to think and learn.
- AI technology is quickly advancing from it's initial conception in the 1950's.
- The Turing Test is a test to determine a machine's ability to think and, therefore, imitate human behaviour.
- Machines that incorporate AI appear to make decisions similar to humans.
- AI lacks emotional intelligence, "the human factor".
- AI can be categorized based on ability and functionality.
- Machine learning and deep learning use algorithms and neural networks to imitate the way humans learn.
- Autonomous technologies are one of the most widely used applications of AI. They include nanobots, driverless cars, and UAV.
- Robots are a type of autonomous technology that automates processes with little or no human interaction.
- Expert systems have been used for many years to streamline knowledge and make decisions.
- Extended reality (XR) is an umbrella term that covers all forms and combinations of real and virtual environments, including AR and VR.
- Emerging trends in technology include devices that are: wearable, connected, collaborative and super.
- Ethics need to be considered when using intelligent technologies.

Review Questions

1. What is artificial intelligence, and what are some of the capabilities?
2. List some of the different classifications of artificial intelligence.
3. How can we use artificial intelligence systems to help in decision-making?
4. Define robotics and explain how they are being used.
5. What are some of the advantages and disadvantages of robots?
6. What are expert systems and how are they used?
7. What is the difference between XR, AR and VR?
8. List and discuss some of the emerging trends in technology and how they impact business.

Assignment

Overview

This assignment is designed to help you understand the different applications of AI in business.

Assignment

In this assignment, you will research the different applications of AI in business and discuss the benefits. Complete the following questions in a separate document.

1. Research applications of AI for your particular field of study.
2. Write a few paragraphs on the examples found and explain how they are a business benefit. Make sure to provide references to the resources you use.
3. Share your examples with the class.

13.11.KEY TERMS

Chapter 13

Algorithms: which are a set of rules or processes to solve a specific problem or task. (13.3)

Artificial Intelligence: The ability of a computer or machine to think and learn, and mimic human behaviour. (13.1)

Augmented reality (AR): Enhances one's view of the real world with layers of digital information added to it. With AR there is no created scenario; instead, an actual event is being altered in real time. (13.7)

Autonomous Technologies: Autonomous robots and vehicles that work by combining software, sensors, and location technologies. Devices that can operate themselves. (13.6)

Chat-bots: are computer programs that use AI and natural language processing (NLP) to understand customer questions and automate responses to them, simulating human conversation. (13.4)

Collaborative Technology: To share data with each other for mutual benefit. Some of this sharing can be done passively and other data can be reported actively. (13.8)

Deep Learning (DL): A subset of Machine Learning – Deep Learning refers to when computers are able to solve more complex problems without human intervention.(13.5)

Emerging technology: includes new technology and technology that is continuously evolving. (13.1)

Expert Systems (ES): Designed to emulate the human ability to make decisions in specific contexts, and have had a large impact in the world of AI. (13.6)

Extended Reality or XR: XR is an umbrella term that covers all forms and combinations of real and virtual environments. This includes: augmented reality (AR), virtual reality (VR) and a combination of the two or mixed reality (MR).(13.7)

Intelligent Agents: Process the inputs it receives, and makes decisions/ takes action based on that information. (13.6)

Internet of Things: The idea of physical objects being connected to the Internet, embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data. (13.8)

Loop: a part of software code that allows a command to run again and again. (13.3)

Machine Learning (ML): is a technique that is used by an AI system to analyze data, find patterns and make decisions automatically or with minimal human support.(13.5)

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.(13.6)

Natural Language Processing (NLP): Allows computers to extract meaning from human language. Natural Language Processing's goal by design is to read, decipher, and comprehend human language.(13.6)

Reinforcement Learning: A form of Machine Learning in which a machine is given unlabelled data and must find its own connections through analysis, clustering, and identifying patterns. (13.5)

Robots: Are automated machines that can execute specific tasks with very little or no human intervention and are able to accomplish tasks with both speed and precision. (13.6)

Supervised Learning: A form of Machine Learning in which data is labeled and categorized into groups by humans and algorithms are used to classify data based on labels. (13.5)

Unsupervised Learning: The trial and error-based Machine Learning method in which a machine learns from mistakes and improves upon them. (13.5)

