Information Technology Concepts

Chapter 02 – Technological Innovation

Moch Zawaruddin Abdullah, S.ST., M.Kom.
D4 - INFORMATION ENGINEERING

Chapter 02
Technological Innovation

2.1 Innovation

Innovation is indeed a false slogan that many people love and hate. Any corporate leader must agree. However, nobody can agree on what it truly is or what it means. If you are asking Google for a description of creativity, it is less than beneficial to generate over 300 million results that are determined by thousands. His definition of "action or process of innovation" is relatively meaningless. It is not beneficial to use conventional references for a description, such as the Oxford dictionary, to reply: "Change something, particularly by introducing new methods, thoughts or products.".
Based on the researcher, we can see the definition of innovation.

"An innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption." (Everett M.Rogers, 1983). So according to Everett, innovation is an idea that we have, or our way of doing something, or objects such as production goods, objectives, materials, which we perceive as something new for us to adopt.

"Innovation is a new idea that is applied to improve a product or process and services." (Stephen Robbins, 1994). According to Stephen, our new idea, our original thinking, our new habits that we do to increase production, to improve activities or processes in problem-solving, and increase productivity and service. Like this online lecture, our unique patterns are in the learning process. Which we cannot learn directly because of this Covid pandemic. we use the zoom application as our innovation in online learning activities

Schumpeter (1947), *Innovation is a source of economic change, while technological innovation is a source of the business cycle. Therefore, the design is a phenomenon that occurs in one or more of the five things below :*

- *launch of a new product or a new species of an already known product;*
- *application of new methods of production or sales of a product*
- *opening of a new market (the market for which a branch of the industry was not yet represented);*

- *acquiring new sources of supply of raw material or semi-finished goods;*
- *new industry structure such as the creation or destruction of a monopoly position (implementing a new form of Organization)*

According to Constitution, number 19 of 2002, the definition of innovation is *research, development, and/or engineering activities carried out intending to develop practical applications of new scientific values and contexts or new ways of applying existing science and technology into the product or production process.*

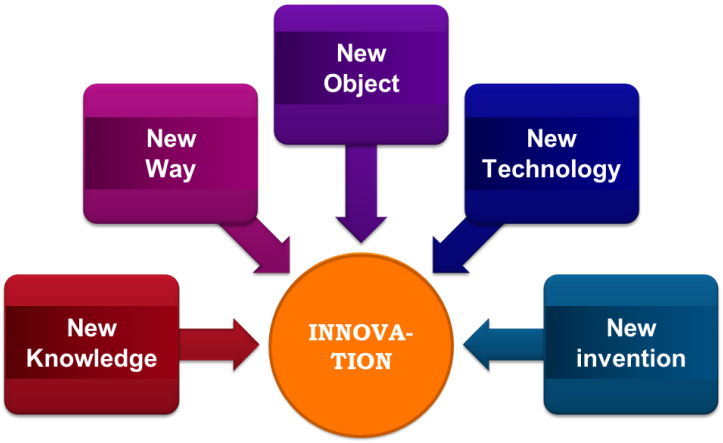

Figure 1.Innovation

Based on Fig. 1 we can describe innovation

» New knowledge; a new insight or new interpretation or new understanding of information that a person or society has to respond to a problem

» New way; new procedures or new methods of solving a problem (such as production processes, activities, services)

» New object; new goods, new production, new services, new goals

» New technology; the use of new technology in solving problems, or creating new technology in solving a problem, new features in technological devices

» New invention; Almost all innovations are the result of new inventions. It is rare for innovation to come about as a coincidence. Innovation is the product of a process that works entirely with awareness and deliberation.

2.2 The six emerging technologies that will change the world

Based on Nicolas Chen's article in medium.com. There is six innovation that will change the world. In the coming decades, there are many innovations which can

profoundly affect our everyday lives. In all of its creations, I would like to list six technologies because I believe these technologies have tremendous potential in the future, are evolving rapidly and will potentially impact the world within the next few decades.

