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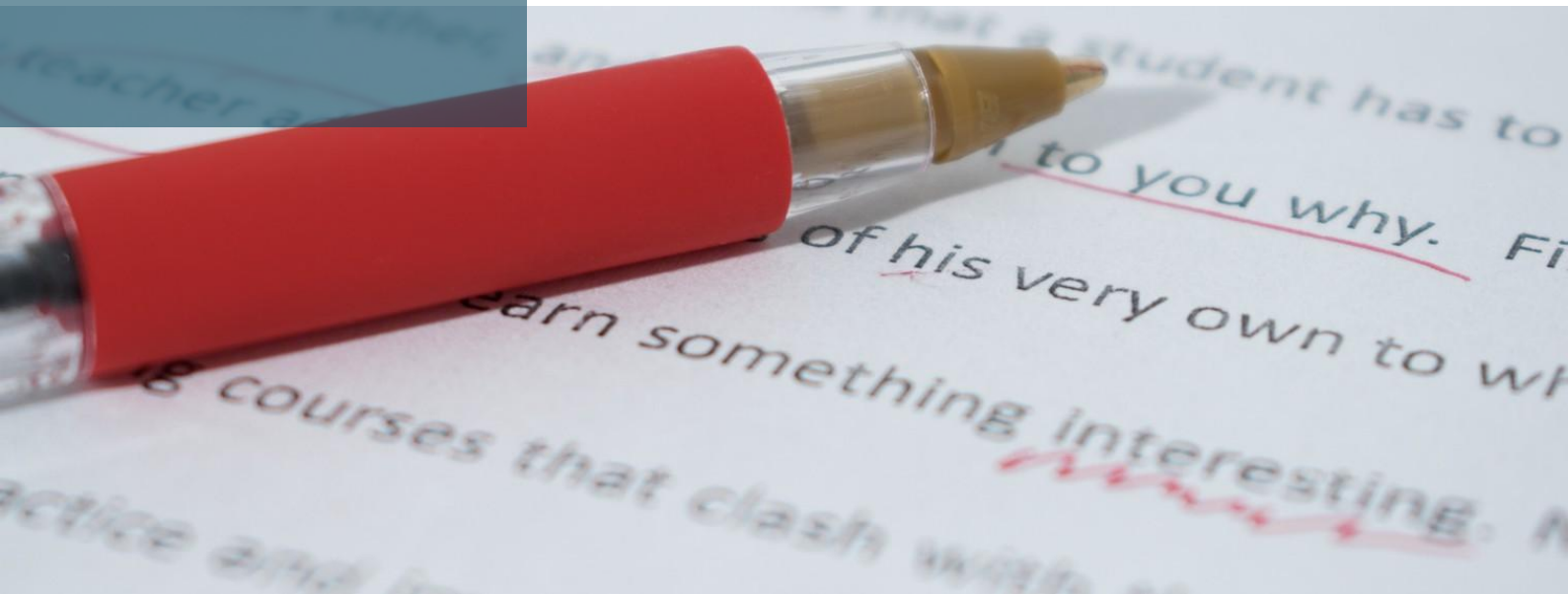

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AI in Decision Support Systems

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Abstract- Decision-making can be summarized as the process of comparing what is perceived with what is desired and taking steps to bring the former closer to the latter. A DSS is an interactive, flexible, and adaptable computer-based information system, especially developed for supporting the solution of a non-structured management problem for improved decision making. This paper explores the integration of Artificial Intelligence (AI) technologies into Decision Support Systems (DSS), examining how this convergence is transforming organizational decision-making processes across various sectors. We analyze current implementation trends, key technological components, notable applications, and challenges in AI-enhanced DSS. The research highlights how machine learning, natural language processing, and other AI techniques enabling more dynamic, personalized, and predictive decision support capabilities. We conclude by identifying emerging research directions and considerations for effective implementation of AI-powered decision support frameworks.

Keywords- Intelligent Decision Support Systems (IDSS), Natural Language Processing (NLP)

1. Introduction to Decision Support Systems

It may consist of sophisticated tools and techniques including databases, models and analytical tools for searching, planning and an interface for human interaction [1]. DSS are broadly classified into two categories: Code based (model-driven) DSS and Knowledge-based systems. The latter is an emerging trend capable of intelligent behavior and self-extensibility. More formally, Intelligent Decision Support Systems (IDSS) are interactive computer-based systems that use data, expert knowledge and models for supporting decision-makers in organizations to solve complex, imprecise and ill-structured problems by incorporating artificial intelligence techniques. The inclusion of AI technologies in DSS is an effort to develop computer-based systems that mimic human qualities to support better decision making.

IDSS are particularly useful for repetitive control applications, such as adaptive or self tuning control and supervisory control. The use of IDSS is intended to enhance the ability of operators and decision-makers to better perform their duties and work together. An increasing number of DSS

include domain knowledge, modeling and analysis systems which provide users with the capability of intelligent assistance. Knowledge-based Intelligent DSS include a knowledge management component which stores and manages emerging AI tools such as machine learning and case-based reasoning. These tools can extract knowledge from previous data and decisions giving DSS the capability to support repetitive, complex real-time decision making. An IDSS has the capability to capture, refine, store and apply the knowledge to support effective decision making.

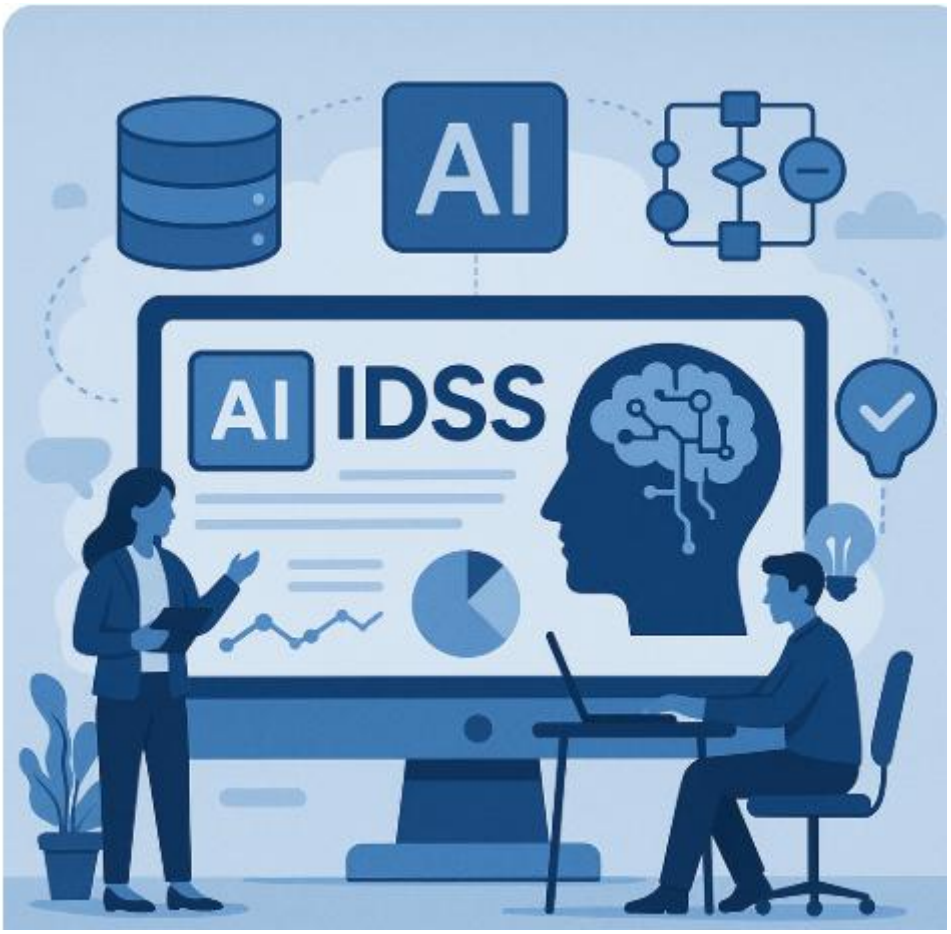
2. Overview of Artificial Intelligence

Intelligence exists in nature everywhere. It is a quality of human beings, animals and plants that enables them to solve their problems, conclude decisions and create something new. Human are the most blessed creation. They have changed this world by their intelligence. There are some attributes that indicate intelligence: creativity, learning ability, problem solving ability and judgmental power. Problem solving ability means how somebody solves any problem correctly. It depends both on knowledge and intelligence. Problem Solving is the most important topic in artificial intelligence. Creativity is the ability to make or create something new. Decision making is the ability that enables us to behave ourselves. A human being uses rules, laws, exceptions and past experiences to decide his/her behavior in a given set of conditions. It involves reasoning. Reasoning is a process that enables us to conclude something. There is no difference between good and bad reasoning. The reasoning process must contain both justification and proper explanation of the conclusion. Intelligence can be defined as the ability to use knowledge and solve problems. Knowledge and intelligence are two different things. Knowledge is a collection of facts. Humans store their previous experiences as knowledge. Reasoning is a process that enables them to conclude something from this knowledge [2].

An AI system can be defined as a machine that can perform various tasks like a human being. In a broad sense, AI is a branch of computer sciences that use techniques to make computers intelligent. It is a science of making intelligent machines. Specifically, it is an interface of computer sciences, psychology, mathematics and engineering. Artificial Intelligence research is concerned with creating machines (hardware and software together) which are capable of intelligent behavior. In a narrow sense, it deals with the problem of creating machines that formulate knowledge and reason with knowledge, learn from experience and communicate in a natural language. Still in a narrower sense, AI is implemented by computer programs that receive data, manipulate them according to the specified instructions and produce the desired output. AI is the ability of a device or computer system

to perform tasks normally associated with intelligence like reasoning, learning and understanding language [1].

Artificial Intelligence (AI) was created by John McCarthy in August 1956. AI is an acronym that stands for Artificial Intelligence. From that invention, there are machines that show intelligent behavior like humans. Its simple definition is to make computers intelligent. AI should be understood by its techniques, its purpose and its expected applications. There are different sorts of approaches to AI such as: Rational Agent, Human Level AI, and Mind Simulation.



3. Integration of AI in Decision Support Systems

Decision support systems (DSS) have been employed as powerful tools for assisting managers to make decisions for over two decades. A DSS is an interactive, flexible, and adaptable computer-based information system, especially developed for supporting the solution of a non-structured management problem for improved decision making. A DSS is an interactive computer-based system, which maintains a model base and a database to assist decision makers in their decision task.

The remarkable advances in intelligent technologies in electronics, computers, and telecommunication have made an intense impact on decision support technologies. The rapid development of large and low-cost data storage devices, high-performance servers, and emerging intelligent technology have made it possible that large, diversified, and continuous high-velocity data come in huge amounts to bodies in both structured and unstructured forms. In the past few years, many improvements have been noticed in the DSS field, with the inclusion of artificial intelligence (AI) techniques in DSS such as knowledge bases, fuzzy logic, multi-agent systems, natural language, genetic algorithms, neural networks, and so forth [1]. In fact, intelligent decision support systems (IDSS) are interactive computer-based systems that use data, expert knowledge, and models for supporting decision-makers in organizations to solve complex, imprecise, and ill-structured problems by incorporating artificial intelligence (AI) techniques. The inclusion of AI technologies in DSS is an effort to develop systems that mimic human qualities, such as approximation, reasoning, intuition, and common sense. Similarly, the use of IDSS is intended to improve the ability of operators and decision-makers to better perform their duties and to ease their workloads in controlling, monitoring, and managing complex tasks. IDSS are in every area of human endeavors where decision-makers, problem solvers, and goal seekers are present, e.g., finance, transportation, manufacturing, and military. An increasing number of DSS include domain knowledge, modeling, and analysis systems to provide users the capability of intelligent assistance. Knowledge-based IDSS include a knowledge management component which stores and manages a new class of emerging AI tools such as machine learning and case-based reasoning. These tools can extract knowledge from previous data, giving DSS the capability to support complex real-time decision making. A DSS library component is usually provided offering standard DSS functions. A variety of action plans and templates can be stored to allow users to utilize them to speed up model building. Artificial neural networks and genetic algorithms are the most widely used techniques for machine learning. An IDSS has the capability to capture, refine, store, and apply knowledge to support effective decision making.

4. Types of Decision Support Systems

Information technology applications that provide assistance in supporting decision-making processes have evolved over the past few decades. At the beginning, Enterprise Systems were introduced with the objective of sharing information among all the departments of the organization within a single software. Although this led to savings in terms of costs and resources spent on data administration, since all business units used the same application there was also the risk of sharing and contaminating information. In this environment characterized by harsh competition, incessant change, globalization, increased access to information, and the deployment of communication technologies, organizations started to realize that their most valuable and differentiated asset was knowledge. This emerging awareness resulted in the definition of the concept of Knowledge Management, which gave rise to several knowledge-based products and systems, and the emergence of completely new markets. And so the vast array of Information Technology applications for decision support continues to grow.

The Decision Support Systems (DSS) landscape is now populated with many different kinds of systems, all justified by their use in real innovative applications. General definitions and formalizations of this broad class of systems seem inappropriate and even meaningless these days. Depending on the presence of fuzzy attributions, uncertainty, time constraints, and other non-standard aspects, DSSs may vary in complexity levels, operating in very simple yet effective application contexts or dealing with real space very complex problems. Intelligent Decision Support Systems (IDSS) have evolved during the past decade and provides users with intelligent assistance, which is to enhancement of the decision-making process. IDSS consist of a Decision Support System and a Knowledge Management component. The knowledge management component is based on a large panoply of technologies, including agents, filters, ontologies, data mining, machine learning, case-based reasoning, decision trees, fuzzy logic, and so on. The specified knowledge management component is able to extract knowledge from previous data allowing it to support complex real time decision-making problems. More precisely, the use of techniques for the extraction of knowledge from historical data as well as intelligence for the characterization of real time events is presented [1].

4.1. Data-Driven Decision Support Systems

Decision support systems (DSS) have been defined in various ways. A recent definition of DSS, which reflects its current understanding and use, is: “a computer-based information system composed of interactive, flexible, and adaptable software and hardware tailored to decision makers’ specific requirements, and used to support the solution of problems that may be either ill-structured or structured, or at any level of structurality in between.” This definition describes a DSS as first and foremost a computer-based information system, it encompasses both hardware and software, it is a system composed of independent but interrelated components, it is tailored to meet a decision maker’s requirements, and it is interactive and user controlled. It is a system that “may be automated, but is never necessarily so.” DSS components are largely independent and may be divided into subsystem components, of which the following are essential .

A data management subsystem that containing an integrated and organized collection of data in a variety of formats. A model management subsystem that providing users with a variety of quantitative techniques in the form of model(s) for use on the integrated data and may utilize a model-base developed by specialists outside the organization. A dialog generation and management subsystem that enforcing users’ control over a friendly interface and allows users to explore and extend specialized models and tools for general computer analysis. A knowledge base that maintains

a variety of user modes to improve operational efficiency. The decision support system (DSS) users interpret the data and results of the models along with their expert knowledge to arrive at a decision.

4.2. Model-Driven Decision Support Systems

AI in decision support systems brings exciting capabilities to the analysis and interaction of critical components in DSS. It highlights the crucial role—that will grow quickly in future systems—knowledge representation plays in analysis and exploration. It describes how the use of genetic algorithms and neural networks can complement the mathematical optimization approaches typically employed in DSS. Understanding how DSS architects and end-users can embed cause-and-effect reasoning into the models they develop is new territory that is being explored.

Model Driven Decision Support Systems (MD-DSS) use structural models as the basis for their operation and analyses . These models are either deterministic, with a unique solution, or stochastic, with multiple solutions depending on the random nature of some of the variables. The MD-DSS's analyses typically involve rigorous and sophisticated mathematical programming analyses. These include predictive, preventive, and prescriptive on-line analyses capable of producing recommendations even before the amount of information each decision maker receives to take their decisions becomes available. These capabilities assume that the underlying MD-DSS models remain static over the years, and that the mathematical programming optimization approaches used in their operation strictly adhere to their scaling and assumptions. This requires improvements such as extending the capabilities of the time-component of the models, embedding artificial intelligence and visualization options in them, learning from the networks interactions, or increasing their involvement in real-world dealings. The maturity of proposed solutions to these problems is uneven among the proposals found in the literature.

Time is a peculiar variable in discrete network models. It is often added flexibly to the input variables, through empirical fitting methods, and runs as a free variable of the models. Many of the debated enhancements will remain in their discussion stages until the shedding of these by MD-DSS. This seems especially so of enhancements built on tools developed in the last twenty years, such as game-theory, network-design with multiple objectives, fuzzy-logic, or social-psychological theories. The original implementation requirements of the MD-DSS seem so strong and demanding that it would take time before they were willing to risk using non-mathematical programming programming approaches. Although user-scripted algorithms come now with standard statistical or optimization packages, it is likely that the modelling paradigm for experiments enhanced by these superior

methodologies will only be switched to them when it will be seen that no MD-DSS is able to produce the proposed improvements. Models to experiment with peer-to-peer systems or spontaneous collective behaviour would provide alternative modelling paradigms, but jeopardizing day-to-day operations, even temporarily.

4.3. Knowledge-Driven Decision Support Systems

Knowledge-driven DSS aim to provide easy access to domain knowledge and detailed models of the systems being analyzed, thereby removing the burden of representing these issues from the end-users. The idea is that once key modules are built, they can be invoked whenever and wherever is needed, sparing users the complexities of knowledge representation. Based on these ideas, there are generally two types of knowledge-driven DSS. The first is triggered when the knowledge base detects that input data has changed sufficiently so that one or more conclusions of its inference structures could be altered. In response, the system asks for more data until the user can confirm this alleged knowledge deficiency. There are extensive uses of this sort of knowledge-driven DSS in the areas of fraud detection, diagnosis of fault conditions, and computer-aided design. The second type of knowledge-driven DSS, the family of auto-compilers, has a much more specific purpose. It aims to speed up the tasks of building new models and keeping old ones up to date. It does this by presenting the user with a set of already available modules that might fulfill their needs, which with sufficient user guidance are then assembled into whatever models are needed [1].

Knowledge-driven DSS users are today expected to constitute a much larger market than knowledge base creators. This may be an indication that acquiring and codifying knowledge in canonic form to fit a knowledge base is a much harder task than originally thought. However, at least as far as building very extensive knowledge bases is concerned, all efforts are still on the drawing board stage. Simultaneously with this proliferation, a number of scholars started to view occasional knowledge-based systems as not being clever enough to warrant using the AI label anymore. Indeed, in many DSS the knowledge base structuring is still performed manually or, worst, not at all. Pre-compiled knowledge bases do serve a purpose on the mass agriculture market, and in very narrowly defined domains knowledge base users may very well be superior to their knowledge base creators.

