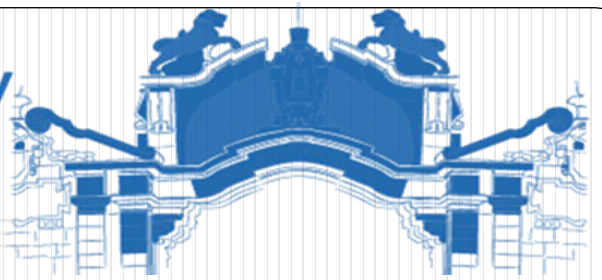


Addis Ababa University

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SEEK WISDOM, ELEVATE YOUR INTELLECT AND SERVE HUMANITY !



School of Information Science

Introduction to Emerging Technologies (EmTe 1012)

Instructor: *Tsegaye Berhanu*

Chapter 1

Introduction to Emerging Technologies

Instructor: *Tsegaye Berhanu*

Outline

- Evolution of Technologies
- Role of Data for Emerging Technologies
- Enabling devices and networks for Technologies
- Human to Machine Interaction
- Future Trends in Emerging Technologies

Objective of the Course

After completing this chapter, students will be able to:

- Develop knowledge about the era of industrial evolutions
- Identify the technological advances that made the industrial revolution possible
- Analyze the changing conditions created by the industrial revolution in both Europe and the united states
- Understand the causes of the Industrial Revolution in Great Britain, continental Europe, and the United States.
- Describe the technological innovations that incited industrialization
- Identifies and understand the programmable device
- Understand the design of human-computer interfaces
- Develop general knowledge about emerging technologies

Emerging Technology

- Emerging technology (ET) is a term generally used to describe a new technology.
- But it may also refer to the continuing development of existing technology in different areas.
- It can have slightly different meanings when used in different areas, such as media, business, science, or education.

Emerging Technology

- ET commonly refers to technologies that are currently developing, or that are expected to be available within the next five to ten years.
- ETs usually are creating or are expected to create significant social or economic effects.
- Technological evolution is a theory of radical transformation of society through technological development.

Technology and Evolution

Technology:

- the application of scientific knowledge for practical purposes, especially in industry.
- systematic treatment of an art, craft, or technique
- Technology is the skills, methods, and processes used to achieve goals

Evolution:

- evolution means the process of developing by gradual changes.

Currently available emerged technologies

- Artificial Intelligence (AI)
- Blockchain
- Augmented Reality (AR)
- Virtual Reality (VR)
- Cloud Computing
- Angular and React
- DevOps (development and operations)
- Internet of Things (IoT)
- Intelligent Apps (I-Apps)
- Big Data
- Robotic Processor Automation (RPA)

Introduction to the Industrial Revolution (IR)

- IR was a period of major industrialization and innovation that took place during the late 1700s and early 1800s.
- An Industrial Revolution at its core occurs when a society shifts from using:
  - tools to make products to use new sources of energy, such as coal, to power machines in factories.

Industrial Revolution (IR)

- The revolution started in England, with a series of innovations to make labor more efficient and productive.
- The Industrial Revolution was a time when the manufacturing of goods moved from small shops and homes to large factories. This shift brought about changes in culture as people moved from rural areas to big cities in order to work.

Industrial Revolution (IR)

- The American Industrial Revolution (II Industrial Revolution), started sometime between 1820 and 1870.
- The impact of changing the way items was manufactured had a wide reach.
- Industries such as textile manufacturing, mining, glass making, and agriculture all had undergone changes.
- For example, prior to the Industrial Revolution, textiles were primarily made of wool and were handspun.

Industrial Revolution (IR)

- **I Industrial Revolution**
  - mechanization through water and steam power
- **II Industrial Revolution**
  - mass production and assembly lines using electricity in the second
- **III Industrial Revolution**
  - the adoption of computers and automation machines.
- **IV Industrial Revolution**
  - enhanced with smart and autonomous systems fueled by data and machine learning.

Industrial Revolution (IR)

The following industrial revolutions fundamentally changed and transfered the world around us into modern society.