Virtual Reality (VR): Computer interaction in which a real or imagined environment is simulated. This allows users to both interact with and alter that reality within the environment. (13.7)

Wearable Technology: A category of technology devices that can be worn by a consumer and often include tracking information related to health and fitness. (13.8)

13.12.KNOWLEDGE CHECK

Knowledge Check 1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=3620#h5p-63

Knowledge Check 2

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=3620#h5p-64

Knowledge Check 3

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=3620#h5p-62

Knowledge Check 4

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=3620#h5p-77

Knowledge Check 5

The following activity will explore just how different humans are from Artificial Intelligence, even though AI systems are able to mimic human behaviors. Drag the features and attributes on the right side and place them into one of the bins on the left side. Think about why you placed that feature into the bin you chose.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/informationsystemscdn/?p=3620#h5p-81

APPENDICES

APPENDIX A: VIDEO RESOURCES

Video Resources

Chapter 1: Information Systems

- What is an information system [New Tab] (2:58)
- Data, Information, Knowledge [New Tab] (2:14)
- The History of IBM: The Personal Computer to Watson [New Tab] (4:36)

Chapter 2: Technology Enabled Strategy

- The Explainer: Porter's Five Forces [New Tab] (2:08)
- Value Chain Defined [New Tab] (1:24)

Chapter 3: Hardware

- What is a Computer?[New Tab] (2:47)
- Inside a Computer [New Tab] (2:17)
- The Personal Computer Revolution [New Tab] (10:14)
- Shenzhen China's Dystopian Future [New Tab] (10:09)
- Over 50 Years of Moore's Law [New Tab](2:03)

Chapter 4: Software

- Types of Software [New Tab] (7:55)
- Operating Systems: Crash Course Computer Science [New Tab] (13:35)
- Open Source software[New Tab] (5:41)

Chapter 5: Data

- Introduction to Databases [New Tab](3:44)

Chapter 6: Networks

- There & Back Again : A Packet's Tale [New Tab](3:21)
- 60 Hudson St[New Tab] (:35 to 2:30)
- What is the World Wide Web [New Tab] (3:54)

Chapter 7: Systems Development

- Video: The Systems Development Life Cycle [New Tab](1:18)
- Video: Build vs Buy [New Tab](1:36)

Chapter 8: Security

- Cyber Crimes You Never Hear About [New Tab](3:31)
- Former NSA Hacker- 5 Ways to Protect Yourself Online [New Tab](3:28)

Chapter 9: Issues

- The Cambridge Analytica Files [New Tab](3:40)
- The Digital Divide: How does it affect Rural Canada? [New Tab](3:12)
- Terms & Conditions May Apply [New Tab](2:19)
- What the Internet is doing to our brains [New Tab](3:53)
- The Social Dilemma Trailer [New Tab](2:34)

Chapter 10: E-Business

- What is Blockchain? [New Tab](2:19)
- Voice Shopping with Alexa [New Tab](1:40)
- Introducing Amazon Go [New Tab](1:49)
- China's Great Leap to Wallet Free Living[New Tab] (10:35)
- Alibaba's New Retail Explained [New Tab](5:17)

Chapter 11: Business Process Systems

- Explanation of MIS, DSS, and EIS[New Tab] (5:27)
- Business Process Re-Engineering with Example[New Tab] (4:53)
- Behind the Scenes at Amazon[New Tab] (4:51)
- Amazon Supply Chain Optimization[New Tab] (1:33)

Chapter 12: Business Intelligence

- Big Data & Business [New Tab](2.44)
- 4 Types of Analytics[New Tab] (9:15)

Chapter 13: Emerging Technology

- The Smart House[New Tab] (12:48)
- The Self-Driving Car[New Tab] (2:47)

VERSIONING HISTORY

This page provides a record of edits and changes made to this book since its initial publication. Whenever edits or updates are made in the text, we provide a record and description of those changes here. If the change is minor, the version number increases by 0.1. If the edits involve a number of changes, the version number increases to the next full number.

The files posted alongside this book always reflect the most recent version.