5. AI Techniques Used in Decision Support

A decision support system (DSS) is an interactive, flexible, and adaptable computer-based information system developed for supporting the solution of non-structured management problems for improved decision making [1]. It utilizes both the data and human knowledge to solve problems

and is a semi-automated management information system which will do complex and large batch processing of data and supply the information required for improved decision making. An DSS should be capable of answering 'what if' questions; that means it should be able to specify alternative course of action and evaluate them against criteria supplied by the decision maker (DM). Recent improvements in DSS include artificial intelligence (AI) techniques such as knowledge bases, fuzzy logic, multi-agent systems, natural language, genetic algorithms, and neural networks. The applications using these techniques are termed as intelligent decision support systems (IDSS). Intelligent decision support systems (IDSS) are interactive systems that use data, expert knowledge and models to solve complex, imprecise, and ill-structured problems. These systems provide decision support at various stages of decision-making process and use AI technologies including knowledge-based systems, artificial neural networks, genetic algorithms, fuzzy logic, data mining for IDSS. Many of AI techniques mimic human qualities such as reasoning, intuition etc. AI DSS tries to enhance the capability of decision making by converting the subjectivity in their decisions into knowledge and using them systematically. These were the period for rapid development of various AI based methodologies in a wide variety of domains. Knowledge-based Intelligent DSS (KIDSS) is a sophisticated DSS (in addition to conventional data, model and user interface management components) with a knowledge management component. It has AI tools such as agent-based computing, machine learning, data mining, reasoning, natural language processing, knowledge acquisition and case-based reasoning for better, faster and smoother decision support to complex real-time decision making.

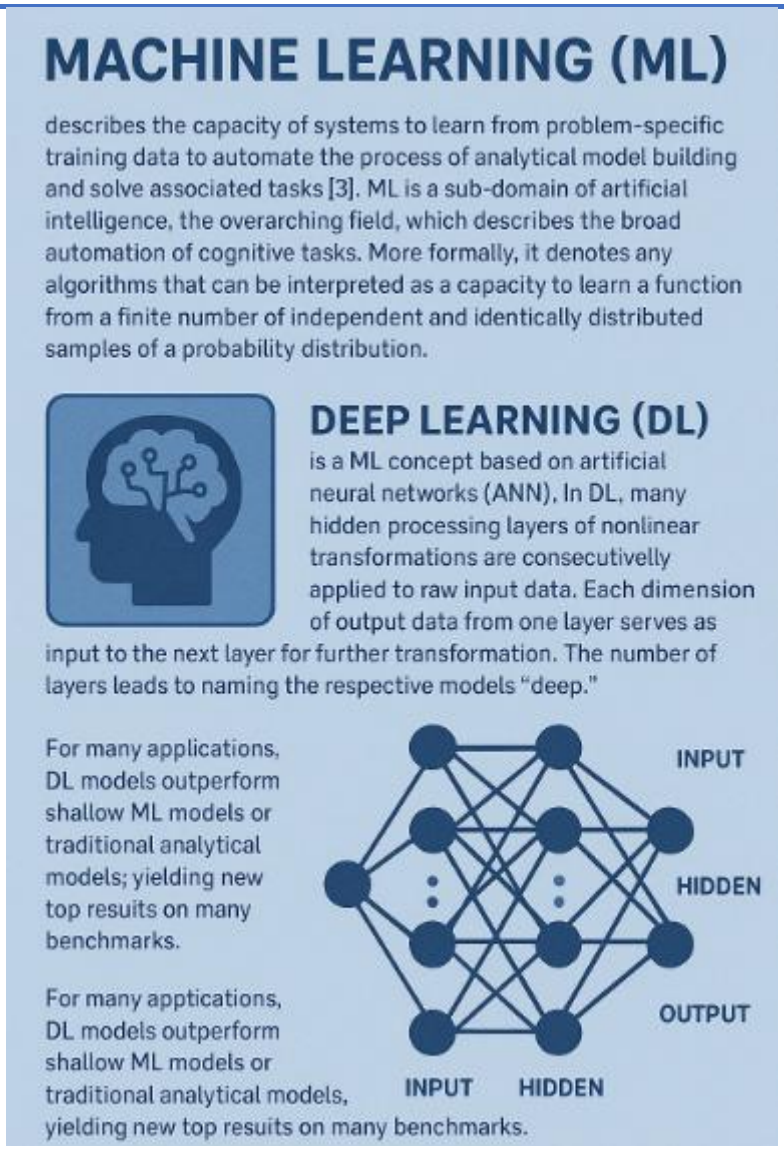
DSS can take up and operate upon various AI techniques such as artificial neural networks (ANN), genetic algorithms, fuzzy logic etc. A combination of these will yield better flexibility and capabilities for solving complex, large and dynamic problems. These allow IDSS to refine, store and apply knowledge for better and effective decision making. AI techniques such as ANN and recently growing field named as genetic algorithms, are widely used for machine learning in IDSS. Machine learning undergone meteoric development in 1980s but remains flabbergasted in marketing decision systems. Computer hardware and software development, Internet evolution and open architecture moved these systems from academic labs to complex real world applications impacting billions in better living. Algorithms for meaningful storage analysis and representation of data expansion are expected to be implemented in IDSS so that as the horizon of knowledge increases better qualitative description is revisable QA in better resolution on convergence at shorter time under competitive

fees.

5.1. Machine Learning

Machine learning (ML) describes the capacity of systems to learn from problem-specific training data to automate the process of analytical model building and solve associated tasks [3]. ML is a sub-domain of artificial intelligence, the overarching field, which describes the broad automation of cognitive tasks. More formally, it denotes any algorithms that can be interpreted as a capacity to learn a function from a finite number of independent and identically distributed samples of a probability distribution. Based on Bayes' theorem, ML defines the optimal function approximator under certain assumptions. Deep learning (DL) is a ML concept based on artificial neural networks (ANN). In DL, many hidden processing layers of nonlinear transformations are consecutively applied to raw input data. Each dimension of output data from one layer serves as input to the next layer for further transformation. The number of layers leads to naming the respective models "deep." For many applications, DL models outperform shallow ML models or traditional analytical models, yielding new top results on many benchmarks.

Presently, ML is part of everyday life since it enables systems to perform tasks formerly requiring human intelligence. For example, intelligent systems with human-like cognitive capacity automatically classify text messages into spam and normal, predict loan defaults, autonomously drive, and play Go. The capacity of such systems for advanced problem solving, generally termed artificial intelligence (AI), is based on analytical models that generate predictions, rules, answers, recommendations, or similar outcomes. Analyses of 'big data', i.e., vast volumes of business-relevant data produced by social media, sensors, transactions, etc., to generate new insights, are also included in AI. However, traditional analytical model building requires prohibitive time, money, and effort. Consequently, demand, opportunity, and huge funding for intelligent services for automatically actionable insights from big data are unprecedentedly high. Over the last decade, research in ML from the 1960s to the early 2000s have gained prominence and a new life.



5.2. Natural Language Processing

An ontology-based cancer treatment support system, namely, COTDSS, that uses natural language processing (NLP) techniques to process and respond to queries in natural language, is proposed. The queries can be expressed in a structured way using clinical concepts and templates [4]. The COTDSS that is currently in use lacks the feature of being user-friendly. Users have to conduct queries in the formal way of an OWL query language using ontology concepts. The way to express queries accessible to users can be improved as most people are accustomed to using natural language as their communication language. However, most databases nowadays are built in a formal approach and, therefore, provide an expensive legacy of manually encoding the knowledge in the input format. An additional effort for knowledge acquisition and preprocessing is thus necessary. Natural language

applications are becoming popular and needed by many people, especially the laypeople who struggle to ask questions using a formal language. In clinical domains, laypeople cannot obtain knowledge regarding clinical processes from existing, inadequate medical databases. This work focuses on researching the problem of classification and diagnosis, and an ontology-based cancer treatment decision support system, namely, COTDSS, is proposed to handle queries from laypeople regarding classifications of clinical problems that may occur for breast cancer patients and provide corresponding treatment solution recommendations using case-based reasoning. Natural Language Processing (NLP) is a powerful technology for information retrieval and knowledge discovery [5]. It attempts to have machines manipulate human language as speakers and listeners do and has broad applications, ranging from research in artificial intelligence and linguistics to commercial applications in language translation, intelligent databases, and automated information retrieval systems. Natural language processing (NLP) is a set of computational techniques for analyzing and representing naturally occurring texts at one or more levels of linguistic analysis. The goal of NLP systems is to process text the same way humans do, extracting meaning at different levels from the lexical, to the syntactic, to thematic/structural, to the pragmatic. To accomplish such goals in practical applications, NLP must be tailored to specific tasks.

5.3. Expert Systems

Expert Systems (ES) can be defined as “computer decision support systems that use knowledge base of human experts and an inference engine to solve problems that would otherwise require human expertise” [2]. Its applications available in almost all fields include but are not limited to: Safety Nets for Weight and Fare Checking Automatons in Manufacturing Sector, Career Counseling for Students, Medical Decision and Prediction Systems, Management Information Systems, Game Show Controllers in Entertainment and Recreation, Forecasting Earthquakes in GeoPhysics. Since from its beginning period it found various applications in: Medical Prediction, Weather Forecasting, Recruiting System, Game Playing, Study Groups, Board Member of Stock Markets, Cruising Coordinates Calculation for Celestial Objects. Actually Expert System is computer decision support system that use knowledge base of human experts and an inference engine to solve problems that would otherwise require human expertise. The basic characteristic of expert systems is its ability to make decision on information which is nothing physical but stored in the memory of the system some its applications includes an automatically operated systems which per carry detailed calculations compare celebrative algorithms for answering turn and tilt of satellite up upon atlas flying 74. It can

tell the checking process of weight and fare assigning and verification process. Another task is to make committee on board of business houses based on profit loss transactions and projector relevant products. The governmental sector can ask such system to forecast next earthquakes on the basis of their size and impacts from previous huge shake ability categories.

5.4. Neural Networks

In terms of decision support problems, a neural network can be characterized as any multiple-criteria optimization task involving a number of alternative 3D alternatives, P18 bi-dimensional criteria, and weights. A neural network trained using the scaled conjugate gradient algorithm is used to find the weight of these criteria from the database of the DM and the evaluation of the alternatives is done using an artificially created problem. The performance of the neural network is finally measured by comparing its results with the ones obtained by an exhaustive search of the feasible domain, revealing some very interesting properties of this optimization tool. A neural network trained using the scaled conjugate gradient algorithm is beneficial because of its computational speed and robustness [6].

The decision-making (DM) process of an organization is an iterative process of choosing among alternative courses of action for solving complicated problems where multi-criteria objectives are involved. The DM process is a multi-dimensional problem where a hierarchy of subjective attributes is normally employed. Each attribute, in turn, is decomposed into a set of objective criteria. Decision Support Systems (DSS) using intelligent paradigms for solving multiple-criteria decision-making (MCDM) problems have already appeared in the literature. Here different SC paradigms involving an artificial neural network trained using the scaled conjugate gradient algorithm, fuzzy inference methods optimized using neural network learning/evolutionary algorithms, and regression trees for developing intelligent DSS are presented. A universal DSS is first presented, and the efficiency of the different algorithms is demonstrated by developing an intelligent DSS for a Tactical Air Combat Environment (TACE).

6. Benefits of AI in Decision Support Systems

AI methodologies have huge potential to address business decisions (decision support systems). Big data, predictive analysis, and data mining enhance decision performance . Decision support systems unfairly blocked gathering information independently: AI models are often considered black boxes with no formal assurance of high performance. Human judgment is crucial for catching many false positives produced by a decision support system. Decision support systems should behave

similar to other human coworkers and provide supporting information. Indirect nudging can be used to improve their decisions by providing statistically predictive cues. Therefore, organizations that adopted merely decision support systems but not explained artificial intelligence may machine learning error and statistical bias could cost clients abandoned and be mistrustful of future business with potential providers [1]. Intelligent Decision Support Systems require intelligent methodologies which should include decision models that explicitly exploit the domain knowledge. Intelligent methodologies are needed that could include knowledge management facilities, knowledge representation models, and decision-making methodologies to share knowledge among users. Knowledge management methodologies are being developed which could be used in Knowledge Based Decision Support Systems. These include health knowledge management applications, knowledge management models, knowledge retention and creation, knowledge-based decision support systems development methodologies, and educational knowledge management systems. Perceptions are developing and developing intelligent methodologies which exploit the debate knowledge discovered through knowledge extraction process in Decision Support Systems. Cognitive agents are intelligent computerized systems that can interactively collaborate with users in a virtual environment. They can simulate human reasoning and decision-making. Existed uncertainty models are used to handle uncertain information that may result from a fuzzy environment of unshaped matter. Uncertainty analysis methodologies are developed and developed hybrid methods that exploit KBS methodologies, uncertainty models, and data mining and modeling algorithms to maximize the logic over the implementation knowledge-based decision support systems. Intelligent Decision Support Systems, Intelligent Decision Support Systems are defined by far very different definitions.

7. Challenges in Implementing AI in Decision Support Systems

The growing complexity and sheer volume of information that organizations face demands more capable and flexible systems to support decision-making. These modern decision support systems (DSS) should enable high levels of user interaction with the model, encourage structured data acquisition and process documentation, assist in the identification of relevant data, include repositories for providing additional information, support the structuring of the decision process, and be responsive to users' needs . AI is primarily viewed as a means of automating decisions based on data patterns while having little involvement of users. In contrast, more advanced DSS are expected to assist decision-makers throughout the entire decision-making process, including problem specification and model design (or adjustment). As such, they need to balance between conveying

scientific knowledge and being transparent, on the one hand, while also being capable of enfolding very complex, highly automated model recommendations, on the other. They would be beyond this spectrum with both low transparency and low recommendation. The design task for such an advanced and flexible decision support system (ADF-DSS) becomes very complex as many of the questions arise in a changing environment and only become relevant when a specific need is recognized.

A new class of AI-augmented decision support systems not only offer the potential of more accessible and more refined decision-making algorithms but also introduce a new range of challenges in data requirements, model-building methodology, maintenance, explainability, and interpretability. They may also give rise to fundamental ethical issues around autonomy and liability that previously were not applied at all or only indirectly relevant. Although design outcomes are unknown a priori, design decisions shape how these systems will be understood and how they will influence the institutions and societies in which they operate as new actors. In most organizations, the development of AI-augmented systems falls under the research and development (R&D) umbrella. To some extent, this reduces the jurisdiction of decision-makers involved in the governance of simpler DSS. However, decision alternatives and their net impact remain embedded in a complex socio-technical system that generates principal-agent problems. This leads to unintended and often detrimental consequences, including biased and discriminatory services and excesses in nudging efforts.

8. Case Studies of AI in Decision Support Systems

Decision support systems (DSS) of various types and natures have flourished over the last three decades. Covering a broad spectrum of boundaries, DSS need not bear any explicit intelligence behind them. Nonetheless, as is the case in most information technology applications, the capabilities of variety of cognizant and incidental tools are present commonly behind most DSS. This paper, therefore, offers an architectural framework for Intelligent Decision Support Systems (IDSS), which, through a Knowledge Management component, store and manage these emerging artificial intelligence tools [1]. Nevertheless, since merely possessing tools and technologies is of little utility, the role of IDSS in decision making is assessed in the context of what improves the quality of dependent decision making or supports decision makers in a traditional non-interfering sense. In order to augment decision making, a decision support system (DSS) or a knowledge-based support system (KBSS) needs to be defined. However, in the information technology age it is pertinent that any notion coined an intelligent DSS is grounded on more than common historical notions; hence, intelligence and IDSS are first characterized. It is posited to some extent in various terms and designs

at various levels, including knowledge acquisition, representation, storage, retrieval and reasoning. The merits of textual, pictorial, symbolic, numerical and graphically modeled information formats have been established. Information may also be perceived as fact, or knowledge, intrinsically or extrinsically. The development of knowledge management (KM) is traced, which has emerged as a vital discipline vis-à-vis a practical trend in human endeavor. The advent of the internet has changed the nature and focus of information systems from passive powerful systems to those attaching intelligence to the retrieval, processing and dispatcher functions. In order to aggregate these key features, knowledge management systems (KMS) are designed. In response to myriad environments, KMS need to either act or claim to act intelligently by handling incomplete, inconsistent, uncertain and trend/fact-ahead information. An intelligent knowledge-based DSS (KBDSS) is, however, a KMS that necessarily supports Decision Support Systems (DSS) .

8.1. Healthcare Applications

Among various sectors, healthcare is, undoubtedly, the most arduous and significant domain where AI technology-based decision support tools have started to intervene . In the recent two or three decades, artificial intelligence (AI) based clinical decision support systems (CDSS) have proliferated in the domain of healthcare, and digitalization and automation of the healthcare market through AI-based clinical decision support systems have been anticipated to be transformative. However, in view of various aspects of the healthcare delivery system, yet there remains a substantial gap in the development and implementation of AI-driven CDSS amid the exponential growth of healthcare data and the inopportune maturation of AI technology in recent years. On the other hand, the significant amount of medical data harvested by healthcare delivery systems provides promising fodder for the development of AI based CDSS to glean the hidden knowledge and facilitate timely and efficient patient management. Moreover, an appropriate adoption of AI-driven CDSS has the potential to reduce variation in decision-making and support world-class health services. Currently, AI technology drives many advanced decision support systems in healthcare systems to mitigate risks, augment decision-making, minimize diagnostic uncertainty, enhance workflow, etc. Foremost among these applications is recognizing the potential for AI-driven CDSS to enable timely pre-emptive intervention to reduce risks and improve patient outcomes. Moreover, in view of the unprecedented volumniousness of newly-arrived advanced therapeutic drugs and medical procedures/operations post-COVID-19 pandemic, the deployment of AI-based systems for comparative effectiveness research on various (new and existing) therapeutic options amid the

rapidly increasing amount of biomedical evidence is particularly warranted. More generally, AI techniques have demonstrated unmatched promise in the medical domain, and the rapid advancement and proliferation of AI-based healthcare decision support systems (DSS) and automatic healthcare advisory systems (AHAS) in healthcare, such as drug discovery and developing treatment plans for chronic diseases endowing personalized care, is envisaged in the coming circumstances. AI-driven DSS have the potential to supplant human review decision processes or inconspicuously provide decision justifications and action suggestions through transparency and efficaciously rectify counseling jitters. However, the extreme sensitivity of health-related decision support applications can pose substantial risk or harm to patients that have far-reaching long-lasting influences.

8.2. Financial Services

In recent years, most financial decisions have been driven by a large number of quantitative factors and an international background, which is more complex than in previous decades. To assist the financial decision support system (FDSS) in its decision-making process, automatically obtaining knowledge and taking advantage of the continuously accumulated knowledge output, it is essential that organizations express knowledge in detail for the FDSS to reason, interact, update, and monitor the models. By modeling them explicitly, the knowledge component of the FDSS can be reused easily, and the FDSS can become more autonomous or intelligent. Additionally, at present, financial decision-making involves both qualitative factors, such as human sentiments and speculative analysis, and quantitative factors, such as financial ratios and stock price trends. It makes more sense to analyze qualitative data mining than quantitative data mining in the current information age. Existing FDSSs attempt either to represent numerical indexes only or to set a fuzzy surface to quantify qualitative factors through numerical indexes. As a result, the quantitative indexes available in the FDSS are insufficient for knowledge representation.

Financial decision analysis is concerned with the decision, planning, and consulting of corporate finance, such as capital budgeting, project evaluation, portfolio selection, and M&A. Decision Support Systems (DSSs) have been widely adopted in the financial services industry for more powerful and effective decision analyses. However, conventional financial DSSs cannot handle the sophisticated decision models and vast databases that are needed. The development of Intelligent Financial Decision Support Systems (IFDSSs) based on Artificial Intelligence is surveyed. AI-based technologies such as knowledge engineering and neural computing provide powerful tools for the design and development of the IFDSSs.

