

Impact of Technological Advancements on Management Information Systems

Aarti Dawra¹ and Saguna Khajuria²

¹Amity University, Manesar

²Trinity Institute of Professional Studies

E-mail: ¹aarti_dawra@yahoo.co.in, ²saguna.khajuria@gmail.com

Abstract—Information Systems are the lifeblood of every organization, it has become the inevitable part of successful organizations and helpful in their managerial activities. It is observed that the technology is enhancing day by day and so the organizations have to be ready to cope up with this kind of technological advancements. This paper will focus on how the recent advancements in technology will affect the management in decision-making, since most of the organizations are using information systems for their decision-making at different levels. So the paper tends to study the impact of technological advancements on management information system.

1. INTRODUCTION

An Information system plays a vital role in the decision-making function of the organizations and it also helps in increasing the effectiveness and efficiency of the business. Today firms are making use of Information technology to support product development teams, customer support processes, e-commerce transactions etc. It has become an important constituent for business success in today's dynamic global environment.

Information system can be any organized combination of people, hardware, software, communication network, data resources and policies and procedures that stores, retrieves, transforms and disseminates information in an organization. (James A O'Brien, 2013). As technology is upgrading very fast, the organizations need to keep up with this pace to have a competitive advantage. In this paper we have focused on two aspects of technology- "Cloud Computing" and "Artificial Intelligence" and how these are helpful to the organizations.

Artificial Intelligence (AI) has moved from research laboratories into business. Recent surveys indicate that a large number of companies have developed AI applications in the last two years and the growth of applications continues today.

Intelligence (AI) refers to an area of computer science that deals with machines, which gave them the ability to think, to react and to give them the power to copy intelligent human behavior. Nowadays AI has moved from research laboratories into business. It is used in every sphere and today the situation

has come where no company can work without AI. Many of the AI applications are stand-alone systems, but maximum are integrated with more traditional Information Systems (IS), such as data processing and Management Information Systems. Most applications are knowledge-based Expert Systems (ES), but there is a growing number of applications of other AI technologies, such as neural networks, knowledge-based planning and scheduling systems, speech-synthesis systems and voice-recognition systems that are also called domains of AI which are discussed in the paper briefly. (Peter Duchessi, 1993) Case study has also been presented that how the AI is gaining importance.

Cloud computing refers to a model computing that provides access to a shared pool of computing resources (Computers, storage, applications, and services) over a network, often the internet. (Kenneth C.Laudon, 2016). Presently cloud computing is considered as the quickest growing form of computing and more and more companies are imbibing this technology. IBM, Amazon, Google, Microsoft etc. are the well-known providers of cloud services; these offer services such as- data storage, computing power, as well as providing high speed internet connections. Apart from these firms, SAP, Oracle, Microsoft, Google, sales force sells software applications, which are delivered as services over Internet.

2. INFORMATION MANAGEMENT

Management is not a new phenomenon; its concept has evolved from last so many years. It is the process of managing employees in that environment where they can work together in a team. Management requires the information according to level-wise, management function-wise and business function-wise. The information that is required at various levels is totally different and on the basis of that information they used to take various decisions. The levels and the information requirements are shown in Fig. 1:

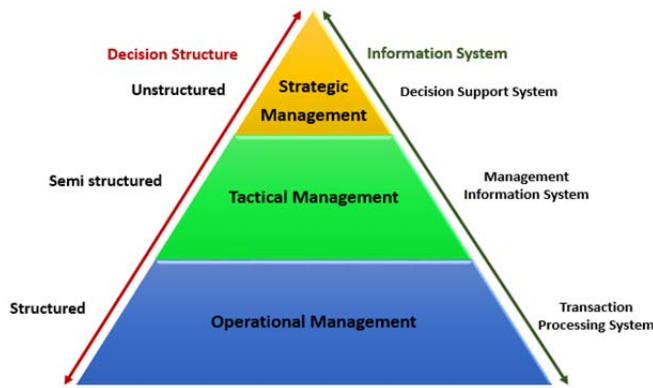


Fig. 1

The levels of management decision-making that must be supported by information technology in a successful organization are often shown as a managerial pyramid –

Strategic management: As part of a strategic planning process top executives develop overall organizational goals, strategies, policies, and monitor the strategic performance of the organization and its overall direction in the political, economic, and competitive business environment.