I clarify why I think that these innovations will transform our environment in the near future with any of these six technologies. These six innovations are as follows:

2.2.1 Big Data

Big Data is a large data set or a massive data volume. We generate a great deal of knowledge every day, e-mails, media posts, web articles and videos, GPS signals etc. Therefore this dataset is Big Data.

We must be able to access and process the data in front of this immense volume of data. In reality, Big Data is capable of processing vast amounts of information through increasingly standard computer media. The knowledge or data volumes are impressive for a wide range of industries, including tourism, trade, advertisement, biology, astronomy or human capital. Big data can be known as the latest modern era, black gold.

Figure 2. Big Data

The 5Vs characterize the Big Data phenomenon:

1) Volume

Volume is the mass of information produced every second. In 2000, 20% of the data was digital and the rest was analog. In 2015, 98% of the data is now digital and the rest is analog. This data is produced by personal computers, smartphones, tablets and other devices.

Every minute we produce:

- 216000 photos on instagram
- 270000 tweets

- 30 billion instant messages
- 200 million emails

Most of this data is collected by two companies that are:

- Google with Gmail, the Google search engine, Android and Youtube
- Facebook with instagram and WhatsApp

Both organizations gather this data and analyze it so that consumers can collect as much data as possible from advertisers. They are responsible for collecting this data.

2) Velocity

Velocity refers to the speed of development and deployment of new data.

3) Variety

Various types of data include photographs, images, messages, voices and other material. All of these data contain 80% of these data, while the remaining 20% is structured data collected concerning data tables.

4) Veracity

The integrity and durability of the gathered data is veracity. Not all information is genuine as a vast volume of data is obtained. For starters, some tweets on Twitter can include technical mistakes, errors in typography, abbreviations or familiar language.

5) Value

Value is the profit that can be derived from the use of Big Data. To illustrate Big Data, we can mention two companies like Uber and Netflix, that will select only the Right Data among the large mass of data.

Figure 3. Uber application

Uber is a US firm that designs smartphone apps to link drivers and consumers to transport. In addition to gathering data, the organization collects primarily contextual data that helps it to connect customers (consumers) and drivers (service providers). Uber

collects massive data from its mobile application that its drivers and passengers use. The two data that helped Uber to make taxis redundant identifies the need of customers (to have a vehicle) and the geographical position of the necessity of customers (to search for the customer).

Figure 4. Netflix

Netflix is an American company which provides a web-based platform for films and TV series. In 2016, 71 million people used the Netflix subscription service. To better understand consumers' preferences, these millions of consumers create data that they gather and evaluate. Users tend to use the robust Netflix Data for this kind of show. It has a recommendation engine and keywords for any TV series. Based on what users most liked, users can generate keyword-based tips.

Big data will, in future, even be used for natural disasters and for the management of conflict effects in the medical sector by developing new care in the humanitarian region. Of instance, Big Data is used to promote the right clients for advertisers, or to promote improved facilities for commercial purposes.

Machine learning-related big data enables predictive research to be carried out in many fields such as hospitals, agriculture, the municipal administration and in particular, marketing. Another example is big data, which will allow you to distinguish various forms of content, including shapes, colours and picture or video signs. Moreover the growth in the Internet of Things offers a great deal of knowledge for the creation of massive data.

2.2.2 Artificial Intelligence

Figure 5. Artificial Intelligence

The history of AI is very brief and indicates that in sixty years, there have been substantial developments in this area. In reality, we went from the first computer to very complex machines that could do such calculations. Deep Blue, an IBM supercomputer that defeated world chess champion, Garry Kasparov, in 1997, was the first system to demonstrate his AI capability. Then Watson's AI was created by IBM and won a "Jeopardy" game show. "In natural language, addressing questions. And eventually, AlphaGo, Google Deep Mind's AI which defeated Go's world champion, Lee Sedol realizes Go's game is a far more complicated game than chess's.