8.3. Supply Chain Management

Supply chain management (SCM) consists of the planning and management of various activities involved in the procurement, sourcing, conversion, and logistics. It also includes the integration of these activities. It is a complex process involving multiple factors and requires careful planning and coordination among suppliers. Meanwhile, technical and managerial best practices and information technology must also be leveraged. The goal is to provide superior customer value and graded product quality while ensuring operational efficiency at the lowest total cost possible.

AI is an integral part of many supply chain systems that are implemented today, particularly those based on recent advances in technologies such as big data, cloud computing, and the Internet of Things (IoT). These connected applications collect and exchange huge amounts of data on a continuous basis. However, the formal identification of AI use in a definitive manner and its potential role in improving the technical and managerial performance of a company's supply chains can provide a meaningful contribution to the existing body of knowledge on public policy, competitive strategy, and government research funding, as well as the operational implementation of SCM. Moreover, to establish and communicate a state-of-the-art understanding of the applicability of AI in supporting organizations' supply chains that would facilitate development efforts involving public and private partnerships, and to identify routes for further basic and applied research could provide a significant contribution to debates on better educational programs and systems.

There are major techniques that can be considered prevalent in the literature. ANNs, FL, ABSs, data mining, and other forms of AI are the most popular forms of AI used in studies of SCM. Some well-established studies in this area of research capitalize on the advantages of the simulation capabilities of agent-based systems (ABSs) to convert behavioral and managerial variables for a coherent representation of different actors in a supply chain. However, such studies are rather few in number and typically associated with modeling some specific aspect of industry supply chain processes or consumer behavior on the Internet. A noticeable gap exists for more complex agent-based representation of execution and planning systems of continuous processes and models for various demand and supply conditions.

9. Ethical Considerations

The widespread use of AI raises important ethical considerations, challenges, and questions that must be addressed in the development of AI-enabled DSSs. AI holds great promise for enhancing decision-making, supporting and augmenting human without replacing them, and improving business

models in numerous settings, including, most importantly, health care . For instance, AI that personalizes training and consultative planning, assists radiologists with detecting breast cancer, and enhances security screening of luggage at airports all add new capability and analytic depth to decisions, duties, and tasks that had been performed manually, based solely on experience and human acumen for decades or centuries.

Scholars developed interest in investigating AI's ethical considerations in general and in AIS more specifically as AI addressed pressing business, management, and medical problems. There has been debate over AI's ethicality. Some believe that the ethical aspects of AI-enabled DSSs and decision-making lie with the technology, while others emphasize that AI, like accounting systems and other artifacts, is apolitical. Scholars proposed frameworks to identify and classify ethical issues based on the perspective taken, e.g., as an IS artifact, a representation of the decision, or a 'malicious' entity. Focusing on context, researchers catalogued AI issues and their maps, from intentional misrepresentation of an AI-enabled DSS, and all possible social ramifications. Several researchers stressed the importance of explicating AI's decisions to users and assessing its inputs, training, and reliability.

DSS research considered ethics since its inception but not AI ethics. DSS scholars published several key articles on the ethics of computer-based decision support systems, including the importance of taking into account ethical issues in the design and to consider the ethical implications of supporting morally important decisions. Most importantly, researchers highlighted the potential harm of empowered actors whose choice might lead to negative societal impact and suggested mechanisms to discourage migration from automated to manual modes to avoid the consequences of unethical decisions. Yet, ethics did not play a major role in topic coverage. Key ethical issues raised decades ago are just as relevant today but could not be analyzed in the context of AI-enabled DSSs owing to the limited capabilities and adoption of algorithms. Clearly AI-enabled DSSs pose ethical challenges to all its stakeholders, including users, decision-makers, developers, and societies at large.

10. Future Trends in AI and Decision Support Systems

Artificial Intelligence and Decision Support Systems have been in relation to each other for a long time. Initially, AI technologies were born as algorithms for solving decision problems. On the one side, Decision Support Systems of all variations developed as proposed solutions for supporting decision-makers in their daily tasks. On the other side, it was clear from the very beginning that it might not be enough to just provide an answer or recommendation to a decision-maker but instead, it

would be crucial to clearly explain the underlying assumptions and show the rationale for how the recommendation or answer was derived, if at all .

Recent years have seen a rapid change in AI algorithms due to the great advances in computing capabilities as well as enormous amounts of data becoming available. As a consequence, attention on understanding how and why AI decisions are made, and to what extent these decisions can be applied in which scenarios, has increased too . Several concepts for classifying and implementing Explainable Artificial Intelligence are available, but so far they do not consider how these explanations might be included in Decision Support Systems. Since in the meantime both AI and Decision Support Systems have seen so many new developments and have diverged a lot, it is time to bring both streams of research back together and to design this vital future development on the basis of knowledge accumulated so far.

With this article, the authors will analyze the state-of-the-art AI in Decision Support Systems regarding the recent development as well as the challenges uncertainty and black-box character in AI leaves. Additionally, a new class of decision support systems is proposed that is enhanced by machine learning-based modeling techniques to provide explanatory black-box models instead of a prediction based on these models. Although the explanation is already a major topic in AI research, including neural symbolic AI, knowledge representation and reasoning, as well as game theoretical explanations, many challenges remain. Many of these challenges arise from the very nature of inconsistent (data-driven) knowledge.

11. Evaluation Metrics for Decision Support Systems

Evaluation of clinical decision support systems (CDSSs), an important application of artificial intelligence (AI), has attracted increasing attention in the last few decades. Although a variety of evaluation metrics are available for CDSSs, there is still an urgent need to explore the evaluation literature and conduct academic consensus to summarize well-defined CDSS success factors and metrics comprehensively. The initial literature analysis highlights success metrics for AI-enabled CDSSs with decision, process, and outcome categories emphasized in mixed methods research. Regarding decision measures, decision change is proposed as a novel evaluation metric for AI-enabled CDSSs, which detects the decision inconsistency on a specific task between the system and user. Consequently, measuring user decision change is more straightforward than measuring appropriate decisions because 1) it focuses on a between-group difference rather than on a within-group difference, and 2) decision inconsistency can often be identified using guidelines while

appropriate decisions are often hard to define. Process measures mainly cover the individual, group, or organization levels of performance improvement. Many individual-level performance measures have been adopted in CDSS evaluations, which typically require users' subjective perceptions to assess their knowledge, skills, confidence, or work efficiency. Group or organization-level measures focus on group-level knowledge improvement or organization-wide health care quality improvement, which provides useful indicators for evaluating CDSS implementations for a whole department or even a whole hospital. Due to their complicated constructions, outcome measures tend to be complicated indicators of AI-enabled CDSS success, which often fail to be objective in clinical settings. Beneficial patient outcomes from AI-enabled CDSS implementations are the biggest concern for all stakeholders, but a few high-quality evidence of outcome measures can be found for CDSS evaluation in the literature. On the contrary, it is valuable to evaluate clinicians' attitude toward perceived benefit for patients that can be obtained from specific AI-enabled CDSS implementations under the health care contexts when objective measures are difficult to qualify.

12. User Interface Design in Decision Support Systems

Providing easy to use human computer interfaces for DSS has always been one of the major concerns for designers and developers of DSS. User interface is the means that facilitate the interaction and communication between the user and DSS. If the interface cannot express information effectively, if it is too difficult for the user to use the system, and if it does not satisfy the user's needs, it is virtually impossible for the DSS to be successful. DSS testers and evaluators usually analyze the screen design against fundamental criteria such as consistency, clarity, understandability, conciseness, relevance and manageability in addition to adherence to design standards and rules.

DSS user interface can take a number of forms, ranging from a simple text interface to a complex, graphic rich multimedia interface. These interface types can also be classified into basic types or modes that must be supported by any decent user interface. These include screen design, command input, feedback presentation, and mechanism for user intelligence acquisition. Important issues there include interface type, interface device and mechanism, screen format, input language, construct design, output language, and output format, all of which are crucial to the development of any user interface.

Graphic Presentation Displays generated by selection are usually made up of a two-dimensional collection of images. The number of directives that can be issued compilation should be limited, otherwise DSSs with too much complexity would be generated and the user himself would have to

resort to some kind of categorization or other devices to sort through the available alternatives for his purpose.

Graphical Previews In a not very usual series of actions some DSS provide previews, summary comments or analysis results that are generated along the assembly process. On the other hand, requirements on the speed of re-execution or re-display grow accordingly. In daily inquiries handling or quick tenders the analyses should be prepared in seconds.

Just-In-Time Compilation A DSS should allow any item involved in the inquiry or tender preparation getting accessible in an arbitrary point of the process as a minimum. Preferably the added tender items etc. should be highlighted and kept in focus on the screen display for improving visibility. The recently added items should have an option to be sent to the front of the DSS. The user should be provided with that or any summary remarks on these items or the entire large sets, preferably displayed or highlighted in readable (compressed) form.

13. Training and Implementation Strategies

Decision support systems (DSS) are powerful computer-based tools that aid in decision-making processes. DSS architects and developers must consider both the design of the underlying models and the methods in which DSS will be used. If these two components are poorly designed, DSS may be untrustworthy or difficult to use. This charge is not new: as systems entered use, they were often dominated by such issues, and researchers and practitioners began to turn their attention to these issues as well. The design and implementation of DSS in these areas focuses on the modeling process and user involvement. Advances in this technology will have little impact on the uptake of DSS. AI in DSS requires either the development of new decision-making models or enhancements to existing models to facilitate the incorporation of AI knowledge with conventional models. Since design modeling often involves knowledge-intensive model construction or large amounts of numerical data, it should be the main focus of this effort. While this approach will enhance pre-existing computer tools, it is also necessary to provide new types of tools focused within the modeling process.

A knowledge-based DSS is defined as a DSS that incorporates AI techniques as part of its methodology. Such a definition raises the broader question of how to classify and categorize DSS. DSS has been categorized with respect to different dimensions, including purpose, data, and processing technology. Most of these classifiers relate to the overall design of the DSS, focusing on the source data input, outcome, characteristics, and processing techniques. Though the methodological aspects of DSS construction have received some attention, a comprehensive

framework with respect to the DSS development process has not yet been presented.

With respect to implementation issues, most research has devoted attention to user and group facilitation issues. Although AI has been claimed to increase the complexity of the DSS and therefore user skill requirements, this claim has not been empirically verified. There is an increasing concern among researchers about the ethical and social implications of AI technology. The media's treatment of AI applications is fragmentary and subject to dramatic changes. Differences among industries, organizations, and individuals lead to varying degrees of technological sensitivity and vigorously divergent perspectives about the nature, challenges, and effects of the technology on jobs, decision-making, and society at large. The purchase of a DSS is often the result of a complicated bargaining process within the overall technology purchasing process. How the components of DSS co-evolve or integrate is as crucial as implementation.

14. Impact of Big Data on Decision Support Systems

Adoption of artificial intelligence (AI) methods, instead of manually constructed formal knowledge representations, in decision support systems (DSSs) in-depth analysis of the latest literature contributions to clinical DSSs, highlighting novel methodologies, and more recently approached challenges concerning transparency and explainability of AI . Likewise, some DSSs based on the term “Intelligent Decision Support Systems” (IDSS). These systems include, in addition to a DSS, domain knowledge, modeling, and analysis systems that profoundly improve decision making and are known as IDSS [1]. Seven broad domains of DSS are identified. On top of this foundation, the IDSS framework is described, which includes a knowledge management component detailing the various types of knowledge IDSS need to store and manage the AI, data, and models to be used on this knowledge. Finally, purposes of knowledge in IDSS, types of knowledge integration processes needed, and technologies and tools supporting these processes are detailed.

IDSS are being increasingly adopted in various application areas, including transportation, logistics, environmental management, and medicine. One of the important features of IDSS is the inclusion of a knowledge management (KM) component that stores and manages AI, or machine learning, tools. These tools are needed to extract knowledge from previous data and decisions to support very complex and mostly real-time decision making processes. Given this situations, system integrity, product quality, and plant safety. Recent advances in computational intelligence and data mining tools have made possible the quantitative extraction of knowledge from data of unprecedented volume and complexity. This paper explores the role of IDSS in decision making,

provides a definition of DSS, and illustrates the IDSS framework, including the supporting tools and technologies.

15. Regulatory and Compliance Issues

AI has been widely used across many domains and industries in recent years. On enterprises' side, the performance guidance tasks of data science (i.e.: predictions and insights of numeric value variables from predictor variables and qualitative variables) have seen an increasing application of AI. Using AI in the decision support systems (DSS) also requires careful consideration of important regulatory and compliance issues, barriers, limits, risks, conduct, and controls in order to ensure that such AI-powered DSS do not infringe upon any rules while functioning well in business processes [17]. This section introduces key themes that are relevant to the concerns of governance and accountability of AI-powered DSS.

Governance Agencies deal with the governance of AI-related technologies to ensure that they embody appropriate ethical considerations and comply with existing laws and regulations. The primary governance approach consists of one or several dedicated regulators that assess, approve, and monitor AI technologies before, during, and after their deployment. In the conduct-based approach, the rules cannot be complete and exhaustive, as such would restrict innovation and is practically infeasible due to the potentially vast and intricate behaviors that AI technologies could exhibit. Instead, AI governance would vary according to a set of ethical principles, and actors would have the freedom to design governance standards based on these principles. In this case, multiple actors would be responsible for the governance of AI technologies. They could work independently, and norms or rules would need to be enforced across jurisdictions due to the mobility of AI-powered technologies.

16. Cross-Disciplinary Approaches

Despite its relative novelty, artificial intelligence (AI) is already widely used in typical decision support systems (DSSs). Several AI-based medical diagnosis systems are designed to assist doctors in their diagnoses. Automatically retrieved and stored data, accompanied by the output from AI-based systems, mostly populate electronic health record systems. But AI may also automatically generate treatment proposals based on predefined standard operating procedures, after assessing the current clinical situation using only the available documentation. A set of automatic proposals is then ranked by their expected effectiveness.

As the debate over the appropriate use of the term "DSS" in conjunction with AI-driven systems shows, there is still no general consensus on these systems' nomenclature. A well-founded definition

of terms and concepts would provide a better basis for exploring the scientific and practical implications of one's investigation. Deep learning and automated reasoning approaches—though sometimes highly regarded—are essential for decision support but not sufficient for that purpose. Hence "AI DSS" was defined as a term that encompasses those systems that leverage AI. This implies that some systems may fall short of that definition because they neither ingest data to create internal models nor utilize those models in decision processes.

Within that scope, similar to conventional DSSs, AI-based ones come in different sorts and circumstances. In particular, they differ according to the prominent "sense," which ranges from cognitively passive ones that only observe the environment and report back their findings to entirely active ones that act on their own to alter the states of the environment in varying modalities . Some AI-based DSSs have a working and an achieved model. The former is usually obtained from a human or a set of humans gradually developing a mental representation of the decision processes on the basis of the decisions that are deemed good or bad. The latter involves the synthetic creation—based on a sculpted model—of an internal representation of the decision processes using iteration.

17. Conclusion

The use of Artificial Intelligence (AI) to build Decision Support Systems (DSS) across many domains ranging from social media applications and online marketplaces to cloud resource provisioning and radiology diagnosis is growing rapidly. Such systems can provide very strategic recommendations of great economic value, but there is significant public concern around their potential to perpetuate potential harms. This paper reports on a series of human-subject experiments designed to observe human response to different characteristics of a DSS such as accuracy and bias. In a user study, participants acted as market makers in an auction for a resource, and completed a set of these in a fixed amount of time. Participants in the control group played the game without receiving any assistance, while in treatment groups they were assisted by a DSS suggesting places to drill. For certain treatments, the DSS did not consider costs, but only rewards, leading to a bias that was observable by users. Between subjects, we varied the accuracy and bias of the DSS, and observed the participants' total score, time to completion, the extent to which they choose to follow or ignore suggestions, and how participant response varied with the independence of the proposed and executed actions. Most participants scored better with the DSS than without it, and the score increase was due to users following the DSS advice more than in the control group, and related to the difficulty of the game and the accuracy of the DSS .

Participants followed the DSS advice most of the time, but exhibited some algorithmic aversion, automation bias, and follow-up adaptation, all of which varied with the treatment group. There was little evidence of a system rebound effect or human inability to respond to lack of guidance, and the same factors that drove DSS follow-up also drove user choice to ignore. Overall, this study is a promising start to empirically characterizing human response across the space of DSS design choices, and lays the groundwork for future research to explore this wider parameter space. AI is being increasingly integrated into human decision-making across many domains, with a growing body of research examining both human trust in and reliance on AI. However, there are emergent concerns that these systems could perpetuate the ills they were designed to cure, leading to public skepticism around the implementation of these systems.

Based on past work in algorithmic aversion, automation bias, and algorithmic post-hoc explanations, each with known human behavioral strategies that temper their effects, this study investigates human reaction to both the accuracy of AI and its fitness for purpose (as measured by a combined notion of bias). A simple game with exploitable structures was designed within the framework of market-making for an auction system, which shares many key elements with contemporary decision-support systems. An AI DSS was built to algorithmically suggest actions based on estimated unknown rewards that were imperfectly observed, creating a bayesian setting in which advisement could be accurate and biased. A large, incentivized human-subject study was designed, including a control group and treatments where participants were assigned an AI DSS with varying advice accuracy and bias.

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Impact of Mergers and Acquisitions on Efficiency - Evidence from Indian Commercial Banks

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ABSTRACT

Several changes have been made in global banking sector over the past decades with mergers and acquisitions. Like any other business entity, banks also need their protection against financial risks and use all the opportunities available in the market. Mergers and acquisitions have been rising over the years in banking sector both in India and across the world. Banks can get competitive strength only through mergers and acquisitions locally and internationally as a lot of industries are making strategic partnerships in India and worldwide.

To deal with unhealthy competition in banking sector and to achieve economies of scale, mergers and acquisitions have emerged as competitive force in global economy. “Mergers and acquisitions of commercial banks in India” are some of the strategies to survive and thrive in this economy. In light of rising M&A trends in banking industry, this study focuses on key issues and trends related to commercial banks and “impact of M&A on efficiency of banks”. This study is aimed to highlight the motivation behind M&A in Indian banks since liberalization. This way, this research highlights the present scenario of Indian banking mergers and some important recommendations.

Keywords: mergers and acquisitions, M&A, global economy, banking sector, commercial banks, M&A trends, Indian banks

INTRODUCTION

Banking system in India has definitely earned a lot of great achievements in such a short time for the most diverse and largest democracy in the world. The reform of banking industry is the part of strategies made by the government to restore banking sector in India and align the same with global financial system. Indian banking sector has made a lot of reforms along with some of the successful M&A activities, which helped it to grow in different ways. Mergers and acquisitions are most popular strategy used to maintain and boost positions of firms in the market. Mergers and acquisitions are considered to be quite efficient and instant way to expand position into new markets and add new technologies (Liargovas & Repousis, 2011).

Merger refers to a consolidation of multiple firms in which the buying firm absorbs the assets and liabilities of selling firm(s). Even though the acquiring firm may be significantly different after the merger, it holds its true presence. Meanwhile, acquisition refers to the event when a firm acquires most or all the shares of another company to control that. Acquirer can make decisions related to new assets without shareholders' approval by acquiring over 50% of stocks of the target firm and other assets (Khan, 2020).