Tactical management: Business unit managers and business professionals in self-directed teams

- i Develop short- and medium-range plans, schedules, budgets and specify policies, procedures, and business objectives for their sub-units of the company.
- ii Allocate resources and monitor the performance of their organizational sub-units, including departments, divisions, process teams, project teams, and other workgroups.

Operational management: Operating managers and members of self-directed teams

- i Develop short-range plans (e.g. weekly production schedules), and direct the use of resources and the performance of tasks according to procedures and within budgets and schedules they establish for the teams and other workgroups of the organization.

Decision maker at different levels of the organization are making more or less structured decisions. Typically there are three types of **decision structure**:

- *Unstructured decisions* (usually related to the long-term strategy of the organization)
- *Semi-structured decisions* (some decision procedures can be pre-specified but not enough to lead to a definite recommended decision)
- *Structured decisions* (the procedure to follow, when a decision is needed, can be specified in advance). (Boston University Metropolitan College, 2011).

2.1 MIS & Decision Making

Decision-making is an intellectual process that results in the selection of a course of action among several alternatives. In the process of decision-making, we may use many tools, techniques, and perceptions. Effective and sound decisions always result in profits for the organization, while unsuccessful ones cause losses. Therefore, corporate decision-making is the most critical process in any organization. For taking any kind of decision information is the very important and that too should be correct, complete and authentic. Without proper information no one can take proper decisions. So information is the heart for taking any kind of decision. The information obtained without proper searching the proper perspectives, there will be no alternatives to compare, and without a comparison of alternatives the choice of a particular course of action is unlikely to yield the desired result. MIS is very much crucial in decision-making as it provides information that is needed for better decision making on the issues affecting the organization regarding human and material resources. MIS can be seen as a means for transformation of data, which are used as information in decision-making processes. Fig. 2 shows this understanding about information as data processed for a definite purpose.

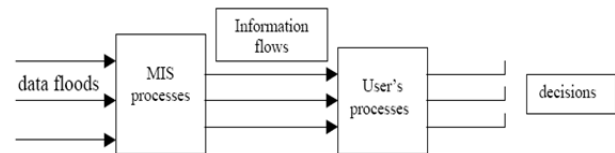


Fig. 2

Source: (G.Satyanarayana Reddy, 2009)

The Fig. clearly shows how the data is transformed into information with the help of MIS and after collecting the information the end user is taking the decision while considering the various course of actions. A well-constructed and well-organized MIS can provide management with the knowledge it needs to reduce operating costs and increase profits. MIS also help management in increasing the efficiency by quickly providing critical information about procedures and operations. (G.Satyanarayana Reddy, 2009)

3. ARTIFICIAL INTELLIGENCE (AI)

Intelligence, as applicable to human beings, is defined as a natural logic and thinking through which new knowledge emerges. Applying this concept of natural intelligence in computers refers to Artificial Intelligence (AI). AI commonly defined as the science of making machines to do things that would require human intelligence. Acc. (Prasad, 2011)

Artificial Intelligence is kind of computer program that enables the computer to think or behave the way programmer wants. Thus, the level of AI depends on programming capability as well as computer capability.”

3.1 Applications of AI:

Artificial Intelligence (AI) has now been moved from research laboratories into business organizations. Recent surveys indicate that a large number of companies have developed their AI applications in their day-to-day working and now a days AI is used in various spheres and it is the utmost requirement in every organization. Many of AI applications run on stand-alone systems, but others are integrated with more traditional Information Systems (IS), such as data processing and Management Information Systems. Most applications are knowledge-based Expert Systems (ES), but there is a growing number of applications of other AI technologies, such as neural networks, knowledge-based planning and scheduling systems, speech synthesis systems and voice-recognition systems. These are shown in Fig. 3 (Peter Duchessi, 1993)

3.2 Domains of AI

The major domains of AI are:

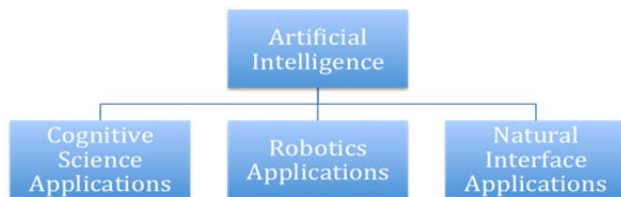


Fig. 3

- **Cognitive Science Applications-** It includes expert systems, learning systems, fuzzy logic, genetic algorithms, neural networks and intelligent agents. These systems add a knowledge base and some kind of reasoning capability to information systems. These systems also include the adaptive learning systems that have the capability to modify the behavior on the basis of information they acquire.
- **Robotics Applications-** It includes visual perception, tactility, dexterity, locomotion and navigation. This kind of technology can produce robots machines with computer intelligence and human like physical capabilities. This technology can give the robots the capabilities of navigation, locomotion, dexterity or the intelligence to find one's way to the destination.
- **Natural Interface Applications-** This the important domain of AI which includes natural languages, speech recognitions, multisensory interfaces, virtual reality, which can ease the task of human for conversing with computers. (James A O' Brien, 2013)