Version	Date	Change	Affected Web Page
1.0	December 2021	First Publication	N/A
1.1	January 2023	Re-colour images to meet accessibility requirements Added 3D printing example Added content on cloud computing Added content on USB-C	Many pages. Section 3.7 Section 3.5
2.0	April 2023	New Chapter 13 Emerging Tech	Chapter 13
2.1	January/February 2024	Replaced footnotes with in-text citations, and moved references to the reference list. Added end of section attributions. Created test banks for each chapter.	Many pages Reference List

REFERENCES

Accenture.(2019).The cost of cybercrime-ninth annual cost of cybercrime study. https://www.accenture.com/_acnmedia/pdf-96/accenture-2019-cost-of-cybercrime-study-final.pd.

Association for Computing Machinery. (1992, October 16). ACM Code of Ethics and Professional Conduct

Association for Computing Machinery.(1992, October 16).ACM Code of Ethics and Professional Conduct.

Aston, J., Vipond, O., Virgin, K., & Youssouf, O. (2020, July 24). Retail e-commerce and COVID-19: How online shopping opened doors while many were closing. Statistics Canada. https://www150.statcan.gc.ca/n1/pub/45-28-0001/2020001/article/00064-eng.htm

Baker, S., & Grow B. (2004, August 9). Gambling Sites, This Is a Holdup. BusinessWeek Online. http://www.businessweek.com/magazine/content/04_32/b3895106_mz063.htm.

Bennett, C., Gratton, T., & Yao, J. (2020, April 2). Website cookies in Canada: Is consent required?: Insights: DLA piper global law firm. DLA Piper. https://www.dlapiper.com/en/canada/insights/publications/2020/04/website-cookies-in-canada-is-consent-required/.

Bilodeau, H., Lari, M., & Uhrbach, M.(2019, March 28).Cyber security and cybercrime challenges of Canadian businesses, 2017. Statistics Canada. https://www150.statcan.gc.ca/n1/pub/85-002-x/2019001/article/00006-eng.htm.

Borowski, P.F. (2021). Innovation strategy on the example of companies using bamboo. J Innov Entrep 10, 3. https://doi.org/10.1186/s13731-020-00144-2.

Brant, T. (2021, April 28). What is USB-C? An explainer. PC Magazine. https://www.pcmag.com/how-to/what-is-usb-c-an-explainer

Bryndin, E. (2019). Robots with Artificial Intelligence and Spectroscopic Sight in Hi-Tech Labor Market. International Journal of Systems Science and Applied Mathematics, 4(3), 31-37. https://doi.org/10.11648/j.ijssam.20190403.11

Bursztynsky , J. (2020, August 19). Apple becomes first U.S. company to reach a $2 trillion market cap. CNBC. https://www.cnbc.com/2020/08/19/apple-reaches-2-trillion-market-cap.html#:~:text=Apple%20becomes%20first%20U.S.%20company%20to%20reach%20a%20%242%20trillion%20market%20cap,-Published%20Wed%2C%20Aug&text=Apple%20hit%20a%20market%20cap,a%20%241%20trillion%20market%20cap

Canada's Public Policy Forum. (June 2014). Northern connections: Broadband and Canada's digital divide: final report (PDF) (Report). Ottawa, Ontario.

Canadian Centre for Cyber Security. (2021, May 13). Baseline Cyber Security Controls for small and medium organizations. Canadian Centre for Cyber Security. https://cyber.gc.ca/en/guidance/baseline-cyber-security-controls-small-and-medium-organizations.

Canadian Intellectual Property Office. (2020, February 24). Archived – A guide to patents. https://www.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/eng/h_wr03652.html#understandingPatents1.

Canadian Intellectual Property Office. (2021, August 16). Trademarks guide. https://www.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/eng/h_wr02360.html?Open&wt_src=cipo-tm-main&wt_cxt=learn#registering_outside.

CENGN. (2021). Bringing High-Speed Connection to Underserved Communities. https://www.cengn.ca/residential-broadband-program/

Chaffey, D. (2017). Global social media research summary 2017. [Online] Available at: www.smartinsights.com/social-...edia-research/

Charette, R. (2005, September). Why Software Fails. IEEE Spectrum.