BACKGROUND

According to the RBI, 5743 frauds had been reported by "public sector banks (PSBs) from April 1, 2019 to September 30, 2019 amounting to Rs. 95,760.49 crores, to be precise. PSBs have uneven share of 85%, which drastically exceeded their qualified business share (Vidhisastras, 2020). An initial investigation was conducted and it, prima facie, revealed that not just mid-level employees, but also seniormost management employees were involved because of "pro-corporate" attitude of policymakers and political interference. High levels of "non-performing assets (NPAs)" have plagued the banking system as they exposed financial distress of borrowers like Dewan Housing, Vijay Mallya, Nirav Modi, etc. as well as inefficient banking mechanisms.

India ranked 10th among the largest global economies in 2018, with highest "bad loan ratio" followed by Italy. Lenders controlled by the government are reportedly holding over 90% of those NPAs. "IDBI Bank Ltd, Bank of Baroda, Central Bank of India, and Oriental Bank of Commerce" are the four public sector units which incurred the losses of Rs. 21,646.38 crores by March 31, 2018, causing merger of these banks by the government. Forced bank mergers were

observed due to these devastating situations (Vidhisastras, 2020).

Consolidation of those banks is the main agenda for M&A in order to reduce NPAs and bad loans accumulating eventually to boost financial growth, upgrade technology, and achieve economies of scale. It also gains a lot of new customers quickly. Along with giving more capital to work with, acquisition provides banks with larger geographical access to untapped areas to operate, in terms of investments and lending. The PSBs have been witnessing significant mergers and acquisitions in recent years. M&A helps firms to scale up faster and gain more new customers quickly (Gomes et al., 2012).

Along with giving more capital to work with, acquisition provides larger geographic footprint to operate in terms of lending and investments. Mergers may be an alarming challenge for economy of India if it goes above the edge. Even though, the consolidation has resulted unexpected rise in concentration of bank in the market and it may impact competition in banking sector. The sudden rise in bad debts and NPAs has affected its position worldwide. The government must strongly control the existing "Anti-Competitive Consolidations" and dominance in industry.

LITERATURE REVIEW

On the basis of firm-level panel information in Chinese electric and energy industries from 2007 to 2018, Shen et al. (2021) adopted "panel data of OLS regression model" to conduct empirical study on the effect of "geopolitical risk (GPR)" on "mergers and acquisitions (M&A)". It is observed that GPR promotes mergers and acquisitions significantly and GPR has a significant positive impact on mergers and acquisitions with possible systems of potential synergy effect and "real option." They further inferred that "ownership property" and "debt ratio" further attenuate positive "impact of geopolitical risk on mergers and acquisitions".

Sha et al. (2020) examined the relation between "M&As" and "economic policy uncertainty" in China. With all the listed organizations in "Shenzhen and Shanghai Stock Exchanges" along with 4188 mergers and acquisitions from 2001 to 2018, they found that Chinese companies are more likely to acquire other firms during high uncertainty of economic policy, which contradicts US firms' behaviour. It is observed that "state-owned enterprises (SOEs)" are not much likely to engage in M&A deals than non-SOEs during high uncertainty. During that

uncertainty, SOEs are not much likely to engage in acquisitions using only cash.

"Tampakoudis & Anagnostopoulou (2020)" explored the impact of M&A on "environmental, social, and governance (ESG)" performance and market value of EU business acquirers. They used a sample of 100 mergers and acquisitions in European Union from 2003 to 2017 for which matching data of both acquiring and target firms are accessed on ESG performance. It is found that there is a rise of "post-merger ESG performance of acquirer firms" after acquiring the target firms with "higher ESG performance than acquirer" before merger, while the market value of acquirer after merger is increased after the rise in "post-merger ESG performance of acquirer." Finally, they provided partial evidence of positive relation between market value after "merger of acquirer and acquisition of target showing higher ESG performance."

Technological advancement with cross-border M&As over the past 3 decades has grabbed the attention of policymakers in business practice and research. The increasing studies on this topic focuses on a specific phenomenon but it doesn't have cumulative empirical inquiry and theoretical underpinning in terms of micro-foundational perspective. So, "Christofi et al. (2019)" conducted a systematic review on increased technological innovation with M&As globally through a "micro- foundational perspective". They identified various contextual, theoretical, and methodological problems that should be addressed.

Renneboog & Vansteenkiste (2019) gives an insight to academic literature for corporate control on the market and focuses majorly on performance of firms after the takeover. Irrespective of aggregate mergers and acquisitions market valuing several trillions of dollars every year, acquiring firms usually not perform well in comparison to their non-acquiring counterparts, especially in terms of public takeovers. A lot of academic studies have tested the firm- and deal-level factors related to returns from M&A announcements, short-term returns are usually not continued for the long term.

RESEARCH GAP

There are plenty of studies conducted on mergers and acquisitions of different types of firms across the world. There is still a knowledge gap in Indian context when it comes to mergers between commercial banks. This study is an attempt to fill this gap and provide important knowledge about recent mergers and acquisition trends in India.

RESEARCH QUESTIONS

- What are the "recent trends of mergers and acquisitions in banking sector in India"?
- What is the "effect of mergers and acquisitions on banking efficiency"?
- What to consider before merging with other banks?

RESEARCH OBJECTIVES

- To assess recent trends related to mergers and acquisitions in Indian banking sector
- To investigate the impact of mergers and acquisitions on banking efficiency
- To suggest important aspects to consider for decision-makers regarding mergers and acquisitions

RESEARCH METHODOLOGY

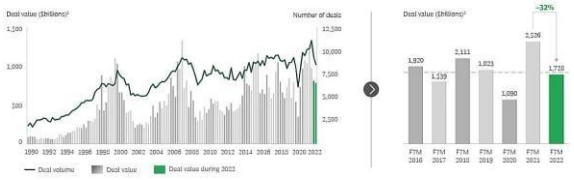
This study is based on bibliometric analysis approach, which is usually applicable to knowledge areas which are vital and useful to understand the dynamics and helps to visualize existing industry trends (Chain et al., 2019). Literature review was conducted for this study to give a panoramic view on the pattern of mergers and acquisitions both in Indian and global contexts. Secondary data has been collected for this study from decisions, results, and discussions of authors who conducted similar studies on mergers and acquisitions published in peer-reviewed journals and databases like Scopus, Google Scholar, Research Gate, etc.

ANALYSIS OF STUDY

RECENT TRENDS OF MERGERS AND ACQUISITIONS IN BANKING SECTOR IN INDIA

Global mergers and acquisitions have faced significant challenges in 2022, especially due to aftereffects of geopolitical conflicts by war situations in Ukraine, skyrocketing prices of oil in international markets, risk of recession in Europe, the US, and China, inflation, and funding winter due to uncertainty of recession. Various industries have seen constant layoffs, shutdowns, and salary freezes, which caused fear among stakeholders across the world. There was a 13% drop in volume of global M&A deals within the Q1 and Q2 of 2022, in comparison to first few months of 2021, apart from a subsequent decline of 32% in deal value (Kengelbach, 2022). There has been the biggest drop in "year-over-year percentage" in total deal value globally in 2022 after two decades (2).

Figure 1 – Global M&A Activities declined in 2022



Source – Kengelbach (2022)

Irrespective of those negative trends, experts are still optimistic towards the rise in deal momentum in 2023 (Broughton, 2023). Surprisingly, India has seen a record of $152 billion for M&A deals amidst fear in 2022 (Roy, 2022). In terms of banking sector, the "merger between HDFC Bank and HDFC Ltd" was one of those expensive deals in 2022 (Shah, 2022). Hence, it wouldn't be wrong to say that the future of mergers and acquisitions in India is safe and will play a vital role in economic growth of the country. With that said, here are some of the recent trends related to mergers and acquisitions in India along with major legal and commercial developments -

Increasing governance and activism of shareholders

There has been a marked rise in board governance and activism of shareholders in India in recent years. Minority and retail shareholders have been more aware of their rights ahead of institutional investors in Indian firms. Stakeholders have been more aware of their remedies and authorities as per "Indian company law, which may have long-term implications" on deals related to M&As in India. Shareholders are protected against mismanagement and oppression as per "Section 241 of the Indian Companies Act, 2013". These concerns might form key discussions among potential targets and acquirers while having transactions.

Revival of IPO markets

Despite the decline in M&A activities in 2022, Indian market is most likely to restore for "Initial Public Offerings (IPOs)" in 2023 (Anand, 2022). There are two reasons behind this development

– (1) Gradual growth in participation of retail investors in IPOs in the country (Mascarenhas, 2022) and (2) Rise in listing approvals by the "Securities and Exchange Board of India (SEBI)" to firms, i.e., with the rise of IPO market of around Rs. 57,000 crores in previous year (Singh, 2022).

General Elections in 2024

When there is only one year left for the upcoming general elections, it is vital to discuss how the last quarter of 2023 might affect M&A deals which are scheduled,

especially considering the fact that "deal-making is a long-term process. During the months after Q3 of 2023, deals might be slowed down, especially due to uncertainty related to future government. In addition, administrative and judicial machinery might not be working smoothly, causing a delay in granting approvals and pronouncing judgments.

Rise in Overseas Acquisitions by Indian banks

With the enactment of "OI Rules" or the "Foreign Exchange Management (Overseas Investment) Directions, 2022" the RBI and Government of India have repaired the Indian regime in August 2022 related to foreign investments made by Indian firms. Though the "OI Regime" is blatantly different from the predecessor, i.e., the "Foreign Exchange Management (Transfer or Issue of any Foreign Security) Regulations, 2004", it has been signalled as a liberal development for its measures to make M&A deals easier in India, according to stakeholders (Dolzer et al., 2022). The major characteristic of this "OI Regime" is that it enables companies offering non-financial services to invest in foreign companies offering financial services overseas automatically, which means "non-financial services organization" in India can generate profits.

IMPACT OF MERGERS AND ACQUISTIONS ON BANKING EFFICIENCY

Mergers and acquisitions are the most popular strategy for corporate restructuring adopted by the companies worldwide. There are several studies on the phenomenon of merger, given the rising trends of mergers and acquisitions (Boateng et al., 2011). Mergers and acquisitions and reorganizations are important for the overall growth of an organization (Gao & Kling, 2008). Despite the rise in number of mergers taking place all around, it is also important to discuss the success rate of mergers and acquisitions at the same time. Corporate mergers are environmentally bound to a large extent like other businesses (Cooke, 1991).

When a merger takes place, it leads to change in the market structure and policies. Even without any gain in efficiency, banks have incentive to merge with flexible policies (Fikru & Lahiri, 2013). Merger is affected by a lot of financial and strategic goals (Kalra et al., 2013). Success of any merger activity relies on the motives and realization in the long term. Mergers and acquisitions are mostly considered for geographical expansion, acquiring customers, and diversification. A merger manages competition by several firms

in the industry with consolidation (Ladha, 2017). There could be any motive behind merger, but it is important to determine the effect of merger on the firm which is acquiring.

This impact would determine the failure or success of the merger and it takes a lot of time to acquire a firm. This herculean task needs a lot of time, energy, and funds. Since stakes are high and huge cost is involved, success of the merger is very important for the management. Decision- makers need to measure the accounting performance of the firm which is acquiring another firm to analyse the impact. Researchers have explored this domain widely across the world and found various conclusions. The failure or success of a merger is a matter of debate among academicians and practitioners (Bhaskar et al., 2012).

Indian companies are going through a tough competition because of the rise of globalization over the past decade. Companies are adopting a lot of strategies to make a prominent position in this age of competition. Merger and acquisition are a way to retain or regain the market share of the company. The process of merger starts on the basis of multiple analyses to identify opportunities and risks, strength and industry position, as well as competitive positioning of target firm in the market (Caiazza & Volpe, 2015). M&A is an inorganic approach to grow a business. In a way, organic growth is time-bound and takes a long time, while inorganic growth is a shortcut to growth (Bi, 2016)". Even though every merger is aimed to boost accounting efficiency, every merger cannot achieve its goals. To acquire important resources or access new markets, managers have to handle the overall risks of investments and secure shareholder investments (Dell'Acqua et al., 2018).

IMPORTANT ASPECTS TO CONSIDER REGARDING MERGERS AND ACQUISITIONS

There has been a significant growth in deals related to corporate restructuring in India after liberalization in 1990s. It has been because of growth of competition with overseas companies due to opening of economy, technological advancements for added transparency, lower bureaucratic barrier to ease corporate control, and lower transaction costs across the whole business cycle. M&A have been the most important part of "corporate restructuring" due to several reasons. Corporate goals of M&A consist of achieving more market strength, access to core competencies, while controlling

the risks associated with the growth of new service or product, reshaping competitive scope of the firm, and increasing competence through "economies of scale" (Hitt et al., 2006).

There could be several reasons behind failed mergers, such as high acquisition cost, wrong selection of target, lack of forecasts, cultural differences, etc. No matter what the reasons are, the impact of failure would be seen in accounting performance. In case motives of merger are fulfilled, its impact would be reflected in financial records. A lot of studies have been conducted on post- merger accounting performance of banks. It is found that merger has been successful with significant improvements in accounting measures. There are also several cases when mergers were not successful and it had significantly affected accounting performance. Opinions of researchers vary on the effect of merger on firm. Both the measures to determine post-merger performance and results were contradictory.

In order to determine the success of corporate merger, accounting performance should be considered by decision-makers. External investors are more valuable for disclosure by the firms as they wouldn't want to disclose any misguiding details if they were complying with governance standards (Song, 2015). Another common measure that decision-makers should consider to evaluate economic performance of the firm are earnings reported by the firm on the basis of accounting standards, which are also considered by stakeholders and market players when it comes to make financial decisions (Lee & Choi, 2016). Financial reporting and accounting are very important for capital market in information economics (Chen et al, 2001). Accounting performance also affects managerial behaviour of the organization (Li et al., 2018). Accounting details can reduce asymmetry in information between contracting parties and it is vital in capital markets (Hu et al., 2014).

RESULTS

Banking sector is explored widely in several studies in terms of impact of M&A activities on economic performance of banks acquiring other banks. It is possibly because of a huge volume of transactions related to M&A in banking sector. Successful merger can be helpful for banks to climb the success ladder quickly (Trivedi, 2013). There are several benefits for banks like scope, size, improved top-line and bottom line, and economies of scale. Mergers have a lot of synergistic benefits

for banks. There are different motives of merger for banks like achieving more customers and geographic expansions.

A lot of studies have evaluated the effect of merger on acquiring firm's economic performance. For example, Healy et al. (1992) determined the cash flow of acquiring companies after merger. They conducted a study on the sample of 50 leading mergers in the US from 1979 to 1984. It is observed that merged businesses achieved significant growth in terms of asset productivity, which had led to higher returns in operating cash flow. There have been strong improvements for the companies when it comes to overlap businesses. There are two types of mergers, such as financial and strategic. Substantial profits had been achieved by acquirers with strategic mergers (Healy et al., 1997).

Capron (1999) conducted a study on 253 acquisitions by American and European firms from 1988 to 1992. It is inferred that both "resource deployment" and "asset divestiture" can play a vital role in acquisition performance. A vast number of acquisitions were observed by Heron & Lie (2002) from 1985 to 1997 and observed that acquiring firms showed higher operating performance after acquisitions than their counterparts in their industry and performed better than control firms with similar operating performance before merger.

However, some studies have also observed decline of performance of acquiring firms after merger and couldn't see the potential benefits from the mergers. For example, Dickerson et al. (1997) found no evidence of benefits of acquisition on overall performance of the firms in terms of profitability. Instead, acquisitions showed a "systematic detrimental effect" on their performance. In addition, Ghosh (2001) compared the operating cash flows before and after acquisition. There was no evidence of the operating performance growth post-merger. Similarly, Langhe & Ooghe (2001) couldn't find any major improvement in post-merger operating performance of small firms.

CONCLUSION

Indian banking system has definitely come a long way with significant achievements in a very short time. Banking sector in India has witnessed a lot of reforms and some of the successful M&A activities, which have been helpful in growth in different ways. Mergers and acquisitions are considered to be a great strategy to improve accounting performance of acquiring firms. Mergers are acquisitions are based on long-term results. Heavy upfront expenses are involved in acquiring another

firm and it takes time for operations to materialize. Another major challenge is cultural integration. So, collaborations don't happen in short time because of these factors. All in all, mergers and acquisitions are investment for the long term results to improve economic and accounting position of an acquiring firm.

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A Review paper on "Workforce Reskilling and Upskilling" with reference to Indian company

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Abstract:

Workforce reskilling and upskilling have become imperative for Indian companies in today's rapidly evolving business landscape. This paper examines the challenges and opportunities surrounding the development of employee skills and capabilities within Indian organizations. The research explores the drivers behind this trend, such as technological advancements, industry disruption, and changing market demands.

Key aspects addressed include the role of government initiatives and corporate strategies in facilitating reskilling and upskilling efforts. Additionally, the paper delves into the methodologies employed by Indian companies to identify skill gaps, design training programs, and measure the impact of these initiatives on employee productivity and organizational performance.

Key words: Workforce Reskilling, Upskilling, Skill Development, Skill Mapping, Reskilling Strategies

Introduction:

In a world characterized by constant change and innovation, employees' skills and competencies can quickly become outdated. In response to these dynamics, workforce reskilling and upskilling have emerged as essential practices for organizations, both in India and globally. Reskilling refers to the process of acquiring new skills to perform a different job or adapt to new technologies, while upskilling involves enhancing existing skills to meet evolving job requirements. The rapid integration of automation, artificial intelligence, and digital technologies into various industries has amplified the importance of reskilling and upskilling. In the Indian context, a review of the landscape and the role played by companies in this domain is essential.

I. Challenges of Workforce Reskilling and Upskilling in India:

Technological Advancements: The rapid pace of technological advancements poses a significant challenge to the Indian workforce. As digital transformation and automation become commonplace, employees need to continuously update their skills to remain relevant in their respective industries. Skill Mismatch: A critical challenge faced by Indian companies is the mismatch between the skills employees possess and those required by the job market. This gap necessitates significant investments in training and development.

Lack of Awareness: Many employees are unaware of the necessity of reskilling and upskilling, which hinders their willingness to engage in these activities.

II. Strategies and Initiatives by Indian Companies:

Corporate Training Programs: Many Indian companies have established in-house training programs to reskill and upskill their employees. These programs often encompass technical training, leadership development, and soft skills enhancement.

Collaboration with Educational Institutions: Some organizations collaborate with universities and educational institutions to provide their employees with opportunities for higher education or specialized training.

Online Learning Platforms: Indian companies are increasingly leveraging online learning platforms and e-learning modules to make training and development resources more accessible to their employees.

III. Government Initiatives:

The Indian government has introduced several initiatives to promote workforce reskilling and upskilling. The "Skill India" program is one such example, which aims to train over 40 crore people in India by 2023. Additionally, the National Skill Development Corporation (NSDC) and Sector Skill Councils (SSCs) play a pivotal role in creating a skilled workforce aligned with industry requirements.

IV. Impact on Organizational Performance:

Indian companies that invest in workforce reskilling and upskilling are witnessing various benefits. These include increased employee productivity, reduced employee turnover, and improved innovation. Moreover, a skilled workforce can help organizations adapt to changing market conditions more effectively.

V. Hypothesis Testing & Data Analysis

Hypothesis Testing

- Null Hypothesis (H0): Workforce reskilling and upskilling do not significantly affect employee performance.
- Alternative Hypothesis (H1): Workforce reskilling and upskilling significantly affect employee performance.