The advancement of AI in recent years has been contributed by developments in algorithmics, computational power and data sciences. That's why lately we've seen a lot of AI. AI may be described as a collection of theories and techniques that are used to apply high-level computer programs such as perceptual learning, memory control and critical thinking. In reality, the strong AI part, and the weaker AI amount can be split into two parts.

The “strong” IA is based on learning; that is, it stores new data and changes its functioning. The “weak” AI differs from the “strong” AI in that the computer program simulates intelligence. AI is, therefore, a very global term. I think that the scientific name for AI is instead machine learning, because most of the techniques used in AI come from machine learning, in particular deep learning (one of the branches of the machine learning) which is widely used for image recognition such as the Convolutional Neural Networks (CNN).

The AI is now used in a variety of ways, for instance, in the Watson medical system, where doctors can diagnose. There are also autonomous vehicles using AI for a certain

degree of freedom on the lane. Indoor virtual assistants including Apple's Siri, Microsoft's Cortana, Google's Google Now, Samsung's Galaxy S8's Bixby and Amazon's Alexa also use AI focused on learning about our preferences, on providing contextually useful details.

Aircraft application numbers are so high that there are various markets for the Web giants including GAFAM and BATX (Baidu, Alibaba, Tencent, Xiaomi) as well as GAFAM (Google, Apple, Facebook, Amazon and Microsoft).

Applications and AI markets contribute to:

1) The recognition of static images, their classification and marking

Web giants want to use the AI to collect and analyze images hosted on their servers to find them more easily.

2) The use of the trading algorithm to improve financial performance

The financial sector is interested in AI to anticipate economic opportunities and risks with trading algorithms that deal with stock indices and geopolitical factors.

3) Object detection and classification to avoid collisions and navigation

Autonomous cars need to identify, detect obstacles and track objects to be able to drive on the road.

4) Treatment of medical data of patients

In the medical field, this would detect certain diseases in some patients before the manifestation of the disease

5) Learning of some tasks by robots

Robots could learn some functions without the need to program them for that.

6) Predictive maintenance in IT and the industry

Anticipating possible computer failures or industrial products can save time and money for companies.

7) The identification of images by the textual request

Find an image through a text query.

8) Automatic detection of geophysical characteristics

This detection would anticipate lousy weather such as storms, cyclones, tsunamis or earthquakes.

9) Distribution of content on social networks

The display of content adapted to the preferences of the user.

10) Object identification, detection and tracking

11) Prevention against attacks related to cybersecurity

The military sector is also interested in AI to integrate it into weapons and drones, which raises many controversies about autonomous weapons that could accelerate conflicts.

2.2.3 Self-Driving Cars And 6 Autonomous Driving Level

The three aspects that form the future of the vehicle, namely the automated and connected electric car, are electrification, autonomous driving or networking. The problem of emissions and noise in new vehicles can be addressed by electrification of the cars. The number of injuries would be minimized significantly by independent driving. The connection enables passengers to consult details and take care of the journey (weather, road traffic, etc.).

An autonomous car (driverless car or self-driving car) is a vehicle capable of driving on the road without the intervention of a driver. This vehicle is designed for perceptive atmosphere with various sensors such as ultrasonic sensors, cameras and lidars. In order to monitor your surroundings and track other cars, barriers, signs and pavement boundaries, data obtained by sensors are analyzed by software and processors.

Figure 6. Self-Driving Car

I saw this pattern of electric vehicles during my visit to the Paris Motor Show since the majority of carmakers have introduced electric cars. Semi-autonomous vehicles have also been launched by several manufacturers that confirm the pattern of independent driving. We also use the Internet, touch screens for mobile phones and Laptops, and networking infrastructure also exists. We, therefore, find the three factors which enable autonomous vehicles to evolve in the way we live.