Conway, M.(1968). How do committees invent. Datamation: 28–31.

de Ponteves, H. (2019). AI Crash Course: A fun and hands-on introduction to machine learning, reinforcement learning, deep learning, and artificial intelligence with Python. Birmingham: Packt Publishing Ltd.

Dean, J. (2014). 4G vs 5G Mobile Technology. Raconteur. https://www.raconteur.net/technology/4g-vs-5g-mobile-technology.

Desjardins, J. (2019, April 17). How much data is generated each day? World Economic Forum. https://www.weforum.org/agenda/2019/04/how-much-data-is-generated-each-day-cf4bddf29f/.

Dignan, L.(2007, December 11). Survey: One in 3 IT Projects Fail: Management OK with It. ZDNet.https://www.zdnet.com/article/survey-one-in-3-it-projects-fail-management-ok-with-it/

Dilmegani, C. (2021, Aug 11). Will AI REACH singularity By 2060? 995 experts' opinions on AGI," AIMultiple, 19-Jun-2021. https://research.aimultiple.com/artificial-general-intelligence-singularity-timing/

The Economist. (2013, September 13). 3-D Printing Scales Up.

Evans, N. D. (2015, August 26). How Digital Business disrupts the five forces of industry competition. CIO. https://www.cio.com/article/244954/digital-disruption-from-the-perspective-of-porters-five-forces-framework.html

Evans, N. D. (2015, August 26). How Digital Business disrupts the five forces of industry competition. CIO. https://www.cio.com/article/2976572/digital-disruption-from-the-perspective-of-porters-five-forces-framework.html.

Fernandes, B. (2017, October 20). Personal telephone interview

Gartner UK Ltd Tamesis. (2010, July 26). Gartner says majority of consumers rely on social networks to guide purchase decisions. PresseBox. https://www.pressebox.com/pressrelease/gartner-uk-ltd/Gartner-Says-Majority-of-Consumers-Rely-on-Social-Networks-to-Guide-Purchase-Decisions/boxid/361969

Government of Canada. (2020, February). Baseline Cyber Security Controls for small and medium organizations v1.2. Communications Security Establishment. https://www.cyber.gc.ca/sites/default/files/publications/Baseline.Controls.SMO1_.2-e%20.pdf.

Grigonis, H. (2018, April 5). Nine Things to Know About Facebook and Cambridge Analytica. Digital Trends. Retrieved from https://www.digitaltrends.com/social-media/what-facebook-users-should-know-about-cambridge-analytica-and-privacy/

Hammer, M.(1990). Reengineering work: don't automate, obliterate. Harvard Business Review p. 104–112.

Holst, A. (2021, June 7). Total Data Volume Worldwide 2010-2025. Statista.https://www.statista.com/statistics/871513/worldwide-data-created/.

Iansiti, M. and Lakhani, K. R. (2017, January). The truth about blockchain. Harvard Business Review. Retrieved from https://hbr.org/2017/01/the-truth-about-blockchain

IBM Cloud Education. (202,0 June 3). What is Artificial Intelligence (AI)?. IBM, https://www.ibm.com/cloud/learn/what-is-artificial-intelligence

Ibm.com. (2021). IBM Watson Advertising Conversations – Overview. https://www.ibm.com/products/watson-advertising-conversations

Ibm.com. (n.d.) What is a chatbot? https://www.ibm.com/topics/chatbots

Ikea.(2022). It's Time for Some Good, Cleaning Fun. https://www.ikea.com/us/en/campaigns/escape-the-clutter-pub7490bf20

Interact Corporation. (2021, May 15). Why 2018 was another banner year for Interac e-Transfer. Interac In The Know. https://www.interac.ca/en/content/business/why-2018-was-another-banner-year-for-interac-e-transfer/.

International Telecommunications Union. (2018, January 23). UN Broadband Commission sets goal broadband targets to bring online the world's 3.8 billion not connected to the Internet. https://www.itu.int/en/mediacentre/Pages/2018-PR01.aspx

Jelvix. (2021). Difference between AI vs Machine Learning vs Deep Learning.https://jelvix.com/blog/ai-vs-machine-learning-vs-deep-learning

Krishnamurthy, S. (2003). E-Commerce Management: Text and Cases. p.73.

