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Decision-Making with Technology

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Abstract
In every organization decision-making is an integral part of the management process. Technology is booming and in decision-making, it is taking key responsibilities. Every company deals with a huge amount of data from various sources daily and operating with the volume of data is absolutely astounding compare to what the organizations used to do decades ago. In today's world, business intelligence tools are very important components of any successful business strategy. These tools allow users to modernize the effort needed to search for, combine and query data to obtain the information required for good decisions. In this article, we will discuss the technology trends in decision-making, the capabilities of technology in managerial decision-making and the cognitive ability of decision-making. We will also discuss supervised and unsupervised learning of machine learning techniques, how artificial neural nets (ANNs) use supervised learning to predict outcomes in decision-making with real-world examples.

Keywords: decision-making, ANN, machine learning, neural network, genetic algorithm, GIS, AI

Introduction
Technology supports decision makers in various phases of the decision process. There are mainly four phases - Intelligence, Design, Choice, and Implementation of the decision-making process. These four phases are elaborated below for better understanding.

Intelligence
Business intelligence systems are used to preserve, enhance and restructure the current operations. The term mentions to skills, requests, and practices for the group, incorporation, examination, and performance of business information. The purpose of business intelligence is to support data-driven business decision making. Business intelligence is occasionally used interchangeably with updating books, report and query tools, and decision-making information systems.

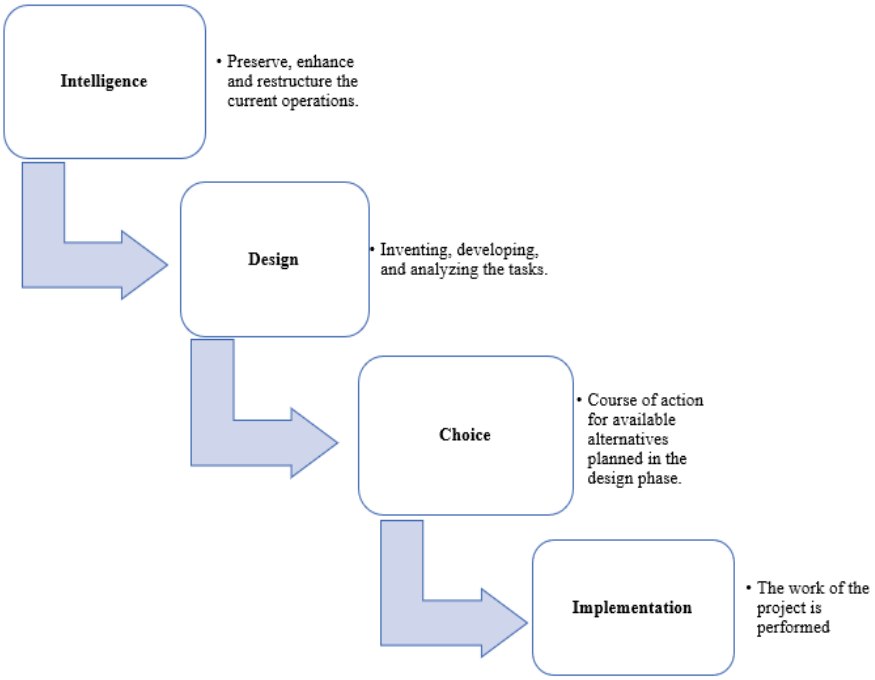

Fig 1: Phases of the decision-making process

Business intelligence advances and upholds operational effectiveness and assist companies to develop productivity. Business intelligence software proposes many assistances, including influential reporting and data analytics competencies. Using BI's rich data visualization mechanisms like real-time dashboards, managers can generate instinctive, clear reports that contain pertinent, actionable data.

Business intelligence needed for reporting and analytics.

- **Reporting:** is the procedure of establishing data into informational summaries to monitor how different areas of a business are accomplishing. It gathers data and delivers it in an edible format.
- **Analytics:** is the procedure of discovering data and reports to extract meaningful insights, which can be used to better understand and improve business performance.

Design

Design is inventing, developing, and analyzing possible courses of action.

The design phase can be divided based on the below -

- **Formulate a model:** Creating a model in the decision-making process is mandatory. Both the top and lower level model should be created. Examples for the top level model are computer application, the technology required, user model, problem identification and solving, reports, connectivity, security, installation, etc. which are needed to define before creating a model. Few examples for low-level models are user model, user access, historical data storage for future reference, inventory of equipment or software used, etc.
- **Set some criteria for choice:** Various criteria may be a checklist for features, user model like data access, archive data storage and retrieval, create a different group for access, adding a new individual to the group, etc.
- **Search for substitutes:** This can be as a requirement letter to suppliers, posting advertisement explaining the product, demonstrations with internal teams, end customers, etc.
- **Predict and measure:** Checklist should be marked when completed, get the count how many customers may buy the product, how to sell the product in a more efficient way, how many can buy the product within a certain time, etc.
- These all are in the design phase. This is a very important phase in every organization as based on the design, the future goals can be set on how to sell the product and grow in the business.