I assume that the production of autonomous vehicles would benefit from the advances achieved in artificial intelligence. Of course, this arrival would upset everyday travel and mobility. Furthermore, several automakers are operating in autonomous vehicles and many Internet, electronics and electrical firms.

Faced with the development of autonomous vehicles, standards have been created to classify cars according to their level of autonomy. There are six autonomous driving levels:

1) **Level 0: No assistance**

The driver maintains full control over all vehicle functions (management, brakes, acceleration, steering). The on-board computer, however, can assist the driver on line crossings by issuing an audible alert.

2) **Level 1: Driving Assistance**

The on-board computer can support speed or direction, and therefore not both at the same time. The driver always keeps control of the other function (speed or direction) as well as the complete control of the vehicle.Example: cruise control, lane departure radar, automatic emergency braking, collision warning.

3) **Level 2: Partial Automation**

The on-board computer can take control of speed and direction. The driver supervises the operations, but must always remain attentive, monitor the vehicle environment, and regain full control of the vehicle in case of failure as the driver's responsibility is fully engaged. Example: a driving assistant in traffic jams (adaptive cruise control) or a parking assistant.

4) **Level 3: Conditional Automation**

The driving may be entirely delegated to the on-board computer, but only for pre-defined situations such as on the motorway for example. The onboard computer is, therefore, able to monitor the vehicle environment through object detection functions (roads, lines, vehicles). He is also able to recognize his limits when he is unable to handle the situation and invites the driver to regain control of the car through an audible or visual alert sent several seconds in advance. Example: highway pilot, automatic parking, platooning.

5) **Level 4: Strong automation**

The computer takes control of the entire vehicle, only in predefined areas such as on the highway or a parking lot. The driver can read the newspaper or his messages without worrying about the road. However, as soon as the vehicle leaves this predefined automated driving zone, the driver must regain control. Still, if the driver does not regain control, the car can react on its own by security position.

6) **Level 5: Full automation**

The vehicle is capable of driving in all situations. The on-board computer, therefore, has control over all the functions of the vehicle. Control elements such as the steering wheel or the pedals can be removed.

To build automotive cars, taxi robots, that is, a fleet of autonomous vehicles could also require development. The automobile business is therefore changing from a product to a service industry, recognizing that the cars are the property of the carrier.

Driverless vehicles can soon be linked and connected to the internet. The customer and his passengers will be aware of the temperature, traffic and jam forming. They will also allow passengers time to incorporate embedded resources, including details on self-driving vehicles, which will be an incredible opportunity for Google and Apple.

2.2.4 Blockchain

The blockchain is a transparent, secure, decentralized and non-central information storage and transmission technology. In short, it is a kind of digital protocol for the processing of records, a broad and protected database. This blockchain can be regarded as a sort of record book or log for a list of all customer transactions.

Figure 7. Blockchain

As it is decentralized, this register is held on the user's servers. This register is modified and tamper-proof in real-time since it relies for any operation on a User Cryptographic Validation Method. After validation in the book, these transaction sets (the register rows) are written by blocks of records, creating a series of unchanging blocks: blockchain.

The blockchain is often mistaken mistakenly with Bitcoin, but since any blockchain has its encoding code, Bitcoin uses the blockchain to allow traceability of transactions. A customer can then use his Bitcoins only for a single transaction-related receiver.

I was able to attend a conference on the blockchain during my visit to the Microsoft Experiences show, and it turned out that this blockchain can be used in three different categories:

- The transfer of assets: currency, securities, shares, bonds, votes, etc.
- Register: better traceability of products and assets.
- Smart contracts: autonomous programs that automatically execute the terms and conditions of an agreement, without requiring human intervention once started.