Leary, K. (n.d.). The World's E-Waste Is Piling Up at an Alarming Rate, Says New Report. https://www.sciencealert.com/global-electronic-waste-growth-report-2017-significant-increase

Likens, S. (2019, April 8). The XR factor: The incredible potential of extended reality. https://www.pwc.com.au/digitalpulse/extended-reality-xr-essentials-101.html.

Liu, S. (2021, August 31). Topic: Microsoft. Statista. https://www.statista.com/topics/823/microsoft/#dossierKeyfigures. /

Loesche, D., & Richter, F. (2018, March 6). Infographic: Mobile e-commerce is up and poised for further growth. Statista. https://www.statista.com/chart/13139/estimated-worldwide-mobile-e-commerce-sales/.

Lu, C. (2017, February 19). How AI is helping detect fraud and fight criminals. Retrieved December 3, 2021, from https://venturebeat.com/2017/02/18/how-ai-is-helping-detect-fraud-and-fight-criminals/

Marciano, J. (2021, August 10). Fake online reviews cost $152 billion a year. Here's how e-commerce sites can stop them. World Economic Forum. https://www.weforum.org/agenda/2021/08/fake-online-reviews-are-a-152-billion-problem-heres-how-to-silence-them/.

McClelland, C. (2021, August 27). Data brokers are tracking you – and selling the info. financialpost. https://financialpost.com/technology/data-brokers-are-tracking-you-and-selling-the-info.

Medium Predict. (2021, May 8). What is 'new retail' and why is it the future of retail?https://medium.com/predict/what-is-new-retail-and-why-is-it-the-future-of-retail-76a6ac07d6ac

Merriam-Webster Dictionary. (n.d.). Ethics. http://www.merriam-webster.com/dictionary/ethics

Merriam-Webster Dictionary. (n.d.). Intellectual Property. http://www.merriam-webster.com/dictionary/intellectual%20property

Microsoft. (n.d.) Microsoft software license terms.https://support.microsoft.com/en-us/windows/microsoft-software-license-terms-e26eedad-97a2-5250-2670-aad156b654bd

Mims, C. (2020, Sept 19). Huang's Law Is the New Moore's Law, and Explains Why Nvidia Wants Arm. The Wall Street Journal. https://www.wsj.com/articles/huangs-law-is-the-new-moores-law-and-explains-why-nvidia-wants-arm-11600488001

Miniwatts Marketing Group. (2018, May 23). The Digital Divide, ICT, and Broadband Internet. https://www.internetworldstats.com/links10.htm

Moawad, G.N., Elkhalil, J., Klebanoff, J.S., Rahman, S., Habib, N., Alkatout, I. (2020 Nov 25). Augmented Realities, Artificial Intelligence, and Machine Learning: Clinical Implications and How Technology Is Shaping the Future of Medicine. J Clin Med. 9(12):3811. doi:10.3390/jcm9123811. PMID: 33255705. PMCID: PMC7761251.

Moore, G. E. (1965). Cramming more components onto integrated circuits. Electronics Magazine, 4

Mottl, J. (2017, January 20). Lululemon taps data intelligence to amplify customer experience, relationship. Retail Customer Experience.com. https://www.retailcustomerexperience.com/articles/lululemon-taps-data-intelligence-to-amplify-customer-experience-relationship/.

Nielsen, J. (2006).Digital Divide: The 3 Stages. Nielsen Norman Group. http://www.nngroup.com/articles/digital-divide-the-three-stages/

Office of the Privacy Commissioner of Canada. (2018, October 29). What you need to know about mandatory reporting of breaches of security safeguards. Office of the Privacy Commissioner of Canada.https://www.priv.gc.ca/en/privacy-topics/business-privacy/safeguards-and-breaches/privacy-breaches/respond-to-a-privacy-breach-at-your-business/gd_pb_201810/.

Office of the Privacy Commissioner of Canada. (2019, May 31). PIPEDA Fair Information principles. https://www.priv.gc.ca/en/privacy-topics/privacy-laws-in-canada/the-personal-information-protection-and-electronic-documents-act-pipeda/p_principle/.