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Choice

Selecting a course of action for available alternatives as planned in the design phase. Typical activities include

- **Selection of best alternatives:** There may be various analysis for a project plan. Discuss with the team, rank them and select the best one, negotiates better term for each leading product.
- **Implementation plans:** Once the product is developed before implementation do proper testing of the product. Arrange demo/training to get feedback from teams and enhance the product. Do proper testing with customer's data, if not with the raw data then with the de-identified data after getting proper approval.
- **Controlling system design:** Managing the command or regulates the behavior of other related devices, plan to control the system automatically, apply the automation scripts to avoid manual tasks, etc. comes under controlling system design.
- **Get the information:** Get all the information and consolidate all in one place and train employees so that if the issue arises it can be avoided automatically. Update the requirement document if changes applied, validate it before implementation.
- **Final evaluation:** Once the project comes closer to implementation, the final evaluation can be made. A final evaluation reviews the overall project cycle draws conclusions and extracts lessons learned from the experience.
- **Sensitivity analysis:** Sensitivity analysis can be done when uncertainty arises in an output model. The part of the application can be divided among developers to do the analysis of the uncertainty.

Implementation

During this plan, the project plan put into motion and the work of the project is performed. During the project implementation, the tasks performed, and the progress performed are reported during regular team meetings. Typical activities include

Following the plan of implementation: Implementation plan is the procedure that turns approaches and plans into actions to achieve planned objectives and goals. Applying the strategic plan is as significant, or even more important, than the strategy.

- **Gate review:** All necessary approvals are needed before implementation. Various teams like a commercial, marketing, quality, engineering, service teams must have to attend meeting to understand the product during the gate review. The team must check if the product is developed as expected based on the requirement and will give sign off for release.
- **Conduct training:** Various training can be conducted to understand product design, development, and quality. Engineers or service will explain about the product and all team members will gain knowledge about the product.
- **Move to production:** Once the gate review is completed and sign off is received then finally the product will get launch. Mostly engineers will involve launching the project, once launched testing will be done and everybody involved in the process will be notified about the successful implementation.

Systems used while making correct decisions

To make vital and prompt decisions in any organization, technology offers the following systems:

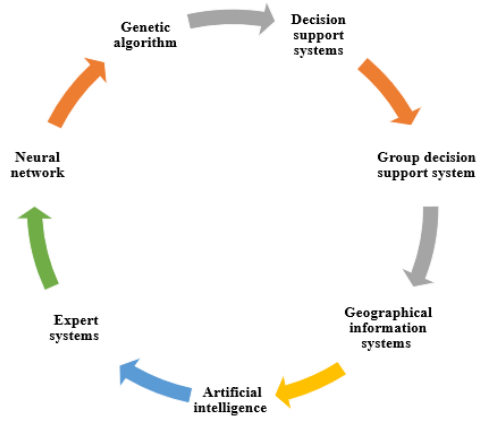

Fig 2: Systems while making correct decisions

- **Decision support systems (DSS)** – Decision support systems help the management, processes and development levels of an and benefit people to take their decisions about the troubles that may be quickly varying and not easily quantified in advance i.e. when the problem is not structured. Decision support systems can be either completely electronic or human-powered or a combination of both.
- **Group decision support system (GDSS)** – There can be many decisions that the organization need to take as a team. The organization may need collaboration and participation of many employees to come up with a strategy and solution about any problem or product. For example, a company is running a software application, to do any defect fix or new enhancement of the application, the decision can take place as a team.
- **Geographical information systems (GIS)** – This decision support system is intended to detect, supply, operate, investigate, accomplish the geographic information. GIS tools allow users to generate queries, verify the information, edit data maps, and present the results of all these operations.
- **Artificial intelligence (AI)** – Artificial intelligence is called machine learning. It is established my machines indifference to the natural intelligence exhibited by humans and animals. AI is an area of computer science that highlights the formation of intelligent machines that work and respond like humans. Speech recognition is an example of AI
- **Expert systems** – An expert system is a computer system that rivals the decision-making capability of a human practiced. These types of system usually solve complex problems by cognitive over forms of information, signified mainly as if-then rules rather than over conservative technical code.
- **Neural network –** Artificial neural networks are computing systems imprecisely enthused by the biological neural networks. These types of system learn to do tasks by considering examples, usually without being programmed with any task-specific rules with differentiate patterns.
- **Genetic algorithm** – In computer science and operations research, a genetic algorithm is a metaheuristic enthused by the procedure of normal selection that belongs to the bigger class of evolutionary algorithms.