Data Analysis : Researchers used T-tests, ANOVA, or regression analysis to assess the relationship between workforce development programs and employee performance.

After the Analysis the results of the statistical tests. The p-values was less than the chosen significance level (e.g., $\alpha = 0.05$), so we rejected the null hypothesis in favor of the alternative hypothesis. Researchers have found statistically significant evidence that workforce reskilling and upskilling affect employee performance.

VI. Case Studies:

To illustrate the impact of workforce reskilling and upskilling in Indian companies, let's explore a few case studies:

Tata Consultancy Services (TCS): TCS, one of India's leading IT services companies, invests heavily in training its employees. The TCS Learning and Development Center offers a wide range of courses to help employees keep pace with technological advancements.

Infosys: Infosys has established its training facility called the Infosys Global Education Center (GEC). Here, employees receive training on emerging technologies and domain-specific skills. This initiative has been

instrumental in maintaining Infosys' reputation as a global IT leader.

VII. Challenges in Implementation:

While there is a growing recognition of the importance of workforce reskilling and upskilling in India, several challenges remain. These include the cost of training, the reluctance of employees to ivest their time, and the need for companies to adapt to new learning methodologies.

1. Needs Assessment:

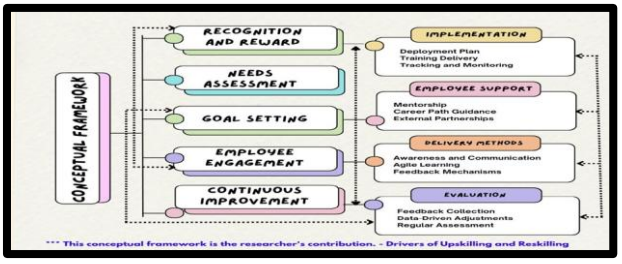
Identify Skill Gaps: Conduct a thorough analysis to identify the existing skill gaps within the workforce.

Future Skills Mapping: Predict future skill requirements based on industry trends and technological advancements.

2. Goal Setting:

Define Clear Objectives: Establish specific, measurable, achievable, relevant, and time-bound (SMART) goals for the reskilling and upskilling initiatives.

Alignment with Business Strategy: Ensure that the skill development goals align with the organization's overall business strategy.



3. Training Design:

Curriculum Development: Create a curriculum that includes technical training, soft skills, leadership development, and industry-specific knowledge.

Content Selection: Choose a mix of in-house training, external courses, online learning, and specialized workshops.

Customization: Tailor training programs to meet the unique needs of the organization and its employees.

4. Delivery Methods:

In-House Training: Conduct training sessions within the organization, utilizing internal subject matter experts.

External Partnerships: Collaborate with external educational institutions, training providers, and online learning platforms.

E-Learning: Utilize digital learning platforms to offer flexible, self-paced training modules.

5. Employee Engagement:

Awareness and Communication: Inform employees about the importance of reskilling and upskilling and the available opportunities.

Feedback Mechanisms: Establish channels for employees to provide feedback on the training programs.

Recognition and Incentives: Recognize and reward employees who actively participate in skill development initiatives.

6. Implementation:

Deployment Plan: Develop a timeline for rolling out the training programs.

Training Delivery: Deliver the training programs through various channels and modes.

Tracking and Monitoring: Continuously monitor employee progress and gather data on the effectiveness of the training.

7. Evaluation:

Assessment: Regularly evaluate employees' skills to measure progress and identify areas that require further improvement.

Feedback Collection: Collect feedback from employees regarding the quality and relevance of the training.

KPIs and Metrics: Define key performance indicators (KPIs) to measure the impact of reskilling and upskilling on organizational performance.

8. Continuous Improvement:

Data-D

iven Adjustments: Use data and feedback to make necessary adjustments to the training programs.

Technology Integration: Stay updated on emerging technologies and integrate them into the training process.

Agile Learning: Implement an agile approach to adapt quickly to changing skill requirements.

9. Employee Support:

Mentorship: Provide mentorship and coaching programs to support employees in their skill development journey.

Career Path Guidance: Offer guidance on career advancement and opportunities within the organization.

10. Recognition and Reward:

Recognize Achievements: Celebrate and acknowledge employee achievements in skill development.

Incentives: Provide incentives, promotions, or salary increases for those who excel in upskilling efforts.

11. Feedback Loop:

Regular Assessment: Continuously assess the effectiveness of the reskilling and upskilling model.

Adaptation: Make iterative improvements based on feedback and changing organizational needs.

This model serves as a comprehensive guide for Indian companies looking to establish a structured approach to workforce reskilling and upskilling. It emphasizes the importance of alignment with business goals, employee engagement, continuous improvement, and support mechanisms to ensure a successful skill development program.

VIII. Findings:

1. Challenges in Workforce Reskilling and Upskilling:

2. Technological Advancements: Rapid technological advancements and digital transformation pose significant challenges. Employees must continuously adapt to new technologies to remain relevant in their roles.

3. Skill Mismatch: A significant gap exists between the skills employees possess and those demanded by the job market. Bridging this gap is a substantial challenge for Indian companies.

4. Lack of Awareness: Many employees remain unaware of the need for reskilling and upskilling, affecting their readiness to engage in learning and development activities.

5. Reskilling and Upskilling Strategies:

6. Corporate Training Programs: Indian companies have established in-house training programs that span technical training, leadership development, and soft skills enhancement.

7. Collaboration with Educational Institutions: Collaborations with universities and educational institutions offer opportunities for employees to pursue higher education or specialized training.

8. Online Learning Platforms: Companies are increasingly leveraging e-learning platforms to make training resources accessible, offering self-paced and flexible learning options.

IX. Recommendations:

Customized Training Programs: To address skill mismatches, Indian companies should focus on tailored training programs that meet the specific needs of their employees and industry.

Employee Engagement Initiatives: Developing campaigns to raise awareness

about the importance of reskilling and upskilling will encourage employee participation. Feedback mechanisms and recognition systems should also be implemented.

Government-Industry Partnerships: Collaboration with government initiatives like Skill India and Sector Skill Councils can help companies access resources and expertise for effective workforce development.

Data-Driven Decision Making: Indian companies should leverage data analytics to assess the effectiveness of training programs and make informed adjustments to meet evolving skill demands.

Technology Integration: Companies should prioritize the integration of emerging technologies, such as AI and VR, into their training programs to create immersive and efficient learning experiences.

Mentorship and Career Path Guidance: Establish mentorship programs and offer career guidance to provide employees with clear pathways for advancement.

X. Conclusion:

Workforce reskilling and upskilling are critical components of the evolving corporate landscape in India. As industries continue to transform due to technological advancements, organizations that prioritize employee development will be better positioned to thrive. The Indian government's initiatives, in conjunction with corporate training programs, present a promising landscape for skill development. As this review paper has demonstrated, the importance of reskilling and upskilling cannot be overstated, and it is imperative for Indian companies to embrace these practices to remain competitive and ensure the continued growth of the nation's workforce and economy.

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Exploration of End-to-End Big Data Engineering and Analytics

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Abstract -The emergence of Big Data represents a timely opportunity for industries and service organizations to generate value and meaningful knowledge or insights from capturing, storing, managing, and analyzing massive datasets. Most of the commercial value is expected to add to the data economy in the next years. In recent years, the advent of new sources of data from sensors, social networks, point of sale, logs, and interactions became an overwhelming opportunity for exploring the knowledge contained in these data. Traditional processing platforms and Big Data Management systems were not able to deal with this ever-increasing volume of data. Defining a system with the capability of handling large and complex data sets has been a challenge of civil engineering, computer science, business and economics, and many other disciplines.

Big Data is a concept that describes the data and its reflections in business, services, and management, usually associated with the three properties of high volume, high variety, and high velocity. The analysis of the Web by tools capable of handling large datasets for analyzing link-based social networks and web services became an important theme of research and development. Earlier definitions of these systems stated the four Vs (volume, variety, velocity, and veracity), and research has also extended this degree of relevance. There is also a definition that stems from the four Vs and can be stated as: “the Big Data is a data set so large and complex that its creation, processing and analysis have a low return on investment with the tools and techniques that are on the market”.

1. Introduction to Big Data

Analytics is the extraction of knowledge from information, and, specifically for the Big Data domain, Big Data Analytics denotes analytical techniques applied to Big Data systems characterized by their size and need for advanced technologies for data storage, analysis and visualization. For analytics, the overall process of extracting insights from Big Data can be represented in 5 stages. These stages are

divided into 2 main groups. In the 'Data Management Group' are the stages: Capture, Storage and Management. Data that is generated and acquired to be stored in a Data Warehouse should be in accordance with the three raw processes of Extraction, Transformation and Loading (ETL) conducted by an ETL module.

2. Fundamentals of Big Data Engineering

Big Data Engineering is a multidisciplinary and comprehensive set of concepts and activities that encompass the strategies, technologies, and processes to work with big data with the intent of ensuring its accessibility and usability at the right time by the users. This set of a subset of activities, technologies, and architectural standards are also known as a Big Data Engineering Stack. By following a Big Data Engineering Stack, it is possible to enhance the establishment of a big database with the intent of facilitating significant knowledge for business activities. This paper includes a deep description of what Big Data Engineering is and how it relates to other key concepts in the development of a Big Data ecosystem. Additionally, it presents an overview of the Big Data industry players and the analytics of innovative education and training approaches to undertake this critical key domain for society and the economy in the short, medium, and long term.

Engineering is the methodology that assures the reliability of the constructions that are part of an industry. Specifically, it is expected that the construction will be properly implemented and work as expected for the intended purpose. With the purpose of having a scientifically sound and effective engineering activity and discussing the concepts that define its activities and constituents, the approached knowledge domains are Construction Engineering, Software Engineering, and Data Engineering. Big Data Engineering is a part of Data Engineering that specifically addresses the construction and preparation of Big Data. In this regard, Big Data are data and metadata whose volume, velocity, and variety are beyond the ability of commonly used processing tools to capture, store, manage, and analyze.

Data Engineering is the discipline that aims to ensure the accessibility and usability of data on time by the users who need it. This is accomplished by means of a comprehensive set of constructs, comprising tools, languages, processes, and architectural standards. Big Data Engineering is Data Engineering in the context of Big Data. Data engineering, based on an integrated set of data information and knowledge strategies, languages, and processes, is a cornerstone in all the data

activities, ranging from the most trivial to the most sophisticated ones. There are several data analytics technologies employed to produce knowledge from data.

2.1. Data Ingestion Techniques

Data ingestion refers to the process of acquiring and importing data for immediate use or storage in a database. The data to be analyzed is traditionally obtained from one or more operational systems, fed through an Extract, Transform, and Load (ETL) process, and stored in a data warehouse. However, in today's Big Data era, the data that people work with includes social network messages, sensor readings, user click-streams for web and mobile applications, and user process data in control systems. This data is continuously generated, possibly at a very high rate. Such an ever-widening view of the data universe becomes increasingly undesirable to stage the data in large batches and process it overnight, due to the volume of the incoming stream and the need to analyze current data, if necessary [1].

To support the ingestion of continuously generated data and provide near-time data analysis where possible, streaming engines have been introduced into the Big Data analysis architecture. Incoming data is collected by a streaming engine and then pushed to a warehouse for later complex data analysis. A streaming engine typically has a programming interface that is like SQL/DDL DML and provides some standard declarative queries. Adding a streaming engine simplifies the ingestion process for the data warehouse, but at the expense of introducing data routing overhead between different systems.

Nevertheless, in many systems, the two services are still separated. To allow interested users to take advantage of a streaming engine, it is, therefore, increasingly common to provide an integrated ingestion facility to enable users to ingest data directly. The ingested data needs to be enriched to reveal more valuable insights. However, when the enriched data needs to be queried frequently by joined queries, for instance, its computation is often pushed into the ingestion pipeline as well: the ingestion framework needs the ability to process the incoming data efficiently. Most streaming engines support incoming data processing. Still, there are also cases that support only a limited query syntax or opt for a suboptimal plan. If a processing task requires some existing data currently in the warehouse, most of the streaming engines would need to query the continuously running warehouse repeatedly. Frequent queries to the warehouse would keep fetching the same result repeatedly and therefore increase the load on the system.

2.2. Data Storage Solutions

In end-to-end big data pipelines, the way data is stored has a profound impact on most usage scenarios and must be planned carefully. Local storage is often expensive and hard to maintain. Moreover, data availability is not guaranteed because locally stored data can be lost due to hardware failures and other anomalies, prompting some organizations to maintain redundant offline backups as safety measures. However, this leads to new challenges such as restoring entirely unstructured data back to a state that can be processed correctly and maintaining synchronization between storage systems. Data security is also a concern. Regulatory or security strictures might always limit the accessibility of locally stored data, further complicating and embargoing data distribution across processing performances. Also, attacks on data centers or storage service providers are common, and leaking information can lead to catastrophic consequences. Storing big data on traditional physical storage on-premises is troublesome. More recently introduced HDDs and SSDs offer various capacities and configurations to choose from but become slow and sometimes fail when datasets become larger than a few terabytes or hundreds of dollars' worth. Where massive data collections exist or can be produced locally, their structuring and immediate processing often cannot keep up with quickly accumulating data and them being stored "on-the-spot." Hence it is instantaneously cheaper and easier to stream data to remote storage and process data where it is stored or streamed, i.e., "compute closer to data" paradigms [3]. Cloud storage systems, i.e., storage-as-a-service solutions, have come to the rescue. They offer an almost endless supply of storage and support cluster processing of data there as a service. Coping with the high amounts of data growth and fast arrivals of data, PaD needs a more flexible framework when it comes to planning storage transfer operations. This entails searching for and provisioning multiple different cloud storage services. In a hybrid cloud setting, it is often sensible to keep frequently accessed, small compute jobs on cheaper storage services with worse latency instead of balancing on more expensive ones with better performance.

Most commonly, the cloud solution being suggested is to go for a storage-as-a-service alternative. I.e., services like Google Drive or Dropbox come to mind. There are many examples for these types of service; however, they cannot deal with the high-volume big data or with a great number of files involved. To transfer and share "big" data, a lot of customized data or file sharing services exist as well. Recent years have seen plenty of services tried, suitable methods invented, and standard APIs built for this purpose. However, not all services offered are those needed or desired at the same time

since they depend heavily on the exact nature of the given big data problem. Each of the service providers has a different set of offerings that are specifically tailored to their target audience. However, these service providers have only recently begun to expose their services via a programmable API or otherwise machine-readable method, which presents new opportunities and challenges for BDP resource allocation since all the low-level details of supporting each service need to be handled.

2.3. Data Processing Frameworks

Big Data frameworks have evolved for two main reasons: the emergence of the large volume of data and the arrival of cheap clusters of machines. Big Data techniques to process large data are cloud computing, stream computing, and in-memory computing. In this section, we present an overview of the most popular frameworks for Big Data processing: Hadoop, Spark, Storm, and Flink. For each of these frameworks, we describe the architecture, the programming model, and the API of the framework using a simple and commonly used word-count application.

There are many applications to process Big Data. These applications can be classified into two main categories based on the nature of the incoming data. In Batch applications, data is collected and stored in a repository. It is processed later on request. In Stream applications, data is continuously produced as a stream. It is processed on-the-fly [4]. The emergence of a huge volume of data is due to the World Wide Web, social networks, scientific data, connected sensors, etc. Processing huge amounts of data is currently needed to uncover useful, previously unknown information. Searching the web, detecting spam, analysing a transaction in a banking system, monitoring the climate, estimating the visitor traffic in a mobile application, determining the ranking of a site on the web… all these operations need the analysis of very large amounts of data in a short time.

3. Data Architecture

Data analysis plays a significant role in extracting meaningful information from big data. Data analysis consists of acquisition, storage, management, analytics, and visualization of data. These actions create insights into the data, which could lead to monitoring a phenomenon, predicting its behavior, and optimizing the parameters affecting it. Data Architecture is one of the ways to provide that, focusing on aspects such as complexity, quality, and performance [5]. It consists of several sub-architectures, which define different aspects of the target architecture.

Model-Driven Engineering (MDE) could help achieve the goal of providing a DAA model by abstracting common knowledge. Industry wants more efficient ways to generate applications using the intelligence developed for a Data Analytics Architecture (DAA) that is reusable, cheap, and modify a model rather than an implementation. A high abstraction level allows the modeling of the system capabilities and policies more quickly [6].

Data analysis exists in the form of number, speed, complexity, and diversity of data. Moreover, the analytics has to properly create insights about the data, monitor a phenomenon from the data, predict its behavior, or optimize a parameter affecting the data. This process is achieved through a cycle of acquisition, storage, management, analytics, and visualization of data. Although every action involves a big effort, it is worth it as it could generate a resource from chaos. Besides that, there are lots of related actions and knowledge to extract value from data with both historical and recent studies on different aspects of the process.

3.1. Designing Scalable Data Architectures

Today, big data are popular. The data can be described by the amplification of some essential data properties: volume, velocity, variety, variability, veracity, and value. Successful data architecture should eliminate those barriers and be adaptive, scalable, able to learn, collaborative, truthful, multiplicative, constraint-handling, practical, customized, and all times. Fundamental constraints have to be resolved: data architecture should be scalable horizontally, vertically, and longitudinally. The autonomous subsystem should be scalable horizontally. Big data architecture should evolve and enlarge to keep with ever-growing needs for data. A scalable architecture splits a data hierarchy-dependent architecture into independent data sub hierarchies. A scalable database management system maps a schema-dependent data warehouse information system into independent schema-subsystems and process-modules. Once the database management systems have been constructed and bootstrap data stored, the description files can be loaded to build database group. The architecture evolves into a data highway to communicate with other systems. All processes are born free. They learn to be tied together in accordance with meta schema and human rules. To remake the architecture, a big data real-world-group generates sub-group. Components databases, web servers, active modules, rules, and reliability can be split into independent units. Each component or service is described by the input-output message format, interfaces between them, executing and reliability

information. When a new database joins a database hierarchy, this database should be prototyped, mined, and loaded with source-data description files or rules. The equivalent global views of the component sub-group semantics should be built. User friendship rules are generated by the data lake, commented and graded according to the users' requests. The grand future of acquired big data waits for personalization, recommendation, and prediction [7]. The process-executing schedules automatically generation is realized like a ring list. A new process can be added, caught, and evicted afterward. The demanded process can be pinned-up using a nondelivered process. To ensure reliability, a blockchain-like recording of all exchanged messages is used, and messages only ferment locally. Once a chain is lost, a suspicion is produced. After off-line examination, the process is pruned out [8].

3.2. Data Lake vs Data Warehouse

A **data lake** is a curated repository containing a structured, semi structured, and unstructured data repository. The data is stored without fixing the scheme and usually in a raw format. Data lakes are cheaper than a warehouse, and they can be easily extended. A warehouse is a single data repository of read-only data in a flat structure. Data from the data lake is cleansed, conformed, structured, and at least partially joined and loaded to the data warehouse.

In many companies, all changes made to corporate data are mirrored into a staging area. In such a way, an analytical view of data is built from production databases. The structure of a staging area, as a rule, has an all-dimensional hierarchy in a star or snowflake type. A hierarchy in the staging area is similar to a DTO object which is partially joined by means of ETL tools and is near a target DW structure. Integrated data from production databases are cleaned, conformed, and aggregated data and a schema becomes virtual one (backend processed). On-line analytical processing capabilities of OLAP DBMS are used to allow multi-dimensional view of data [9].