- The steam engine
- The age of science and mass production
- The rise of digital technology
- Smart and autonomous systems fueled by data and machine learning

Industrial Revolution (IR)

Some Inventions of the Industrial Revolution are:

- Transportation:
  - The Steam Engine
  - The Railroad
  - The Diesel Engine
  - The Airplane
- Communication.
  - The Telegraph
  - The Transatlantic Cable
  - The Phonograph
  - The Telephone
- Industry:
  - The Cotton Gin
  - The Sewing Machine
  - Electric Lights

Historical Background (IR 1.0, IR 2.0, IR 3.0)

- The industrial revolution began in Great Britain in the late 1770s before spreading to the rest of Europe.
- The first European countries to be industrialized after England were Belgium, France, and the German states.
- The final cause of the Industrial Revolution was the effects created by the Agricultural Revolution.
- As previously stated, the Industrial Revolution began in Britain in the 18th century due in part to an increase in food production, which was the key outcome of the Agricultural Revolution.

Industrial Revolution

The four types of industries are:

- **The primary industry** involves getting raw materials e.g. mining, farming, and fishing.
- **The secondary industry** involves manufacturing e.g. making cars and steel.
- **Tertiary industries** provide a service e.g. teaching and nursing.
- **The quaternary industry** involves research and development industries e.g. IT.

Industrial Revolution (IR 1.0)

- The Industrial Revolution is described as a transition to new manufacturing processes.
- The Industrial Revolution was first coined in the 1760s, during the time where this revolution began.
- The transitions in the first Industrial Revolution included going from hand production methods to machines, to the increasing use of steam power
- The development of machine tools and the rise of the factory system.

Industrial Revolution (IR 1.0)



Industrial Revolution (IR 2.0)

- The Second IR, also known as the Technological Revolution, began somewhere in the 1870s.
- The advancements in IR 2.0 included the development of methods for manufacturing interchangeable parts and widespread adoption of pre-existing technological systems such as telegraph and railroad networks.
- This adoption allowed the vast movement of people and ideas, enhancing communication.
- Moreover, new technological systems were introduced, such as electrical power and telephones.

Industrial Revolution (IR 2.0)



Industrial Revolution (IR 3.0)

- IR 3.0 introduced the transition from mechanical and analog electronic technology to digital electronics which began from the late 1950s.
- Due to the shift towards digitalization, IR 3.0 was given the nickname, "Digital Revolution".
- The core factor of this revolution is the mass production and widespread use of digital logic circuits and its derived technologies such as the computer, handphones and the Internet.

Industrial Revolution (IR 3.0)

- These technological innovations have enabling people to communicate with another without the need of being physically present.
- Certain practices that were enabled during IR 3.0 is still being practiced until this current day
- Example of IR 3.0 is the production of digital computers and digital records.

Industrial Revolution (IR 3.0)



Fourth Industrial Revolution (IR 4.0)

- The IR 4.0 is characterized by the new advancements in various technologies such as:
  - Robotics
  - Internet of things
  - Additive manufacturing and
  - Autonomous vehicles
- The term "Fourth Industrial Revolution" or IR 4.0 was coined by Klaus Schwab, the founder and executive chairman of World Economic Forum, in the year 2016.