Perkoic, M. (2022, September 29). How Smart Wearables Are Shaping Our Future. Forbes.https://www.forbes.com/sites/forbesbusinesscouncil/2022/09/29/how-smart-wearables-are-shaping-our-future/?sh=53a8fdde6b24

Porter, M. (2001). Strategy and the Internet. Harvard Business Review, 79(3). http://hbswk.hbs.edu/item/2165.html.

Porter, M.(2001). Strategy and the Internet. Harvard Business Review: 79 (3) 62–78

Porter, M.E. (1980). Competitive Strategy: Techniques for Analyzing Industries and Competitors. Free Press, New York.

Ranger, S. (2018, January 19). What is the IoT? ZDNet. http://www.zdnet.com/article/what-is-the-internet-of-things-everything-you-need-to-know-about-the-iot-right-now/.

Reynoso, R. (2021, May 25). A complete history of artificial intelligence. G2.https://www.g2.com/articles/history-of-artificial-intelligence

Rogers, Everett M. (1962). Diffusion of innovations (1st ed.). New York: Free Press of Glencoe

Sharma, P. (2020).8 Real-World Applications of Reinforcement Learning. MLK – Machine Learning Knowledge. https://machinelearningknowledge.ai/8-real-world-applications-of-reinforcement-learning/

Sinha, D.(2022). Top 5 Most Controversial Scandals in AI and Big Data.Analyticsinsight.net. https://www.analyticsinsight.net/top-5-most-controversial-scandals-in-ai-and-big-data/.

Stair, R. & Reynolds, G. (2017). Principles of Information Systems. Cengage.

Statista. (2018). Number of apps in Apple App Store July 2008 to January 2017. https://www.statista.com/statistics/263795/number-of-available-apps-in-the-apple-app-store/.

Statista.(2001).Number of monthly active Facebook users worldwide as of 4th quarter 2021. https://www.statista.com/statistics/264810/number-of-monthly-active-facebook-users-worldwide/

Statistics Canada. (2016, May 24). EnviroStats. Trash Talking : Dealing with Canadian household e-waste. http://www.statcan.gc.ca/pub/16-002-x/2016001/article/14570-eng.htm

Statistics Canada. (2020, October 20). About one-fifth of Canadian businesses were impacted by cyber security incidents in 2019. The Daily. https://www150.statcan.gc.ca/n1/daily-quotidien/201020/dq201020a-eng.htm.

Statistics Canada. (2021, June 22). Online shopping by Canadians in 2020: Results from the Canadian Internet Use Survey. https://www150.statcan.gc.ca/n1/pub/11-627-m/11-627-m2021048-eng.htm

Steinbeck, A. (2023, Jan 8). ChatGPT explores its own ethical implications. Medium. https://medium.com/illumination/chatgpt-explores-its-own-ethical-implications-17a56b913b06

TechTarget. (2021, May 14). What are robots and how do they work? Retrieved January 12, 2022, from https://www.techtarget.com/searchenterpriseai/definition/robot

Thomas, L. (2020, February 18). Walmart changed the way it buys shopping bags and saved $60 million-and that's just one way it cut costs. CNBC.https://www.cnbc.com/2020/02/18/walmart-saves-millions-of-dollars-each-year-by-making-these-small-changes.html.

Vadapalli, P. (2020, September 15). *AI vs Human Intelligence: Difference Between AI & Human Intelligence.* upGrad blog. https://www.upgrad.com/blog/ai-vs-human-intelligence/.

WebFx. (2022). How Much Should a Web Site Cost? www.webpagefx.com/How-much-should-web-site-cost.html

Whitten, S. (2021, January 3). Studios are experimenting with film release models. here's what that could mean for movie piracy. CNBC.https://www.cnbc.com/2021/01/02/studios-experiment-with-release-models-what-that-means-for-film-piracy.html#:~:text=Last%20year%2C%20the%20Global%20Innovation,in%20lost%20revenue%20each%20year.

Wikiversity. (n.d.). Amazon Web Services. https://en.wikiversity.org/wiki/Amazon_Web_Services ↵

Wood, P. & Kelly, M.L. (2023, January 26). 'Everybody is cheating': why this teacher has adopted an open ChatGPT policy. NPR. https://medium.com/illumination/chatgpt-explores-its-own-ethical-implications-17a56b913b06