4. Data Integration

Data integration suggests transforming the required source data to a compatible target format to permit efficient querying and analysis. Properties of raw personal data do not reflect input data sources but rather programs that export them. Hence, data integration can model the exporting data

programs and focus on data programs approved by the user instead of the data sources. Programming with comparable imperatives reduces data integration complexity, although overlapping program executions should be avoided. To forget accidental personal data granules, they should become un-updated in traced remote sources. Finally, to assist users with comprehending and perform inevitable choices, a mechanism is required to adequately inform users and explain the best matching states and its clarifications. Executed Simply Interface Queries should be maintained if selected output data programs are also preserved, and their execution results persist. The proposed framework permits the tracing of processes when users execute pre-defined jobs.

4.1. ETL Processes

After acquiring data from the embedded sensors of the nodes, it is converted into standardized form through an ETL (Extract-Transform-Load) type of procedure that ensures data integrity, consistency, and usefulness. The topics of data extraction and data processing are covered in here. In order to gain a comprehensive overview of ETL processes, the basic concepts of organization, understanding, and query are introduced in this working environment. The structure of data representation and database queries are presented based on which the popular scientific papers and the databases discussed are described. Main purpose of this component is to introduce the basic ideas of big data, the organization of big data, and the definition of the basic predicates. Preceding to this online environment, a big data environment and architecture as well as details of big data framework provided by Apache Hadoop such as HDFS file system, HBase storing, and ZooKeeper synchronization are introduced and described. Then the basic manipulation and processing of observations turned into data with Matlab relevant to the specification of the framework are presented. Taking into consideration the complexity of big data analytics, with its profusion and complex characteristic, an altered version of Weka and a Java-based RDBMS framework DBMS-like are introduced and presented. In order to build available infrastructures for big data analytics, with the feature of transferring computational workload into large-scale clusters, Apache Hadoop framework, as one of the well-known big data processing infrastructures, is introduced.

4.2. Real-time Data Integration

Data integration is a vital aspect to load data from heterogeneous sources into data warehouses and

prepare it for analysis. With the growth of Big Data technologies, large volumes of streaming data are generated in addition to bonus data. Existing ETL (extract, transform, load) models are not able to meet the demands of streaming data. Thus, classical ETL models need to be applied with some modifications to process streaming data. Further, to provide differential and various analytic capabilities, data is cleaned, transformed, and also reshaped in ETL before being loaded into data warehouses based on different ETL models such as classical ETL, streaming ETL, big data ETL, and intelligent ETL. In this context, it is necessary to measure meaningfulness, correctness, fidelity, relevance, and plausibility of the data before proceeding with major ETL processes. Proposed are three levels of pre-cleansing of data to incorporate new records or progressive datasets alone on a regular basis with confidence. The model provides decision rules based on integrated scores and their weightage with respect to gold datasets. Some general rules are formulated along with rules specific to each data variant designed to measure sonic preconditions before important ETL processes. The designed framework provides insights into the dynamism of Big Data sources by classifying them using semantic, structured, semi-structured, and unstructured data types. The user interface provides an environmental view of each chosen source along with the alternative actuators to process it. Then, different data models based on a tree structure-hierarchical format for input files and knowledge-based mined semantic summary for structured sources are generated provided with options to visualize them. Necessary schema creation scripts are generated for real-time insertion into the allocated base storage locations. These scripts describe relationships and constraints in addition to the original scheme selected by users with options for manual design.

5. Big Data Technologies

Big Data is defined by the problems involved in efficiently managing massive volumes of data and is categorized into three major types: Structured, Semi-structured, and Unstructured. As the world is moving towards the digital age, the volume of data is increasing exponentially, leading to a new development that challenges the current tools in efficiently managing this data. Increasing digitization of personal information, social media, business transactions, online services, and text data is fuelling the Big Bang. Technologies specifically designed to manage huge amounts of unstructured data including NoSQL Databases, Cloud Computing, and Data Warehouses are being developed, but still do not satisfy every company's need. Data usually become useless when they outgrow the current

management capabilities. In this context, it is necessary for organizations to invest in Big Data technologies to keep their data assets relevant.

A number of issues facing the Big Data ecosystem are addressed, namely a platform that enables the thorough testing and evaluation of Big Data technologies. This platform is expected to benefit researchers and organizations come to grips with Big Data. As well, future expectations of Big Data technologies are discussed relative to their impact on ICT and societies. Big Data is defined by the problems involved in efficiently managing massive volumes of data. While Big Data is a relatively new development, data have been created and archived in overpowering quantities for many years. Current database management systems based on relational technology are fast approaching their carrying capacity in terms of volume, diversity, and complexity of data [8]. Therefore, a configuration would be made which could accommodate rapidly growing data and allow the easy assessment of forthcoming data management technologies.

An ongoing technological trend leads to an exponential increase in the quantity of data, resulting in a new development in Information and Communication Technology (ICT) that is referred to as Big Data. Organizations face an opportunity and a challenge in terms of potentially, but not necessarily, managing ever-growing amounts of data. The academic interest in addressing Big Data issues is also exponentially growing, exemplified by newly established data-driven programs at research-intensive universities. However, recent image advertising forces an abstract perception of what Big Data is. A method is provided for theorizing Big Data based on established knowledge relating to data and information. It is expected that the understanding of Big Data will improve in regard to issues that serve as innovation benchmarks for data-related initiatives and research.

5.1. Apache Hadoop

The data being generated in today's world is at a great scale, and this is getting worse on a day-to-day basis. This huge amount of data is observed in both structured and unstructured form. The contemporary systems convert this structured data into unstructured format, which most of the systems are not prepared to process. Since organizations are now trying to analyze this data, the gap between available and manageable has widened. The number of bytes that a typical corporation consumes and produces has grown 10X in the last decade. Emails, logs, sensor data, text documents, pdfs, images, videos, and many more are among the various forms of data being generated in volatile formats.

It has now become mandatory for corporations to proactively find ways to derive some insight from this data to either counterattack rivals or enhance their positions. All the existing systems are available only in some structured format, primarily in relational databases kept in tables and forming a schema. It emerged as a natural progression from the Google file system and MapReduce. It receives search results and parsing updates via Dataset and DMap respectively. Hadoop is not a solution but is just a system containing methods to design a solution. Hadoop Distributed File System (HDFS), which can store huge amounts of data and thereafter query that data with various levels of abstraction, is one of the several components making up Hadoop. There is also a distributed version of MapReduce, which performs the query. These are hadoop distributions, but many more packages which expand the Hadoop ecosystem exist.

The most popular and efficient tool for managing the data is Apache Hadoop and its infrastructure, i.e., Hadoop ecosystem. This installation is gaining ground, and guarantees can be made about the arrival of more installations in the near future. The purpose here is to identify and examine the basic reasons, or the key obstacles transgressed by Hadoop in exploring the enormous sets of data to adapt to the ever-changing business environments. A brief comparison of the Hadoop techniques with the conventional systems techniques is provided, alongside a quick take on their present status of adoption. Hadoop can be declared as the alternative emerging out of the compendium of these prototypes.

5.2. Apache Spark

Apache Spark is a powerful open-source engine for large-scale data processing, with a fast and general-purpose cluster computing system. It provides high-level APIs in Scala, Java, Python and R, and an optimized engine that supports general execution graphs. Spark has gained popularity rapidly, especially since open sourcing its original code in 2010, it has become one of the most actively developed projects in

Aside from design considerations, the details of implementation will also be reported. Although the initial target is the FITS format, this approach can be easily extended to applications of other kinds of data. Additionally, the proposed solution can work under both Spark standalone mode and YARN mode. The data source and its connector are implemented in pure Scala and open sourced as an Apache 2.0 licensed application. Moreover, performance tests and examples are provided to illustrate how to optimize the use of the new data source with distributed storage systems, potentially useful for

big data applications in high energy physics, astrophysics, astronomy, or other domains.

5.3. NoSQL Databases

NoSQL (Not Only SQL) databases appear in opposition to relational databases. They depict a wide variety of systems which don't adhere to the relational database management system principles. The major distinctions of NoSQL databases from relational databases are NoSQL databases do not necessarily have a schema and are more on-the-fly; Data can be stored in various formats (key-value pairs, documents, graphs, etc.); It is generally impossible to define a universal query language. On the one hand, it imposes more restrictions on operations. On the other hand, it allows for better support for complex queries. Unlike SQL databases, where data relations are predefined, NoSQL databases provide a set of operations that can be utilized in a more flexible manner.

6. Data Quality and Governance

Data-driven decision-making has become a must among organizations of all types. Organizations aiming to leverage data for this purpose are confronted with several challenges, such as data deluge, data heterogeneity, and data distribution over several cloud and on-premise repositories. Although technology can provide solutions, the first obstacle to tackle is data governance: What data may be available? Where is it? How to fetch it? How to combine, tame, and harmonize such heterogeneous data? And when the data is obtained, how to curate it for data analytics?

Data governing covers three high-level activities. Determining what data exists, what it describes, and what semantic relations exist between assets is the first step. They can use it in subsequent phases or decide to publish it as an internal service. This first phase curates this information at the semantic level with the aim of creating a coherent view of data across domains. The second phase consists of extracting and providing data. Data extraction is defined as fetching relevant data from data sources, applying cleansing and transformation functions to bring the data to a common, homogeneous format, and applying enrichment functions to enhance the warehouse with newly generated data. Once there is sufficient data in the warehouse, data style and computation jobs must be created from scratch or injected from previous analytic processes.

Governance, cleansing, data extraction, and publishing and curation receive data as inputs and provide in output data for querying with a completed set of services. To guarantee timeliness, robustness, and improvement, such processes must be iteratively elaborated and refined. Feedback

data, data within the agenda, and queries executed must be retrieved, analyzed, and acted according to express maintenance actions. A middleware solution can integrate the required technologies, allowing the definition and execution of refined analytics services.

6.1. Data Quality Frameworks

Corruption of the data is where fraudulent data is deliberately entered to cause the generation of an incorrect result. Machine learning algorithms are capable of learning optimal sort functions from historical data and sorting data by validating their location relative to other data and storing data over time to learn their expected location and locks. In addition, solid viewing features may be added to suppress the contents of the document for contracted/secured views. Such events could be treated as telemetric data out of which new information could be inferred. The data associated with such events are view requests, data sharing requests, events in the data pipeline like requests, views and storage. Such events could either be used for offline collection/analysis or used for reporting certain data patterns proactively. The latter approach could be used to design a watch tower either by formulating the patterns as a threshold of statistical probabilities or building classifiers out of them. For classification, unsupervised/online models could be built based on clustering the data and extracting features out of clusters. Involvement of user transactions in such data patterns could be recorded and the users/profiles involved could be unified as individuals for possible profiling on them. Such profiling over user data may be used for obtaining priority to suggest review over certain requests or viewing history.

Understanding nature of values in the data could deepen knowledge of the data source and improvement on efficiency of operations. All differentiating values that have been found in the data so far could be discarded and transformed into unseen/unknown ones so that no additional information is held up. The unseen values could be continuously generated until they are exhausted, or sampling threshold is reached. Such unseen/unknown values are additional information-free data. Values in queries as well as other scenarios could be interpreted into conditions and replaced by random/non-zero values for an additional amount of information. Comparisons in queries could be replaced by random comparisons, OR can be used in place of AND, time-units blurred to agentive units. All such techniques could help toughen the learnability for better defense as the techniques get adopted to change the behaviors of standard data constructs continuously by also calculating the overhead.

6.2. Data Governance Strategies

The need for well-defined data governance strategies to ensure efficient and responsible data management practices, with emphasis on automation and operationalization, is as important as ever. This section presents an overview of the proposed framework to implement automated and operationalized data governance strategies. Following from the specific challenges detected in the WISCENTD use case, a general framework to operationalize the data governance through a zoned The framework supports both incremental and historical data ingestion, accommodating a wide variety of source access schemes. Moreover, the framework provides effective mechanisms to deal with evolving data sources, enabling the propagation of source schema changes to the rest of data lifecycle. Lastly, by maintaining the correspondences between the data sources' variables and a common schema, the framework facilitates the integration among complementary or akin data, providing a more complete and consistent view of the domain.

7. Data Analytics Techniques

Data analysis is referred to as the extraction of knowledge from information [1]. In the Big Data domain, the term 'Big Data Analytics' describes a set of analytical techniques aimed at applying Big Data analytical techniques. The term Analytics is held to describe an overall process of extracting insights or data analysis. In this sense, analysis means a conceptual category that includes data classification and cleaning, visualization and presentation of data; and extraction of information and knowledge from data via business intelligence (BI) and data mining (DM) techniques. For the Big Data domain, there are several analytical subcategories that address semi-structured and unstructured data analysis needs. Text analysis concerns the analysis of documents of diversified formats collected in Big Data systems; techniques performed using analytical techniques categorized in Text Analytics. Analytic techniques and Visual Analytics techniques deal with data analysis and visualization of multidimensional data concerning attributes; Mobile Analytics techniques analyze data collected from mobile devices enhancing business opportunities; and Social Analytics techniques that analyze data from different types of social networks.

In order to the Big Data domain, it is required to be revised the data mining properties consideration of semi-structured and unstructured data. In addition to the accomplishments afforded for concerning research, challenges and opportunities for the Big Data Mining domain must deal with a growing

number of heterogeneity of sources and schemas; extreme scale requirements for near real-time processing; literature on extreme scale and streaming; velocity governing the overwhelming and near real-time rate at which Big Data are generated; scalability of visual data mining; understanding privacy and security issues; accuracy and trust; and insufficiency of general-purpose technology and systems for Big Data convergence and analysis. In regard to the need for professional qualification, an extensive survey of Big Data technologies was performed on the job opportunities in the technology and business area. Document survey to identify specific skill sets for the job needs was also performed. From the academic and industry view, business models as well as data models are needed to generate the demand and value from massive datasets. In that sense, the question on whether an organization has the right ability to capture, store and manage the data concerning known specific technologies and infrastructure is asked. On the other hand, it has been also considered and justification is brought on why organizations need a Big Data Strategic Plan in order to define what analytics must be used.

7.1. Descriptive Analytics

Data Analytics is a broad area that can be categorized according to different criteria. Based on the evolution of the data in an organization, Data Analytics can be classified as Descriptive, Predictive and Prescriptive [1]. Descriptive Analytics describes and summarizes datasets. Generally, it is analyzed in the context of a reporting system in the organization, where the users make queries regarding the data aggregated in the databases. Predictive Analytics provides answers to forthcoming problems. It is generally performed using mathematical and statistical models that use historical data to create predictions of future events. Descriptive Analytics techniques must model relationships in the data to aid in forecasting forthcoming scenarios. Using inferential statistics and from a sample, descriptive techniques must estimate distributions on population. For Big Data, Data Acquisition Systems must be adopted. Descriptive techniques must model the data to identify the underlying patterns and to summarize the information. It includes data abstraction, data mining, statistical analysis, pattern recognition, information retrieval and knowledge discovery. It aims to discover previously unknown, understandable, and actionable knowledge from the data. It is described by KDD process. It is distinct from computer science and database management focuses on AI techniques in the context of data. It can be categorized by applications, data types, research

techniques used, and domains addressed. It requires extensive expertise in statistics, mathematics, machine learning, optimization, data mining, pattern recognition, data engineering, data visualization, DB/NLP and domain of applications knowledge. Entering a Master/PhD program in KDD constitutes an investment in time, finance and energy. It is essential preparation to meet a growing demand for KDD-experted professionals in industry and governments. State of the art techniques in KDD has been reviewed. KDD remains at the top of academic agendas. Future challenges are listed. Most successful high-tech companies in the 21st century have exploited the ability to extract wealth from data, in markets valued trillions of dollars. Big Data KDD techniques extends the terrain of research, development, and professionals' knowledge/skills.

7.2. Predictive Analytics

Predictive analytics is a decision-making process used to analyze social Big Data in a meaningful way. The process involves first using data mining tools to extract and filter raw data. The filtered datasets are then transformed and viewed in Web-based data visualization technologies before being applied in the prediction models. Data are preprocessed to remove noise and/or irrelevant features. Some categorical data are recoded into numeric data, while other irrelevant features are removed. For the prediction modeling step, the filtered datasets are used in predictive modeling tools to train and then evaluate the modeling algorithms. While effective prior to the explosion of social data, these approaches suffer from their assumptions, as the fast rise of social data makes them inefficient in the Big Data era. Some social data contain large numbers of users, posts, comments and other contents. Then, traditional database tools are inefficient to analyze them. Meanwhile, then some social data is text that contains both structured and unstructured information. The use of predictive analytics provides solutions to find the value hidden in large data by building a model. Thus, a research field analyzing social Big Data is relatively new and involves defining a architecture and understanding the techniques to prepare and process the data before analysis, as well as the predictive analytics techniques to find insights in the data.

1) 7.3. Prescriptive Analytics

Prescriptive Analytics is the final and the most advanced stage of the Analytics. Its outcomes also help in decision-making. It selects one of the possible decisions that can be taken by an organization and can make decisions that can be acted upon. It answers the question 'What should be done?' and

its outcome is 'What is the best course of action?' It assumes that the model is deterministic. It uses all forms and data that are required for making a successful decision e.g. decisions being affected by what unanticipated conditions should be taken into account. The keyword "what if" is widely used for Prescriptive Analytics as this stage uses Simulation and Optimization Techniques to prescribe the best decisions against future conditions. Prescriptive Analytics facilitates decision making in real-world contexts using simulation and optimization techniques. However, there is currently no established methodology for developing Analytics solutions at the prescriptive stage. Moreover, there is uncertainty in the parameters affecting the decision variables of Prescriptive Analytics. The previously established probabilistic frameworks are suitable for interpreting uncertainty on the decision-making model, not for constructing the model itself. Such issues in the modelling specifications for Prescriptive Analytics can arise due to incomplete understanding of how processes work in real-world scenarios.

Two perspectives on how the prescriptive model is formulated are provided. One is that a prescriptive model is specified with higher-level concepts from exploratory analyses and requires advanced and contextualized knowledge about the system to translate it into mathematical constructs. The other perspective is statistical learning-based, that is, the prescriptive model is built directly by learning from existing decisions. The former perspective is yet to have a systematic theory that transparently describes the process of replacing high-level specifications with mathematical constructs. The latter perspective is yet to provide a coherent understanding of how to learn more interpretable and actionable decision rules. The Co-planning Exploratory Prescriptive Analytics framework encompasses both perspectives to address the gaps in exploratory and prescriptive analytics frameworks. As no proposals systematically frame Exploratory Prescriptive Analytics, one of its contributions is to formally define and illustrate it.

8. Machine Learning in Big Data

Big Data Analytics is gaining massive momentum in industry and academia due to the unprecedented volume, velocity, and variety of data that has gripped many enterprises. Applying machine learning models to Big Data has become an implicit requirement for most analysis tasks, for answering a wide spectrum of questions hidden in the enormous amounts of data. Typical applications include sentiment analysis of tweets for analyzing the public reactions toward events, image classification for monitoring the daily intake of calories, and stock movement prediction from time-series stock data. Pan-DataCorp, which owns the largest ad platform with massive advertisement data, needs to analyze

the audience to serve more effective advertisements. This analysis can be achieved by building a clustering model to group the audience data. The analysis model can be trained on a cluster with two stages. The first stage is distributed feature selection based on random forest on normal computers, then, distributed ad-hoc ensemble based on gradient boosting decision trees in the context of cloud computing.