3.2 AI & Decision Making

Decision-making is not an instantaneous process, it has to go through the various steps to reach any kind of decision. AI is not a new stream but nowadays its use is not limited in getting

the work done but it also helps in decision making as well. Expert system that involves an interactive computer based session in which the solution to a problem is explored and in the end its acts as a consultant to the user as well which provide the user the decisions to be taken under certainty and uncertainty. A case study has been analyzed that how AI is gaining importance day by day in all spheres:

Case study on AI gaining importance of tech start up Crowd Flower and Diffbot: Computers have become a lot better at figuring out what's in a photo. In 2012, a team of University of Toronto researchers won the world's top image-recognition competition. Google eventually recruited the entire team, and the company and its peers quickly adopted its approach. In 2015, AI systems based on the project's approach, which relies on a technique called deep learning, have become much more accurate. In tests, error rates are down to less than 5 percent, making them better than some humans' performances. Lots of companies are embracing AI, perhaps none more than Google. The Internet giant went from sporadic usage of deep learning in 2012 to applying it to thousands of projects this year as shown in Fig. 4:

Companies Buy More Data to Build AI Systems

In 2012 tech startup CrowdFlower sold around 2 million spreadsheet rows of data to customers to use to train AI systems. This year it sold almost a hundred million.

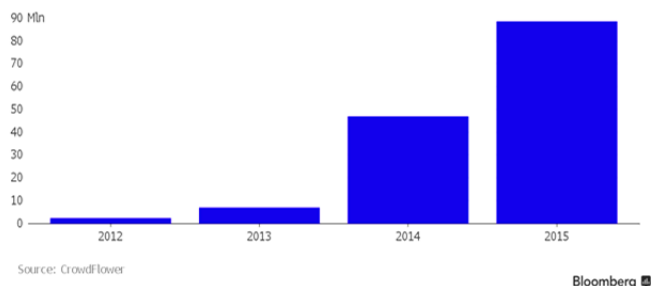


Fig. 4

Computers Get Better at Browsing the Web, with AI

Startup Diffbot has used AI to increase the accuracy of its data scraping tools

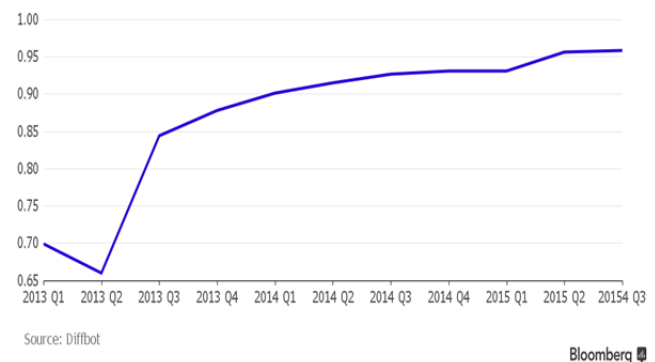


Fig. 5

Startups are adopting AI in big ways, too. Crowd Flower, which supplies structured data to companies, said it has seen a dramatic uptick in the amount of data being requested by businesses to help them conduct AI research. DiffBot, another startup, is using AI to improve its automated data-scraping tools as shown in Fig. 5 (Clark, 2015).

4. CLOUD COMPUTING

Cloud computing is one of the most promising innovations of the century. It is considered as an attractive technology for the organizations as it helps in reducing the costs and increasing the efficiency. If we talk in simpler terms, cloud computing is providing resources (such as software, platform, infrastructure etc.) on demand, just as providing utilities. It is delivery of computer as a service rather than a product. The cloud is basically thought of as a virtual computer that provides the services as demanded by the cloud users over Internet. These services can be storage space, software, operating system, hardware and software, etc.