I also attended the Futur en Seine fair, where expertise, seminars, innovation workshops were arranged, and where many start-ups, such as start-ups, used the voting system blockchain as part of an internal referendum, were taken together. In general, the most centralized "trustworthy third parties" may be replaced by distributed computer networks by blockchains such as financial companies, notaries, land registries etc. The blockchain could then replace the intermediary channels used to centralize information and connections between users by Airbnb, Uber and BlablaCar, which receive a fee, a part of the value exchanged on their network.

There would be no need for intermediaries for blockchain technologies, and consumers could make peer-to-peer transfers directly with a driver or lessor, with absolutely no commission intermediary. This blockchain technology could thus challenge the Airbnb, Uber and BlablaCar companies more or less.

This blockchain technology could thus find many concrete applications such as:

- An online voting system: for example, during an internal election, the use of the blockchain allows a secure vote and a transparent result with a quick announcement of the results. The blockchain applied to the online voting system thus avoids any fraud and contesting voting results, and could therefore interest political parties or countries that sometimes have difficulty counting votes and fraud problems.
- Automatic compensation in the event of late or canceled flights: for example, travel insurance schemes may use the principle of smart contracts which are based

on autonomous programs which automatically launch the conditions of the contract, without the person must fill in any form.

- A money transfer platform: the advantages of using the blockchain in this type of platform are the speed of transfers (a few minutes against several days for some transfers abroad) and the low cost of these transfers (a few cents for each transaction) through cryptocurrencies that are convertible into traditional currencies.

The blockchain, therefore, will have a range of uses in different fields, such as banking, finance, property, health, electricity, transport and online voting. Personally I feel that blockchain is a promising technology since it appears to deliver several advantages such as smart contract automation, confidence-building among two parties without an intermediary platform, modern governance methods (tamper-resistant and ergonomic voting mechanisms, etc. and a dramatic cut in transaction costs (finance).

In reality, the challenge is to build up the user interface and in particular to gain users' confidence in the use of this emerging technology in most future implementations in the blockchain.

2.2.5 Virtual Reality and Augmented Reality

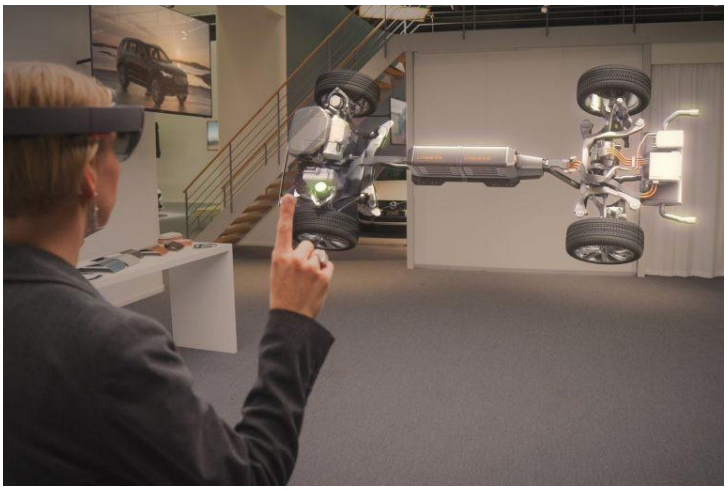

Figure 8. Virtual Reality device

Virtual reality means to create a user immersion in a 3D virtual world in which he can move and interact. Augmented reality is to use the real world to display 2D or 3D information such as images, numbers and texts with which the user can also interact. This augmented reality technology superimposes virtual elements to the real world, so the world as a whole is enriched with digital information to provide more detail to the user about his environment.

There is also the mixed reality, which is in fact, the mixture between the two previous technologies, that is to say between virtual reality and augmented reality which is reflected in the superposition of digital information such as images, numbers and texts in the real world and the superposition of objects or moving elements. There are especially many virtual reality headsets and some augmented reality or mixed reality headsets.