8.1. Machine Learning Algorithms

Machine learning is a powerful computational intelligence method widely used to analyze large scale data sets. The unprecedented increase of the amount of data created over time has negatively affected the computational performance of such methods. Extracting useful predictive modeling from these types of data sets is a challenging problem due to their high complexity.

Here, a new approach for automatic classification of arbitrarily partitioned learning data set is developed. This approach is a MapReduce based Distributed AdaBoosting of Extreme Learning Machine (ELM) to build a predictive bag of classification models. Many data set ensembles are created from the entirety of data. ELM algorithm is used to build weak learners and new idea is proposed to use bagging techniques in order to build a strong learner from a set of weak learners. This new learning model that efficiently works over MapReduce based processing architecture is (i) distributed, (ii) incremental, (iii) ensemble-based, and (iv) any-complexity. The proposed model has been implemented in Java, and Performance of the implemented model has been evaluated over well known benchmark knowledge discovery and data mining data sets.

8.2. Model Deployment Strategies

There are two types of deployment processes for ML systems: first and production deployment. The former includes preparing production environments and factors like downloadable junk infrastructure. The latter is about how to redeploy a model. Such redeployment usually comes with another commercial target or a continuous learning option. Therefore, the first deployment process describes a lot of factors regarding how machines will access a model like technology stacks, CPUs or GPUs, containerized service switching, testing, service address, issues besides feeding the model, etc. The deployment tool should support adequate traceability, scaling capability, and alien domain compatibility at the operational end. However, it is generally acknowledged that deployment tools

have less mainstream and are market-dependent. The operational side is more related to the classic educated market .

The second deployment process will always not be as simple as the first deployment process, as commercial targets may evolve, and systems may need to accommodate old and new models simultaneously. In production, models undergo continual learning, which may create several models running on the same coast at any time. Instrumented systems cannot immediately ingest new models as a replacement but need to perform temporary forecasting models or hot-swap functionality. Migration of models usually comes with fewer sources than the first. Thus, either translating or retraining often decouples models from platforms or more environmentally friendly approaches. For transferring performance in datasets and so on but fought with challenging interpretability, retraining a model is becoming the easier option, which usually has a smoother learning curve.

9. Big Data Visualization

Visualizing big data is an important process of creating visual representations of complicated and huge datasets. Data visualization connects data analysis and exploration at different levels of interaction, providing data scientists interactive tools to query, analyze, or visualize the data remotely. It includes concepts, techniques, and tools that allow the visual exploration of big data in order to uncover patterns and visualize high-dimensional databases, as well as network visualization or visualization in the cloud. Visual data exploration is a fundamental part of any big data and analytics methodology.

Excellent surveys on the visualization of big data recommend several categories of systems and procedures. Some of the visualization tools represent several different types of input from the user. High-level platforms enable different views of a data that could be used for broad visual analysis. Data-driven visualization tools provide visual representations by generating better layout algorithms for the aforementioned structure. Process-driven tools visualize pipeline-like dataflow. The most numerous class of visualization tools is model-driven tools that visualize structure-connected data. It has also been created an interactive online survey for systems involving big data visualization to complement this classification and provide more experts with usage of their systems .

9.1. Data Visualization Tools

Data visualization plays a crucial role in data understanding, exploration, communication, quality

assessment, and construction over time. At the same time, it serves various popular purposes and utilizes different visualization tools to simplify usage. Data visualization has either recently emerged or is in the process of maturing as an online research tool in web systems, web data, web text, web streams, web videos, and social media platforms. Its potential impact continues to gain interest and urges a viable future research agenda and tool roadmap.

There are many tools for Data visualization. Following tools are a great way to represent big data effectively, yet the choice of the Input variable can create an impact in performance of these models. Tableau is incredibly fast and can handle massive amounts of data across all platforms, coming with a simple interface and a plethora of options on how to visualize the data. Ultimately, though, its a proprietary tool i.e. Non open source. With Python, Data visualization can be done with the help of libraries like Matplotlib which allows a lot of customization as per the need. R programming is one of the most powerful statistical language. Its an open-source programming and has libraries like Ggplot which can be used to represent data. R-studio is needed to run R programming script whereas iPython Notebooks is required for python-produced visualization. However, it can be cumbersome to integrate it with other components of analytics. As the easier options are available, unfortunately, it takes a lot of effort to represent data in broadest sense and Packages in R Language.

9.2. Best Practices for Visualization

By emphasizing and reiterating key components within the tasks, the hope is to improve the workflow of data engineers and analysts that independently approaches specific scenarios in the overall pipeline of big data collection, engineering, and analytics to aid decision-making and knowledge extraction. Future work includes evaluation of the tools and techniques applied to the new pipeline arising with the research problem or line of inquiry. An open-source version of the tools employed in the pipeline will be developed to help guide future users of big data tools and techniques to build their own pipelines. In this version, the scripts to manipulate each component of the data engineering and analytics pipeline will apply to a virtual machine and the commands applicable to run it.

Static visualizations are benchmarked on the data, big data analytic workflows with the best open-source tools readily usable in education and industry are outlined. The recent emergence of cognitive computing is reported, and an application to production and exploration of time series energy consumption, and forecasting of price and energy consumption is presented, as a case study integrating tools producing and analyzing smart grid data on a public cloud. Measures taken are

synthesized, a large-scale near real-time flooding attacks detection architecture on adequacy under growing resources is proposed, and verification in a real context considering measures to avoid mitigation is demonstrated, and descriptions of data generation and algorithm development, as well as performance metrics and results are provided. Rendering, understanding graph generation and rendering, as well as exhaustiveness, adjacent clustering partitioning, and caching in the expansion process are described.

10. Case Studies in Big Data Engineering

The growth in information generation driven mainly by revolutionizing data acquisition, storage, and transmission technologies has catalyzed both the data itself (e.g., the amount, heterogeneity) and the user communities interacting with it (e.g., social media). As the volume, variety, and velocity of the information massively increased, this phenomenon was coined as Big Data. Big Data's analytical capabilities, previously restricted to the realm of a few elite data analysts, are attracting an ever-growing number of participants with a varied background. In addition to the familiar data preparation, data exploration, and predictive modeling tasks, traditional data analytic processes now contain information extraction, visualization, and knowledge dissemination tasks, as many end-users interact with the data sources they would consume instead of just request. The continuous pipeline from the data itself to the implications of knowledge using data analytics processes highlights Meta Big Data.

Analytics is the extraction of knowledge from information, specifically for the Big Data domain. ‘Big Data Analytics’ describes analytical techniques applied to Big Data systems that require advanced technologies for data storage, analysis and visualization. The processes for extracting knowledge can be represented in five generic stages: Collecting Information, Pre-Processing Information, Analyzing Information, Knowledge Representation and Knowledge Management; these are divided into ‘Data Management Group’ and ‘Analytics Group’. However, for Big Data, there are several categories of analytics that address the needs related to data analysis and are similar to data management systems. This way of organizing knowledge may favor the aggregation of similar technologies, techniques and models for mining and subsequent actions in data analysis and visualization.

Despite being a step forward, the traditional definition of analytics is too broad and not enough for describing all the aspects of Big Data analytic needs. Data analysis in the Big Data era requires a revision of data mining properties, considering the characteristics of Big Data and conditions imposed by searching semi-structured and unstructured data. From this perspective, many challenges and opportunities for 'Big Data Mining' must deal with issues related to: heterogeneity, extreme scale,

velocity, privacy, accuracy, trust and interactiveness [1]. Moreover, the professional qualification is another need that must be addressed and that entails the clear separation of activities along with the two-dimensional capabilities (technological or business).

10.1. Industry Case Studies

The purpose of this investigation is to explore how businesses can derive real value from their investments in data and business analytics (BA). Organizations are striving to capture value from "big data" and analytics rapidly. However, the complexity of creating value from data is not well understood. In a series of studies, it is investigated the nature of big data in organizations, how organizations are attempting to derive value from their data, and how they are pursuing this goal. Data sources, including social media, digital sensor data, transaction logs and other forms of big data, are rapidly multiplying. These data sources can enhance internal data sources, providing organizations with the opportunity to generate insights about customers, products and other aspects of their operations. Exercises are currently being undertaken across disciplines to derive data-driven insights from various internal and external data sources. It contributes to numerous disciplines, including Business Analytics, IS, Marketing, Human Resource Management, Operations Management, Strategy and Knowledge Management . The discussion focuses on the interaction of the conceptual, technical and organizational data science challenges facing a large organization in their efforts to achieve a "data-driven" operating model. The discussion is linked to a series of current research projects investigating models of the data scientist role in different industry contexts. Case study contributions from bank and oil & gas sector partners are drawn on, exploring the nature of the role and how it is evolving, the landscape of people, skills and tools, and the approaches taken to build a more data-driven operating model/agency. The discussion draws on the Big Data and Data Science/Analytics literature, and organizational reporting practices. It is currently the most active area in IT, causing numerous revolutions in research and industry. The focus is on a "business approach" to analytics and its application to a real company case study. An applied business analytics approach to Big Data IT projects reduces the gap between business and technology, providing a methodological framework applicable to different business sectors. The approach, which combines theories from various fields, is a comprehensive source of knowledge.

10.2. Lessons Learned from Implementations

The big data itself has been discussed in literature for a long time, and it covers various concepts from numerous perspectives. It is a fact that with the rapid development of the Internet infrastructure, the amounts of data available are multiplying. Regardless of the means used for data mining, traditional systems and approaches are not able to cope with such amount and velocity of data. Big data systems and approaches are much more scalable. They introduced distributed computation and storage architecture based on cloud computing principles. Nevertheless, an analytical data pipeline or system is not just the choice of the tools used to develop it.

In addition to the volumes of new data sources, data generated from traditional data sources is now also being stored on an increasing scale. On the other hand, companies are beginning to realize the actual value of decentralized data as they become aware of the many possible applications of the data with respect to their business. Along with this rapid technological advancement and this growing business interest, there is also an increasing number of published articles and research papers on the specific design and architecture of big data applications. However, little has been written regarding the crucial decisions that need to be made with respect to the design of the according architecture, and how these decisions affect the feasibility of large-scale big data implementations in practice.

11. Challenges in Big Data Engineering

Big data technologies continue to play an increasingly important role in society development, and more data are generated from diverse sources compared to ever before in entertainment, security, economy, health, social networking, education, and so on. Huge volumes of different types of data, moreover, with high velocity, are expected to be acquired, monitored, analyzed, and exploited to obtain new knowledge as well as understanding previously unnoticed aspects of the stored data. In particular, discovering novel knowledge from huge datasets is very challenging and deep-rooted research that attracts lots of researchers' focus from both academia and industry to solve it .

Therefore, in the designing and implementation of effective big data technologies, numerous systems and applications need to be considered, which can be categorized into basic facilities for big data management, scalable spatial access methods for efficient data access, graph databases for supporting graph queries, and scalable machine learning libraries for mining big data. Each facility is discussed in detail, together with its design challenges, system architecture, and implementation. Hybrid and composable methods, in addition, are particularly discussed for the facility integration, especially those outside of the machine learning families, which are expected to inspire template designs or concepts for other application domains.

11.1. Scalability Issues

The prevalence of data in our lives has grown over the years, from archives of text and images to the day-to-day usage of electronic mail and more. There exist vast amounts of this kind of data collected by companies that can testify to user activities for the past weeks, months or even years. Companies collect this data in order to classify and segment the different types of users, and thus organize better marketing strategies for each one of them . However these companies mainly have the challenge of how to consider all this enormous volume of data, how to extract useful information from it, or how to speed up their query processing over it.

Dealing with Big Data has mostly to do with machines, mainly considering the physical parts of these machines, like their storage, RAM, computational capabilities, what type of hard drive or solid state drives they use, etc. In most of the cases, these are the bottleneck of the problem. Growing outbound storage won't make much sense if users do not know how to handle the data being extracted. The analysis of huge amounts of text is being seriously explored in other directions, basically involving algorithms that select meaningful groups of words for the answer of massive queries, sorting documents in which these words appear, and calculating the relevance of the different documents with respect to the query recommendations and alternatives systems are also topics of active exploration

11.2. Data Security Concerns

Data security has always been a big tech concern, but with the advent of the big data paradigm, security concerns have elevated levels. The big data Boolean describes data with extreme volume and velocity, mostly housed and analyzed in distributive computing environments like cloud platforms. Big data system providers mine huge amounts of data across multiple geographical locations that the data owners are usually unaware of.

Big Data is being utilized in a number of sectors, including international banking and finance, insurance services, medical services, human resource management, research and development of agricultural fields, social network systems, weather forecasting, advanced automation of factories, government allocation of resources etc. And Big Data is pervading data analytics, scientific

discovery, and organized noisy unstructured data. But the proliferation of this data gives rise to other concerns. Consumer data is generally personal, and if compromised, can be used to identify and carry out surveillance purposes on individuals. Big Data can be monitored to track consumers and affect their personal behavior. An example of the usage of Big Data is "Geo-tracking" of cell phones to monitor the location of consumers and provide location-based ads. Another is the political usage of the micromaps created to target undecided first-time voters to vote for Trump in the US Primaries.

12. Future Trends in Big Data

Big Earth Data presents unique challenges to Big Data and its analytics. The EO phenomena-to-data chain and end-to-end models are complicated agency-wide systems involving diverse observations from many large-scale, federated sensors and numerous numeric variables. Each model can involve hundreds of procedures, parameters, formats, and co-conditions resulting in the explosion of transition event and associated metadata. Furthermore, such end-to-end models couple bulk operations with millions of measurements across various formats and need to model heterogeneously recurring and interacting phenomena.

12.1. Emerging Technologies

At present, big data has already penetrated all walks of life in the world, and various industries rely more and more on big data. With the rapid development and application of big data, it becomes an urgent problem to understand large data sets to extract useful information and make wise decisions. Data comes from a variety of sources, including sensors, environmental monitoring equipment, satellite data, scientific and social networks, bank transactions, etc. The response time of traditional analysis software packages is too long; thus the traditional tools fail to satisfy the operational needs of the existing data volume. In this case, new techniques and new tools are expected for the new methods of data processing and data analysis, data generating and storage, as well as data visualization. Data could be turned into information and in turn to knowledge and wisdom after screening and analyzing the loaded data sets. Mathematical and statistical methods are expected to help mine the information from the data.

12.2. The Role of AI in Big Data

The recent advancements in big data and AI technologies have profoundly impacted all aspects of modern human societies. As the systematic study of human behavior and relationships across spatiotemporal and multifactorial contexts, education is no exception. Due to practical limitations, AI technologies have been categorized as three types based on the capability of systems. Even though AI capabilities are not widely available to the masses, the significantly developed AI research communities have begun to translate some research results into convenient products or services applied to real-world adoption scenarios. The rapid growth of AI technologies is bringing both opportunities and challenges to education. Current AI education areas are classified, including administrative uses of AI, AI education initiative, and data analytics of AI.

13. Conclusion

This paper provided an extensive overview on the topic of end-to-end Big Data engineering and analytic process, detailing various considerations around the tools utilized to extract valuable insights from Global Systems, such as the Internet. Different types of end-to-end Big Data engineering and analytic pipelines were described and classified, detailing their problem-centric and data-centric nature. The Big Data engineering and analytic pipelines were also reviewed, which detail the complex set of data processing and analysis stages a native pipeline may traverse, motivating and guiding practitioners regarding valuable commercially available and open-source software tools.

As a follow-up work to the previous paper, further considerations regarding recent advances in these domains such as Multi-pipeline Analytic Patterns were presented as well, which aim to guide practitioners on how to capitalize upon the ubiquitous data generated by the proliferation of interconnected devices and transmission technologies achievable through Global Systems. Given their technical nature, these analytic patterns were classified into pipeline-level and external behaviors. The former aims to control the execution of the individual pipeline, while the latter carry out exploratory studies on the generated information. These two groups of patterns encompass technical aspects that should be considered when designing a Big Data analytics engineering process. This systematic organization of components and patterns, carried out using a standard model, may serve as a comprehensive guide in both academic and practitioner settings regarding the questions on how to assess and design domestic Big Data engineering and analytic processes and products. As

future work, further information regarding pipeline execution would be extensively described, similarly to what had been done for pipeline architecture generation. This would guide practitioners regarding how to engineer pipelines considering issues such as scheduling. Moreover, case studies on controlling the execution of multi-pipeline systems would further expand the richness of the ideas presented in this paper.

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GREEN MARKETING AND ETHICS IN MARKETING

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Green marketing focuses on selling products and services based on their environmental benefits. Its features include adopting sustainable business practices, creating eco-friendly products, implementing eco-friendly packaging, communicating the environmental benefits of the product.

Marketers have found new ways of thinking leading to a development within the marketing area, the concept of green marketing has emerged and aims to improve communication in terms of ethically conscious products. However, along with the concept of green marketing, companies are sometimes misleading the consumers on their true intention, this phenomenon is called Green washing. This occurs when companies portray themselves to being greener than they actually. Marketing ethics can help a company honor the rights of consumers and gain many other benefits. While people may believe in varying ethical principles, they usually promote the importance of honest communication and safety. It will try to show the standpoint of the consumer and show what they strive for regarding ethical and green consumption. Has. The data collected are both gained from a qualitative and a quantitative method; however the analysis has been conducted in a qualitative way. Moreover, the findings collected from this research have been retrieved from six semi-structured interviews as well as an online questionnaire.

Keywords: Green marketing, Ethical consumption, Green- & Ethical consumerism, Green washing.

1. INTRODUCTION

Green marketing is the marketing of products that are presumed to be environmentally friendly, safe and sustainable in nature. Green marketing aims to promote commodity that are produced using sustainable manufacturing processes and are less harmful to the environment. In contemporary days, there has been an increasing demand for eco-friendly commodities as people have become more attentive of the impact of their actions on the environment. This has led to the emergence of green marketing as a way for companies to differentiate their products and appeal to environmentally conscious consumers.

However, green marketing must be practised with ethical considerations in mind. Ethics in green marketing relates to the principles and values that guide the marketing of environmentally-friendly commodities. Companies must ensure that their green marketing claims are accurate and not misleading. It must also provide that their production processes are genuinely sustainable and not just marketing gimmicks. Ethical green marketing involves transparency and honesty in propagating the environmental benefits of products and services to consumers.

One of the key challenges in green marketing is the issue of green washing. Green washing refers to the practice of making false claims about the environmental benefits of a product or service. Companies that engage in green washing are often accused of using environmentalism as a marketing tool rather than genuinely working to reduce their environmental impact. To avoid green washing, firms must ensure that their environmental claims are backed by verifiable evidence and are not misleading in any way.

Another ethical consideration in green marketing is the impact of products and services on local communities. Companies must ensure that their environmental initiatives do not negatively impact the communities in which they operate. For example, a company that produces eco-friendly products may still be responsible for the pollution caused by the production process. Ethical green marketing involves a holistic approach to viable that takes into account the impact of products and services on the environment, local communities, and society as a whole.

In conclusion, green marketing and ethics are closely intertwined. Green marketing provides companies with an opportunity to promote environmentally-friendly products and services, but it must be practised with ethical considerations in mind. Ethical green marketing involves transparency

and honesty in communicating the environmental benefits of products and services to consumers, and a holistic approach to sustainability that takes into account the impact of products and services on the environment, local communities, and society as a whole. By practising ethical green marketing, companies can build trust with environmentally conscious consumers and contribute to a more sustainable future.