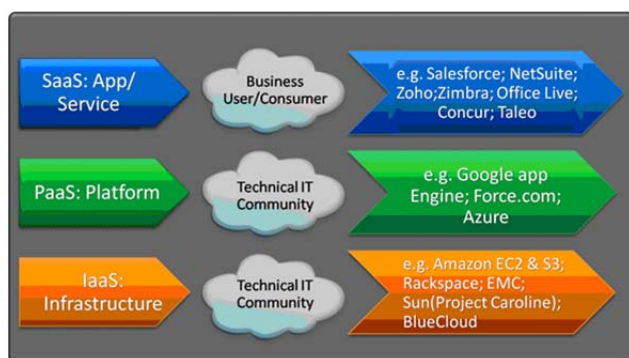


Fig. 6

Source: Annie Shum, *A measured approach to cloud computing: Capacity Planning and Performance Assurance*, BSM Review.com

Three most common services provided by cloud computing are SaaS (Software as a service), PaaS (Platform as a service) and IaaS (Infrastructure as a service). SaaS means providing software applications over cloud, PaaS provides sharing of platform, operating system and IaaS stands for providing complete infrastructure as a service. Cloud computing has caused a paradigm shift in the use of computers. Data and Information are stored in the clouds (Virtual computers) rather than on desktops. The clouds can be either public or private. A public cloud utilizes the public or open network for accessing the services whereas a private cloud is used by an organization itself; it is like a leased line specifically in the name of the organization as shown in Fig. 6:

The cloud, which is referred to as the datacenter hardware and software is of two types- Private and public. The cloud service that is available to general public is known as public cloud, these are the most open networks. Whereas private cloud is

considered the most closed network, here the data centers of a business or other businesses are not available to general public and are offered only to a specific organization and is not shared with any other organization. Apart from the above two types, there are two more cloud types- Community and Hybrid.

Organizations, which are ready to share its cloud with other similar organizations, are said to have a community cloud. These may be situated within the premise or off-premise and might be managed by the organization itself or a third party might control it, depends from situation to situation. Another type of cloud is hybrid, which is a combination of two or more cloud types (Public, Private, Community) and is linked by a standardized technology that allows application and data portability.

Cloud computing has revolutionized the way the organizations work. Let us have a look at some of the advantages cloud computing offers for businesses:

- **Ease of accessibility:** The cloud has made it possible to access computer resources from any device as well as at any time. This has considerably saved the time of employees and thus contributes towards increasing the efficiency.
- **Cost cutting:** Cloud computing helps in reducing the costs of setting up a data center, by providing the pooling services. Two or more organizations can share the resources rather than purchasing the resources, which can lead to reducing the costs thereby increasing the profit margin. Specifically, smaller firms can benefit a lot from these services.
- **Accelerating Innovation:** Cloud computing also helps in lowering of IT barriers to innovation; in other words, it helps in accelerating innovation. It enables Information technology to be deployed, configured and adapted faster, thus spurring innovation. (Engates, 2012). The organizations need not wait for IT department to setup infrastructure for proceeding from idea to implementation, instead within minutes of idea generation, the process of innovation can be started if cloud computing is utilized. The PaaS enables organizations to test, design, develop and deploy applications very quickly; this has reduced the complexities associated with buying and managing software and hardware.
- **Introduction of new classes of applications:** Cloud computing has made it possible for the existence of new classes of applications and delivering services that were not possible before, such as: (Sean Marston, 2010)
 - a. Parallel batch processing, which has enabled users to utilize enormous amount of processing powers for analyzing gigabytes to terabytes of data in lesser time.

- b. Business analytics, which helps in understanding of various patterns such as customers buying habits, supply chains etc.
- c. Mobile interactive applications that are location-environment-and context-aware and that respond in real time.
- d. Augmentation of Compute-intensive desktop applications, that can transfer the data crunching, data processing to the cloud and leaving the display of processed data at the front-end.

- **Easy scaling of service:** With the help of this technology, it becomes easier for the organizations to scale resources up or down quickly. Since it is managed via software, it can be implemented as soon as the requirement surfaces.
- **Increased Security:** The cloud service provider offers better security and protection framework for securing the data and information as compared to any startup organization or that an SME can afford.
- **Reduction in support staff:** Since many of the IT services are utilized from the cloud, it leads to reduction in technology support staff, thereby reducing the costs.
- **Elasticity:** A cloud offers flexible services that can be changed with the change in the environment. Thus, organizations who have taken cloud services are at a better position as compared to those who haven't as they can easily increase or decrease the resources required by them avoiding the hassle of purchasing or selling the resources.