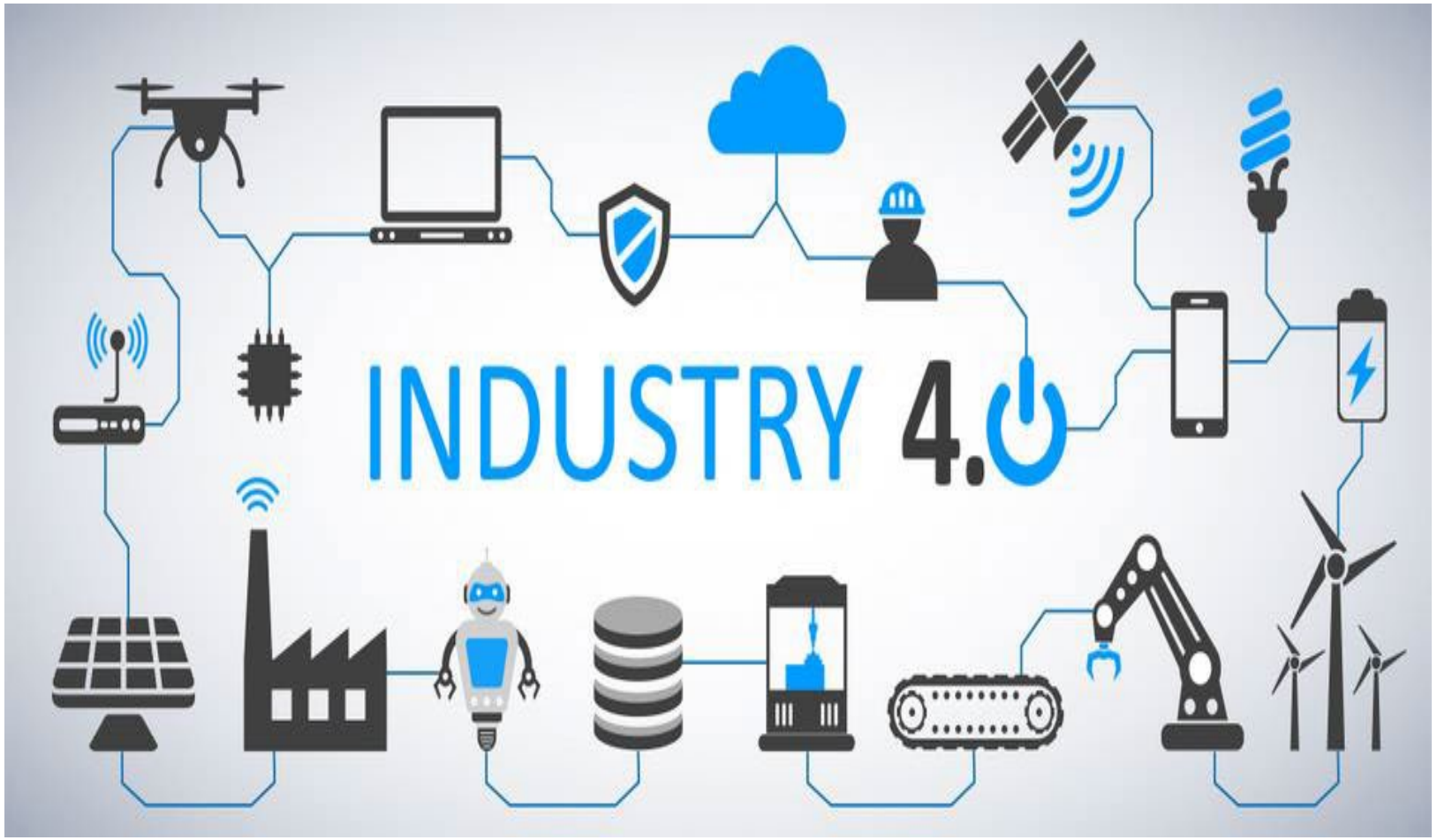
Fourth Industrial Revolution (IR 4.0)

- The technologies mentioned above are what you called the cyber-physical systems.
- A cyber-physical system is a mechanism that is controlled or monitored by computer-based algorithms, tightly integrated with the Internet and its users.

Fourth Industrial Revolution (IR 4.0)

- One example that is being widely practiced in industries today is the usage of Computer Numerical Control (CNC) machines. These machines are operated by giving it instructions using a computer.
- Another major breakthrough that is associated with IR 4.0 is the adoption of Artificial Intelligence (AI), where we can see it being implemented into our smartphones.
- AI is also one of the main elements that give life to Autonomous Vehicles and Automated Robots.

Fourth Industrial Revolution (IR 4.0)



Role of Data for Emerging Technologies

- Data is regarded as the new oil and strategic asset since we are living in the age of big data.
- Data drives or even determines the future of science, technology, the economy, and possibly everything in our world today and tomorrow.
- Data presents enormous challenges that in turn bring incredible innovation and economic opportunities.

Role of Data for Emerging Technologies

- The innovation and economic opportunities could be created, transformed, and/or adjusted by understanding, exploring, and utilizing data.
- Data-intensive scientific discovery as an emerging technology, is the so-called "fourth industrial revolution,"

Role of Data for Emerging Technologies

- *The potential of data science and data analytics* that enables data-driven theory, economy, and professional development is *increasingly being recognized*.
- Data science involves not only core disciplines such as computing, informatics, and statistics, but also the broad-based fields of business, social science, and health/medical science.

Enabling Devices and Networks (Programmable devices)

- In the world of digital electronic systems, there are four basic kinds of devices:
  - Memory
  - Microprocessors
  - Logic
  - Networks

Enabling Devices and Network (Programmable devices)

- **Memory devices** store random information such as the contents of a spreadsheet or database.

- **Microprocessors** execute software instructions to perform a wide variety of tasks such as running a word processing program or video game.

Enabling Devices and Network (Programmable devices)

Logic devices provide specific functions, including:

- Device-to-device interfacing,
- Data communication
- Signal processing
- Data display
- Timing and control operations, and
- Almost every other function a system must perform.