2.2.6 The 3D Printing Revolution

Figure 9. 3D Printer

Through 3D printers, 3D printing has become possible in recent years. 3D printers use the same idea as 2D printers, but rather that the 3D printer artefacts overlapping thin layers of materials like rubber, clay, resin and other materials rather printing ink on sheets of paper. The simulation of the artefacts and the printing with the 3D printer are possible from a 3D program or a 3D scanner. The 3D printer provides massive printing opportunities, and all possible types can be printed. The only drawbacks are the printer's scale and the user's creativity.

The 3D printer is ideal for many uses, for example, industry, robotics, jewellery, medical, alimentary, apparel, armament, brand name, architecture, design, medical aviation and marketing applications. And 3D nano printers like the Nanoscribe are available that print on a few microns size. The 3D Nano Printer, Nanoscribe, uses lasers and spinning mirrors to print beams, based on a CAD model of a spacecraft to construct a polymerized, multi-layer structure.

Individual 3D printers can print multiple meters of items. For example, it helps you to print pieces of wood for building a home. The WikiHouse project is an open-source project providing home models to be constructed from 3D printed models. The printing of a wooden cottage, however, raises insurance and regulatory issues, as well as resistance and insulation problems. In fact, these homes will provide housing for millions of

homeless. Architects use the 3D printer in Amsterdam to print their creations, but also to directly publish their houses. In Shanghai, a business manager thought about doing the same thing with homes, on the premise that the cars and the planes are mass-produced, and thus set up a company that produces series houses with 3D imprinters by combining cement with another substance to solidify the home. You may also think the 3D models can print the furniture.

You can print all the types of items you like using 3D printers. With 3D printing technologies in the aerospace and automotive industries, materials can be manufactured cheaply, and manufacturing costs can be minimized The Divergent Microfactories, which built a car in 3D printing, the Balde is also able to print cars.

I assume that 3D printing is a technological breakthrough because the mass manufacturing model is revolutionized and new products invented that will create the future of tomorrow. Companies such as PSA, Airbus and Safran, for example, are now using 3D printers in car and aircraft manufacturing.

This breakthrough in 3D printing is very troubling in the automotive and aerospace industries. For these industries, 3D printing has two benefits, saving time and customizing parts. Time is critical, and time held in prototyping components is a significant asset for sectors such as automobile and airspace that are highly competitive. In addition, it is a real benefit to configure aircraft or automobile parts without increasing the production time. 3D printers have little to do with business on the private side, but they allow people to create objects or component themselves, for example, for the manufacturing of a robot.

In conclusion, 3D printing is a true technical innovation as it will help businesses to rapidly and accurately produce their products and even encourage individuals to make up their own objects and likely to become architects in their own homes.

2.3 Innovation in Information System and Information Technology

Information System and Information Technology have played a role in today's innovation. Information systems and information technology have an essential part of today's technological advances. So what is the definition of information systems and information technology that are one of the actors in today's innovation?

2.3.1 Information Technology

Information technology is a technology used by humans for information related purposes. Such as the technology used to find information, process information, and make decisions based on the information obtained.

Information technology unites technology and communication. Information technology combines connectivity and data. We use technology to communicate with others, and now almost all of our communication activities use technology. We are sending a letter, Long-distance conversation, and others.

Modern Information Technology

Analysis of a structure, behaviour, and interactions that integrate computers with communication mechanisms to store, receive, and manipulate data storage.

In today's digital age, what does modern information technology mean?

Is it the same thing now between information technology in the past and technology information nowadays? Of course not, nowadays, modern information technology plays a role in the development of computing systems that are combined with communication devices that can work together to solve problems. Examples such as the IoT (Internet of Things)