4.1. Cloud Computing & MIS

Management information system plays an important role in organizations; it helps managers in decision-making as well as in performing day-to-day operations etc. The technology behind cloud computing when combined with management information systems can be very beneficial for the organizations. It can help in optimizing the IT Budgets as well as in increasing the efficiency of the organizations. The different information systems required by management for decision-making etc. can be stored on a virtual system, the cloud and can be accessed as and when required, thereby reducing the cost associated with purchasing the systems. Using a cloud, a manager can access any kind of information anytime of the day and from anywhere.

A study was conducted which proposed cloud based management information system- CMiS. A cloud computing based management information system reduces overhead of the implementing organization. CMiS has the capability of handling various management activities, providing accurate information to all the levels of management, as well as analyzing data and producing automatically generated reports. (Kayal, 2014)

Architecture of CMiS:

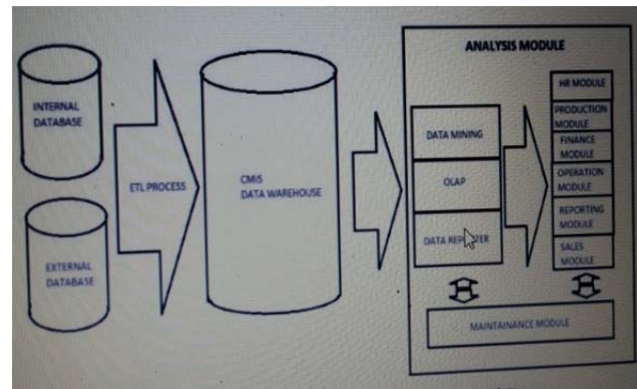


Fig. 7

Source: (Kayal, 2014)

CMiS is based on hybrid cloud architecture. The data is supplied via external (data supplied by sources external to the organization such as stock market related, government policies etc.) as well as internal sources (Data concerning day to day transactions, employee data, financial data etc.) Data from these sources is stored in a data warehouse and the third component, data analysis module help in performing the statistical and analytical functions on the data. Thus, all these components can be accessed or can be shared through cloud, rather than purchasing the necessary hardware, software and storage. PPP is gaining lot of importance in India and it has created various success stories by completing various projects on time and with less costs but still these are overlooked as the media focuses on some pain points that are inevitable in projects involving land acquisition, construction, environmental clearances and other contentious issues. It's time to put these issues behind and focus on rejuvenating the infrastructure sector in India. This is imperative, given the ambitious infrastructure plans such as Housing for All, 100 Smart Cities and stiff goals in increasing the capacity of power projects in conventional as well as renewable energy. Most experts believe better preparation before the process of bidding for a PPP project is the key. Each sector should prepare long-term investment and financing plans to identify revenue sources as well as the extent of financing that can be enabled. This will highlight any gap between capacity increase needed and capacity increase that can be afforded, through visible financing sources. Bridging the gap would require additional revenue sources or capital subsidy. Therefore, the delivery plan should articulate the value expected to be delivered by PPP and lead to a concession structure (or risk-sharing) that is aligned to the expected role of the PPP (or areas of efficiency). Undoubtedly, while there are some gaps in the PPP model, these can be resolved. The Centre has already tasked the Kelkar Committee to review the policy in order to revitalise infrastructure development. The committee will analyse the risks involved for PPPs in different sectors and the existing framework for such risk-sharing, suggest an optimal risk-sharing mechanism between private investors and

the government, and also suggest steps to improve capacity building in government to effectively implement projects. These things will definitely kick start the PPP model and it will help in developing the economy. (AGARWAL, 2015) [10].

5. CONCLUSION

As decision-making is important for every organization in the same way that accuracy of decision is also the responsibility of the organization. This accuracy can be achieved with the help of AI as discussed in the case study of startup Diffbot that how they achieved the accuracy in data scrapping tools. In the same way other organizations can also use this technology for the reduction in the errors and to choose the best option among various alternatives. AI is very useful technology and it can reduce the error rate but its an cost affair as well.

Cloud computing is considered a cutting-edge technology for small and medium scale companies as well as startup enterprises. Such organizations can share the different types of MIS systems rather than purchasing the required hardware and software as it will help the organizations in reducing the costs.

But one of the major drawback that is thought of is how secure or safe is the organization's data on the cloud server provider's services, specifically on the public cloud. Also, certain legal issues are involved as in case of problem, which country's data protection laws apply in case the cloud service provider and the client are located geographically apart.

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