Technology trends in decision-making

- **Digitization of everything:** In the current business and organizational operational environment, the technology trend that is identified is the use of computer systems, computerized data, communications and other infrastructures over the internet. This whole process of transferring operations to the computer system environment is what is referred to as digitization. The trend has existed for a while now, affecting the lives and aspects of people's lives. Examples of such include the use of Automated Teller Machines (ATMs), online retails like Amazon and personal advertisements. Business organizations have been able to adapt to new systems and machines to enhance their performance and management. Health enterprises have also embraced the trend by incorporating computer technologies in administering their services (Lientz & Rea, 2016). News and communication have also been revolutionized. More platforms have been availed for news airing including websites, newspapers, email and social media.
- **Internet of Things:** This technological perspective can be described to be a set of small devices that are computerized and that are self-discovering and self-aware. The devices are programmed in such a way that they can control their own networks. When the devices are deployed and distributed, they can find each other and consequently report back to the server systems. In the business setup, IoT tends to provide capabilities and functionalities of data capturing and retrieval of information. When the devices are used, the business operations become more efficient and automated thus leading to general productivity. This also ensures that all the necessary data is captured and no detail that may be important is left out. It promotes thoroughness in terms of conducting the business.

Capabilities of Technology in Managerial Decision Making

With the use and incorporation of technology advancements and current computer infrastructures, a team of employed staff or members can make use of the group decision support system. This system is basically for the sole reason of making quick but informed decisions. Some examples of capabilities provided for by IT to the decision making include brainstorming and issue categorizing and analysis.

- **Brainstorming:** Team members of the organization primarily generate ideas in this section. For instance, an example of a scenario could be that the team is identifying the strengths, weaknesses, available opportunities and the threats that are faced by the organization. GDSS gets to allow users and members to enter suggestions and comments in a simultaneous manner (Helfat & Peteraf, 2015) [1]. These data are then collected and the results are displayed on individual stations for the team members. This capability offers a competitive advantage to the organization by cutting down on wastage of time. Given that time is a vital resource, adequate and efficient utilization of the resource places the organization above other organizations.
- **Issue categorizing and analysis:** In this section of decision making, the individual team members can arrange the ideas and suggestions presented into classifications that are manageable. These ideas are then further discussed, where clarifications are made, and then each idea and suggestion undergo an evaluation based on its worth and contribution to the objective of the project. The GDSS classifies and sorts these discussed ideas and places them into separate and respective folders (Helfat & Peteraf, 2015) [1]. These folders can be opened to add comments and suggestions.

This capability accounts for effective management and evaluation of data and information. This offers a competitive advantage to other organizations. When information is analyzed and managed well, then the goals and objectives of the organization are met.

Cognitive ability

The traditional model of organizational control and management was basically dependent on human thinking. However, human thinking has some limitations and disadvantages. Organizations have, over time, got to adopt new ways and methods of management and running of the

institutions. This is due to some advantages the technology and information systems have over the human thinking perspective.

- **Inventory Management Systems:** Business organizations have a great task of managing the stock. The inventory systems get to track the quantities of individual assets and items. In case of insufficient stock, the managerial section is alerted, and the stock is upgraded (Pearlson *et al*., 2016) [2]. This is a tedious and hectic task which can essentially not be done by the human brain.
- **Data management:** Data and information are the greatest of all assets and resources in an organization. It is thus critical that each data component is addressed as needed. Human thinking has a limit on the amount and nature of data at hand (Pearlson *et al*., 2016) [2]. Incorporation of technology and information systems gets to supplement the functionalities by managing and analyzing the data, getting to produce reports and additionally keeping the records in case of future retrieval.

Supervised learning is the method linked with machine learning which entails assigning categorized data to ensure a function or pattern from the data can be realized. Unsupervised learning is the machine learning method where implications are deduced from input data which is not labeled (Zhao & Liu, 2007) [12]. The aim of unsupervised learning is to define the hidden grouping or patterns in data from data unlabeled.

Differences between Supervised and Unsupervised Learning

- **Input Data:** The main difference between unsupervised and supervised learning is the use of data in each method of machine learning. In supervised learning, input data is well labeled and known. This shows that the machine is assigned the role of defining the hidden groupings from the data already labeled (Friedman, Hastie & Tibshirani, 2011) [10]. In unsupervised learning, the data used is not labeled or it is unknown. The machine is tasked with the role of labeling or categorizing the raw data.
- **Computational Complexity:** Supervised learning is referred to as a complex learning method while unsupervised learning method is less complex. In supervised learning, one must comprehend and label the inputs while in unsupervised learning, one is obligatory to apprehend and ensure inputs labeling.
- **Accuracy of the Results:** The produced results from supervised machine learning method are more reliable and as matched to the results produced from the unsupervised method. In the unsupervised method, the machine must describe and ensure input data labeling before defining the unknown functions and patterns (Dougherty, Kohavi & Sahami, 2015) [3].
- **Number of Classes:** In supervised learning; all the classes used are known indicating that also the solutions in the analysis are possible to be known. The solitary aim of supervised learning is to find out the unknown cluster. In the unsupervised method of leaning, there is no prior knowledge.
- **Categories**