Information Technology Classification

a) **Input technology** is a technology that has a relation with something to input data in the computer system. Input tool usually found in computer system form keyboard and mouse.
b) **Output technology** is a technology that relation with output system. example of output technology is Monitor and printer
c) **Software technology**; software called program. Of course, to doing computer function, needed software self. For example, Microsoft Word is a software to processing the word and making some document, Adobe Photoshop to processing and manipulating picture.
d) **Storage technology** differs from 2 groups; there are internal and external memories. Internal memory called main memory, and it's used to temporary saver for data, program, or information when processing by CPU—an example to ROM and RAM. External storage called secondary storage, and it's permanently data saver. Model: hard drive, CD, and Flashdisk.
e) **Telecommunication technology** is communication at a distance by technological means, mainly through electrical signals or electromagnetic waves. Nowadays These are technologies for the transfer of information via electrical or light technologies. Such as modem, LAN card, fibre optic

f) **Processing machine** called CPU (Central Processing Unit), microprocessor, or processor

2.3.2 Information System

An information system is a work system all of whose processes and activities are devoted to processing information, which occurs through six types of activities, capturing, transmitting, storing, retrieving, manipulating, and displaying information. (Alter S., 2006)

The information system is an organized combination of humans, applications, hardware, communication networks and data sources for gathering, updating and disseminating information within the organization. (James A., 2007)

Interrelated components working together to collect, process, store, and disseminate information to support decision making, coordination, control, analysis, and visualization in an organization. (Laudon, 2007)

An organizational system that consists of technical, organizational and semiotic elements which are all re-organized and expanded during ISD [information system development] to serve an organizational purpose. (Lyytinen & Newman, 2006).

Information systems involve a variety of elements in the form of humans, computers, information technologies, tools and work processes that turn data into information designed to accomplish a purpose.

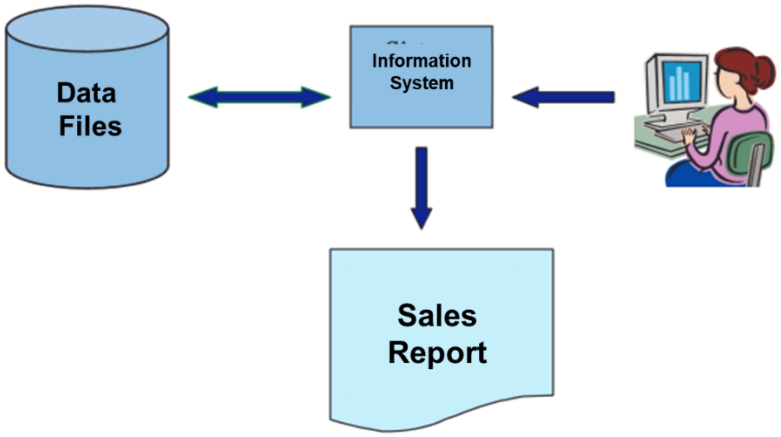

Figure 10. Information System Cyclus

For example, we have a company and want to monitor daily sales reports. We can use a sales information system. We play the role of system users. We access the information system, and the system will process the transaction document files that have been saved into a sales report. This series is what is called an information system.

Another example when we want to see our course material on the LMS. We access the LMS page, we login in the system, and see which material we want to open. The system will display information about the material we choose, according to the data stored in the system.

» According to Turban, McLean, Wetherbe (1999). Capabilities of Information Systems follow as:
» Fast and accurate data processing, with large-capacity storage and rapid communication between sites
» Instantaneous access to information
» Stores enormous amounts of information in small equipment but easily and fast to access
» Increase effectiveness and efficiency
» Present information clearly
» Automating business processes
» Cheaper

2.3.3 The Differential

The differential about information system and information technology:

Information System	Information Technology
- Stream, procedure, processes, and technology usage in the processing of information - The interaction between humans, systems, data and technology - referring to systems designed to create, store, manipulate, or disseminate information	- the subsystem of Information System. - used to store and retrieve data from the computer systems (deals with Information processing, storage, and transmission)

2.3.4 Examples of innovation

Information System	Information Technology
- Transaction Processing System - Office Automation System – Word Processing, Email, Voice Mail. - Management Information System - Academic Information System	- Smartphone - Internet - Data Storage - Data transmission