Enabling Devices and Network (Programmable devices)

- **The network** is a collection of computers, servers, mainframes, network devices, peripherals, or other devices connected to one another to allow the sharing of data.

- An excellent example of a network is the Internet, which connects millions of people all over the world

Programmable devices



Why is a computer referred to as a programmable device?

- Because what makes a computer is that it follows a set of instructions.
- Many electronic devices are computers that perform only one operation, but they are still following instructions that reside permanently in the unit.

Some of the Programmable devices

- Achronix Speedster SPD60
- Actel's
- Altera Stratix IV GT and Arria II GX
- Atmel's AT91CAP7L
- Cypress Semiconductor's programmable system-on-chip (PSoC) family
- Lattice Semiconductor's ECP3
- Lime Microsystems' LMS6002
- Silicon Blue Technologies
- Xilinx Virtex 6 and Spartan 6
- Xmos Semiconductor L series

Programmable devices

A full range of network-related equipment referred to as **Service Enabling Devices (SEDs)**, which can include:

- Channel service unit (CSU) and data service unit (DSU)
- Modems
- Routers
- Switches
- Conferencing equipment
- Network appliances (NIDs and SIDs)
- Hosting equipment and servers



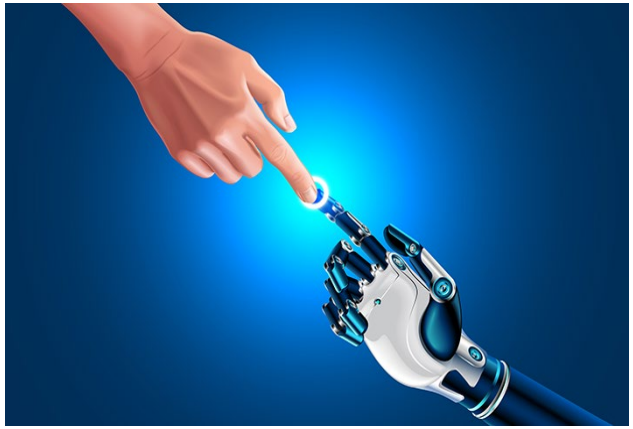
Human to Machine Interaction

- Human-machine interaction (HMI) refers to the communication and interaction between a human and a machine via a user interface.

- Nowadays, natural user interfaces such as gestures have gained increasing attention as they allow humans to control machines through natural and intuitive behaviors

HCI-Human to Machine Interaction

- HCI (human-computer interaction) is the study of how people interact with computers and to what extent computers are or are not developed for successful interaction with human beings.
- As its name implies, HCI consists of three parts:
  - The user
  - The computer itself, and
  - The ways they work together.



Human to Machine Interaction

How do users interact with computers?

- The user interacts directly with hardware for the human input and output such as displays, e.g. through a graphical user interface.
- The user interacts with the computer over this software interface using the given input and output (I/O) hardware.

Human to Machine Interaction

How important is human-computer interaction?

- The goal of HCI is to improve the interaction between users and computers by making computers more user-friendly and approachable to the user's needs.
- The main advantages of HCI are simplicity, ease of deployment & operations and cost savings for smaller set-ups.
- They also reduce solution design time and integration complexity.

Human to Machine Interaction

Disciplines Contributing to Human-Computer Interaction.

- **Cognitive psychology**: Limitations, information processing, performance prediction, cooperative working, and capabilities.
- **Computer science**: Including graphics, technology, prototyping tools, user interface management systems.
- **Linguistics**.
- **Engineering and design**.
- **Artificial intelligence**.
- **Human factors.**

Future Trends in Emerging Technologies

Emerging technology trends in 2019

- 5G Networks
- Artificial Intelligence (AI)
- Autonomous Devices
- Blockchain
- Augmented Analytics
- Digital Twins
- Enhanced Edge Computing
- Immersive Experiences in Smart Spaces

Future Trends in Emerging Technologies

Some emerging technologies that will shape the future of you and your business

- Emerging technologies are taking over our minds more and more each day. These are very high-level emerging technologies though.
- EMs sound like tools that will only affect the top tier of technology companies who employ the world's top 1% of geniuses. This is totally wrong. Chatbots, virtual/augmented reality, blockchain, Ephemeral Apps and Artificial Intelligence are already shaping your life whether you like it or not.
- At the end of the day, you can either adapt or die.