  Supervised learning categories
  a) Support Vector Machines.
  b) Logistic regression
  c) Linear regression.
  d) Linear discriminant analysis
  e) Naive Bayes.
  f) Decision trees.
  g) K-nearest neighbor algorithm.
  h) Neural Networks (Multilayer perceptron)

  Unsupervised learning categories
  a) Clustering-hierarchical clustering,
  b) Anomaly detection.
  c) Local Outlier Factor.
  d) Neural Networks.
  e) dimensionality reduction

Description how artificial neural nets (ANNs) use supervised learning to predict outcomes in decision-making

Artificial neural nets (ANNs) are used in supervised learning to forecast results in decision-making. Artificial neural networks (ANN) are a computational models family founded on architecture connectionist. In the time of training of ANN under supervised learning, the vector input is presented to the network, which then provides a yield vector. An artificial neural network (ANN) is used to predict outcomes in supervised learning by undertaking pattern recognition and the image data classification (Pedregosa *et al*, 2011) [11].

Real real-world examples

Learning associations; for the case of unsupervised learning, an example can be studying the associations between the people that buy a product and the products. If the buyer (person) purchases a product, he will be revealed the same kind of products for there is an association between the two products. When fresh products are presented in the market, they are linked with the old ones to ensure sales escalation.

Classification; in the case of supervised learning, classification launch an effective relation, analysts use data. The example here is where before a bank chooses to issue loans; it evaluates the capability of the customers to repay the loans. Through considering the aspects like savings, earning of the customer, and financial history, this can also be done. Therefore, this information is attained from the loans past data.

Artificial neural networks are mathematical representations encouraged by the organization and operative of biological neurons. There are many artificial neural network distinctions that are related to the nature of the task assigned to the network. There are also many variations in how the neuron is modeled. In some cases, these models resemble closely to biological neurons (e.g., Gluck and Bower, 1988; Granger *et al*., 1989) and in other cases the models depart from biological functioning in substantial ways. Artificial neural networks can be a universal function approximators for even non-linear functions. Artificial neural networks can also estimate piece-wise estimates of functions.

Through artificial neural networks using one or more hidden layers, the networks can partition the sample space automatically and build different functions in dissimilar portions of that space. This means that artificial neural networks have a diffident capability for building piece-wise non-linear models. The artificial neural network model for the exclusive or function is a good example of such a model (Wasserman, 1989, pp. 30-33). Collopy and Armstrong (1992) plotted forecasting experts and found that the experts measured it important to select extrapolation methods that

identified and preserved abrupt changes in historical data patterns, signifying the utility of piece-wise models.

Some statistical time series methods have characteristic limitations due to the way in which the models are assessed. The approximation of many kinds of statistical time series models need human interaction and evaluation. The estimation of artificial neural networks, though, can be automated (Hoptroff, 1993). Also, numerous statistical models must be re-estimated occasionally when new data arrive. Many artificial neural network algorithms study incrementally.

There are also glitches with artificial neural networks. Artificial neural network methodology and modeling systems are speedily changing, while many statistical modeling techniques are stable and well developed. Software is easily available for statistical methods but commercial artificial neural network software, often delays developments in the field. Artificial neural network models are tougher to understand and to give physical connotation than are many forecasting models. Artificial neural networks cover additional limitations to estimate than do most statistical forecasting models. Similarly, artificial neural networks need more computer time than statistical models.

Conclusion and Future Study

Decision-making involves various steps like recognizing problems, creating substitutes, assessing replacements, selecting an alternate, executing the decision, and assessing decision efficiency, etc. Technology is progressively taking a major role in decision-making today in every organization. Any successful innovation is vital for the organizational existence in high-technology service facilities. The probability of innovation achievement is associated with the methodical decrease of decision-making ambiguity, consequently of organizational evidence gathering, diffusion, and processing actions. Every organization depends on various decision-making tools and the goal cannot be achieved without the decision-making process. In conclusion, supervised learning ensures a function or pattern from the data can be realized while unsupervised learning aims at defining the hidden grouping or patterns in data from data which is unlabeled. The key difference between unsupervised and supervised learning is the use of data. In supervised learning, input data is well labeled and known while in unsupervised learning, the data used is not labeled or it is unknown. Finally, the use of an artificial neural network (ANN) is to predict results in supervised learning by performing pattern recognition and the image data grouping.

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