Cost-effective solutions: Green marketing involves finding cost-effective solutions to reduce the environmental impact of products and services. This can include reducing energy and water usage, using recycled materials, and implementing sustainable production processes.

Long-term perspective: Green marketing takes a long-term perspective on sustainability, that identifies environmental issues require ongoing attention and effort to achieve lasting impact.

Hence, green marketing and ethics in marketing involve a focus on the environment and sustainability, accurate and transparent communication, the use of environmental certifications, corporate citizenships, consumer education, stakeholder engagement, cost-effective solutions, and a long-term perspective. By adopting these features, companies can promote sustainability, build trust with environmentally conscious consumers, and contribute to a more sustainable future.

ROLES OF GREEN MARKETING AND ETHICS IN MARKETING

Green marketing focuses on selling products and services based on their environmental benefits. Its features include adopting sustainable business practices, creating eco-friendly products, implementing eco-friendly packaging, communicating the environmental benefits of the product, etc

There are 4 major roles and it is written below:

Differentiation: Green marketing help the companies differentiate their products and services from those of their competitors. By promoting their environmentally-friendly products and sustainable practices, companies can appeal to consumers who prioritize sustainability and ethical considerations.

Reputation: Companies that practice ethical green marketing can build a strong goodwill for being socially responsible and environmentally conscious. So it leads to improve their brand image and increase customer loyalty.

Risk management: Ethical green marketing can help companies manage risks associated with sustainability and social responsibility. By implementing sustainable practices and promoting their environmental initiatives, companies can reduce the risk of negative publicity, regulatory fines, and other legal consequences.

Social impact: green marketing and ethics can have a positive social impact by promoting sustainable practices and raising awareness about environmental issues. Companies that practice ethical green marketing can help create a culture of sustainability and inspire others to adopt more sustainable practices.

Methods of green marketing and ethics in marketing

Green marketing refers to the marketing of goods and services that are environmentally friendly and sustainable in nature. Green marketing aims to promote articles that are produced using sustainable manufacturing processes and are less harmful to the environment. In the latest era, there has been an increasing demand for eco-friendly commodities as people have become more aware of the impact of their actions on the environment.

Types of Green Marketing:

Product-oriented green marketing: This type of green marketing focuses on promoting environmentally-friendly products and services. It involves using eco-labels, promoting product attributes that are eco-friendly, and highlighting the benefits of using sustainable products.

Process-oriented green marketing: This type of green marketing focuses on promoting sustainable production processes. It involves using environmentally-friendly manufacturing techniques, using renewable energy, and reducing waste and emissions.

Consumer-oriented green marketing: This type of green marketing focuses on educating consumers about the environmental benefits of using eco-friendly products and services. It involves using marketing campaigns to alert the peoples about environmental issues and promote environmentally-friendly lifestyles.

Ethics in Marketing:

Truthfulness: Ethical marketing requires companies to be truthful in their marketing claims. It must ensure that their claims are accurate and not misleading. This includes avoiding green washing, where companies make faulty claims about the environmental benefits of their products.

Transparency: Companies must be explicit about their environmental impact and their efforts to reduce it. The firm must provide details about their manufacturing processes and the sources of their materials. This includes uncover any environmental risks associated with their goods.

Social Responsibility: Ethical marketing should consider the companies to take into account the impact of their products and services on society. They must know that their marketing efforts do not promote harmful behaviours or contribute to social issues.

Respect for Consumer Rights: Companies must respect consumer rights, including the right to privacy, the right to safety, and the right to be informed. They must ensure that their marketing promotion do not violate these rights.

Sustainability: Ethical marketing requires companies to promote sustainable goods. They must take into account the environmental impact of their products and services and work to deplete their carbon footprint. They must also promote sustainable lifestyles and educate consumers about the benefits of sustainability.

Hence, green marketing and ethics are closely intertwined. Green marketing provides companies with an opportunity to promote environmentally-friendly products and services, but it must be practised with ethical considerations in mind. Ethical green marketing involves transparency and honesty in transmit the environmental benefits of products and services to consumers, and a holistic approach to sustainability that takes into account the impact of products and services on the environment, local communities, and society as a whole.

Objectives:

- To promote environmentally friendly products and services.
- To know about the organisation ethics.
- To understand awareness of consumers about green products.
- To find out findings and suggestions.

2. REVIEW OF LITERATURE

Literature Review

Green marketing is worth investigating because of its relevance and the relative novelty of how businesses interact with natural environments. It has grown significantly over the past two decades, and knowledge on green marketing across different continents and diverse topics has grown proportionally. According to Kotler, green marketers seek to change marketing practices, and at the foundation of green marketing (strategic and functional) lies the search for opportunities and decisions that can be harnessed by adopting green marketing practices. McDonough and Prothero carried out a literature review of articles published from 1998 to 2013. A review study by categorized earlier literature reviews into thematic categories: green marketing functions, co-orientation, green marketing strategy, and consequences. These chapters summarized the literature on green marketing and key concepts and themes for future research. In the author conducted a bibliometric study of Web of Science (WOS) articles published from 1977 to 2020, investigated with the primary objective of summarizing the current state of green marketing research and analysing and presenting the results of the search after applying selected keywords.

Over the past few years, ecological marketing has received much attention from scholars worldwide and as a result, various literature reviews about the topic have been published. For instance, Kar and Harichandan focused on the Scopus and Web of Science databases comprising data from 1121 articles published between 1990 and 2021 in 462 journals. The results suggest that green marketing techniques, eco-tourism, and sustainable marketing techniques are increasingly important. Despite the attention of scholars, a thorough bibliometric analysis of the green marketing literature still needs to be completed. The concept of bibliometric analysis can be defined as a statistical analysis of scientific articles, book chapters, or books that have been published in the past and are a practical approach to gauge the impact of publications on the scientific community. Biometric research reviews can be used to visualize a topic's framework, identify emerging and current research topics, and summarize the most influential publications and academics.

As part of our bibliometric review process, we created mind maps to organize our literature review, mapped the study's structural area, and compiled a bibliography to provide a complete picture of the literature. By analysing the facts mentioned earlier, this bibliometric review attempts

to draw attention to the numerous attributions related to "green marketing, sustainability, eco, and environmental marketing". Based on the bibliometric analysis of 1348 articles published between 2011 and 2022, this analysis provides the first factual and statistical insight into research trends concerning green marketing and eco-marketing of green products. Furthermore, based on citations and an article's impact, a review of the research on this topic is presented.

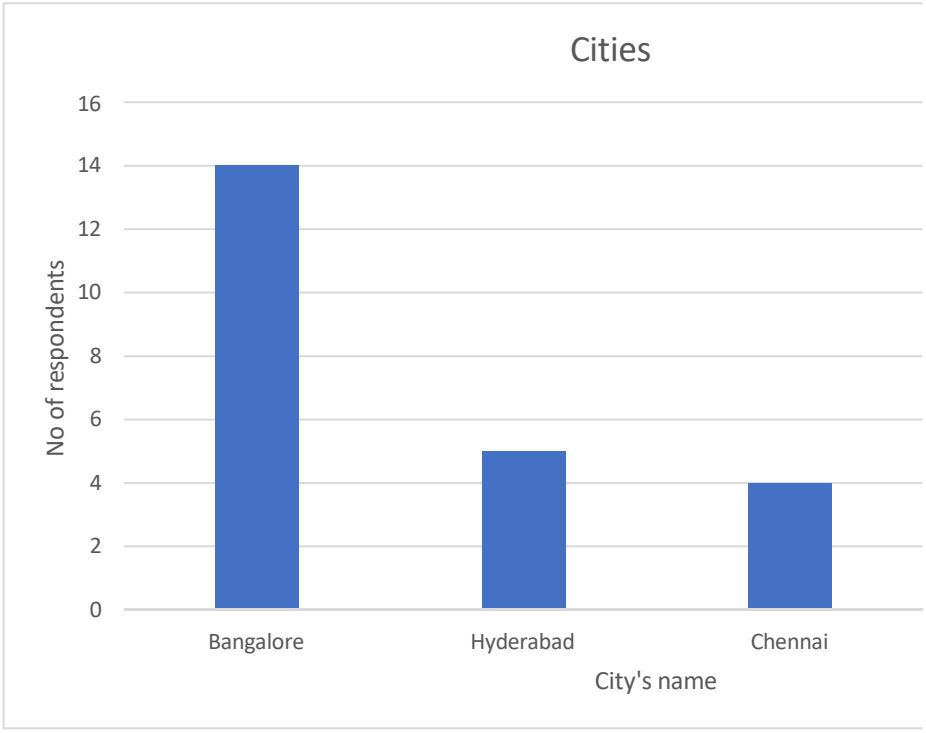
Moreover, a green marketing practitioner must comprehend the types of literature developed and how they have grown, focusing on essential authors, and distribution of articles, high-profile journal articles, and prominent publication outlets. To accomplish this, in this paper, we will review peer-reviewed journal articles published in SCOPUS from 2011 to 2022 with the keywords "Green marketing" OR "eco* marketing" OR "sustainable marketing" OR "Enviro* Marketing" OR "Ethical marketing" to analyse the published literature related to green marketing; group articles by dominant themes; determine how it has evolved; and determine which publication outlets, articles, and authors have impacted the field based on citations and number of pieces. This contribution complements earlier literature reviews that emphasized a context-specific approach and contributes to providing an explicit understanding of developments in green marketing literature

3. DATA ANALYSIS

Table: 3.1 Respondents from area wise

Cities		
Particulars	no of respondents	Percentage
Bangalore	14	53.85
Hyderabad	5	19.23
Chennai	4	15.38
Mumbai	3	11.54
Total	26	100.00

Figure No: 3.1 Respondents of areawise



Source: Primary data

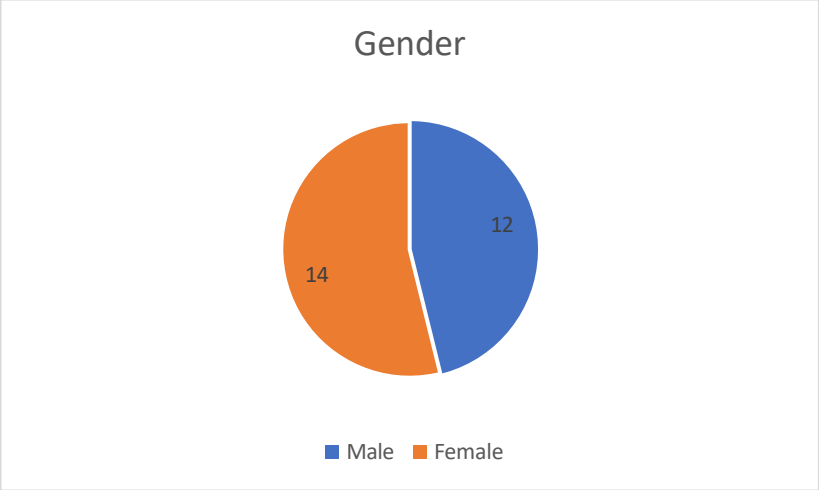
Inference: The above table illustrate that the area of respondents from different cities. profile of selected respondents among the selected group of 26 members. The percentage of members belongs to Bangalore is 53.85%, Hyderabad is 19.23%, Chennai is 15.38% and 11.54% respondents from Mumbai.

Analysis: From the above table, we come to the conclusion that, the highest percentage of respondent from the area of Bangalore and the low percentage of respondent received from the area of Mumbai.

Table:.3.2Respondents based on gender

Responses of gender		
Particulars	no of respondents	Percentage
Male	12	46.15
Female	14	53.85
Total	26	100.00

Figure No: 3.2 Gender of respondent



Source: Primary data

Inference: The table illustrate the gender profile of selected respondents among the selected group of 20 members. The percentage of members belong to male gender is 46.15% and followed by 53.85% members belong to female gender.

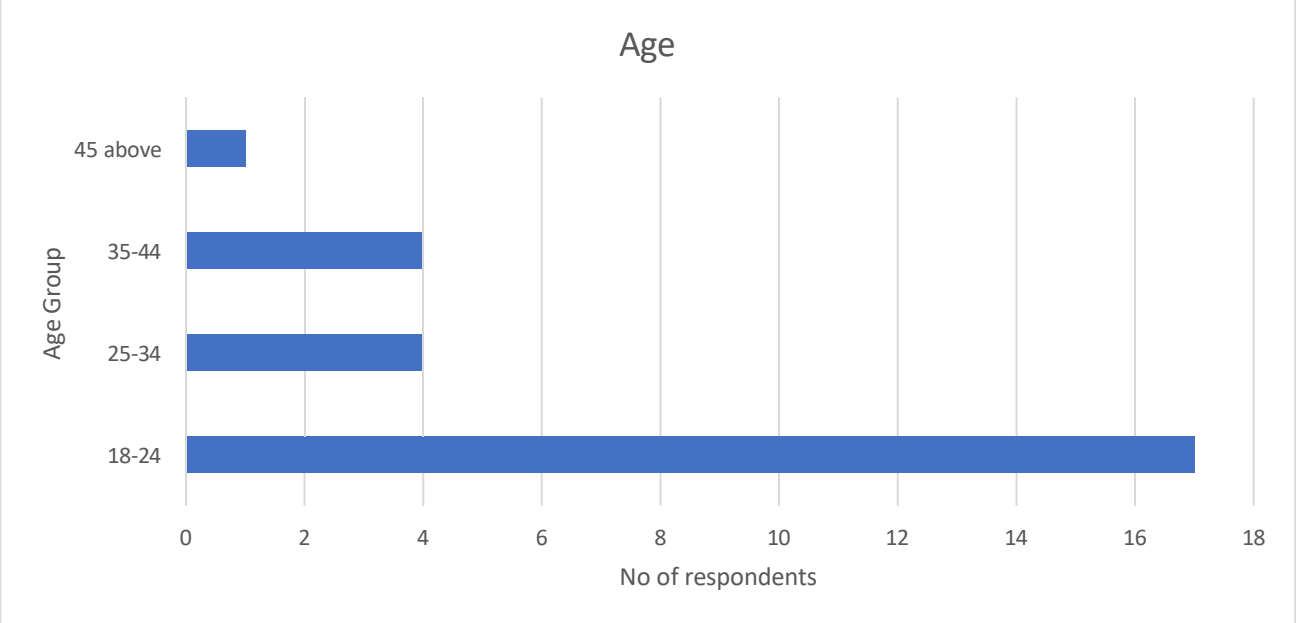
Analysis: The above table shows that the number of respondents of the male is 46.15% and female is 53.85% so; we can interpret that female respondents are more compare to male respondents.

Table: 3.3: Age of

lll: 3 Respondents

Age		
Particulars	no of respondents	Percentage
18-24	17	65.38
25-34	4	15.38
35-44	4	15.38
45 above	1	3.85
Total	26	100.00

Figure No: 3.3 Age of respondents



Source: Primary data

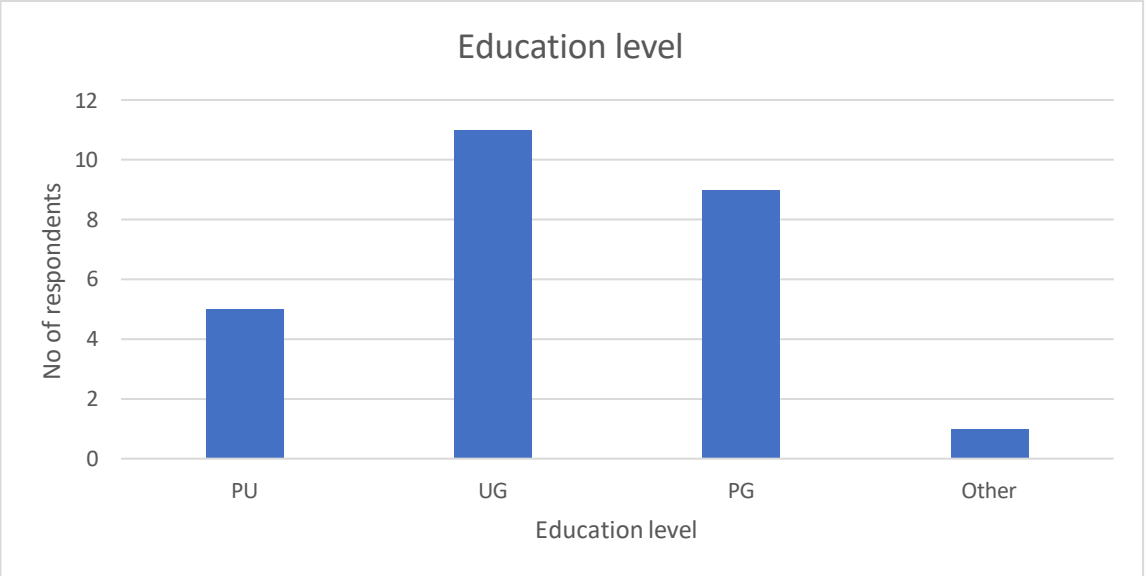
Inference: The above table shows that 17 respondents come under the age of 18-24 age range, 4 respondents come under 25-34 age range, 4 respondents from 35-44 age and 1 respondent come under 45 above age range.

Analysis: The above table illustrate that the age range between 18-24 are responded more compared to other age ranges. It shows that 65.38% respondents are aware of green products.

Table: 3.4: Respondents of Education level

Education level		
Particulars	no of respondents	Percentage
PU	5	19.23
UG	11	42.31
PG	9	34.62
Other	1	3.85
Total	26	100.00

Figure No: 3.4: Respondents of education level



Source: Primary data

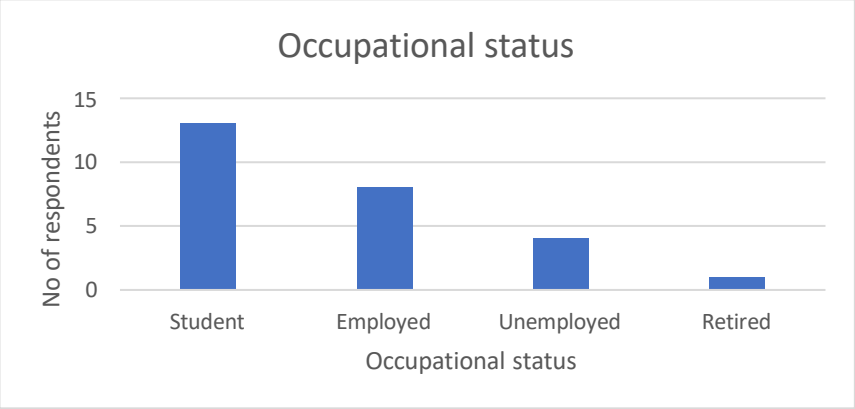
Inference: This table shows that education level of the people. The preferred respondent among selected group of 26 members. The percentage of people belongs to pu level is 19.23%, followed by UG 42.31%, 34.62 % of people belong to PG. And others 3.85%.

Analysis: The above table illustrate that the Education level of UG are given more responded compared to other education qualification. it shows that 42.31% of people are more aware of green products.

Table: 3.5: Respondents based on occupation level

Occupational status		
Particulars	no of respondents	Percentage
Student	13	50.00
Employed	8	30.77
Unemployed	4	15.38
Retired	1	3.85
Total	26	100.00

Figure No: 3.5: occupation of the respondent



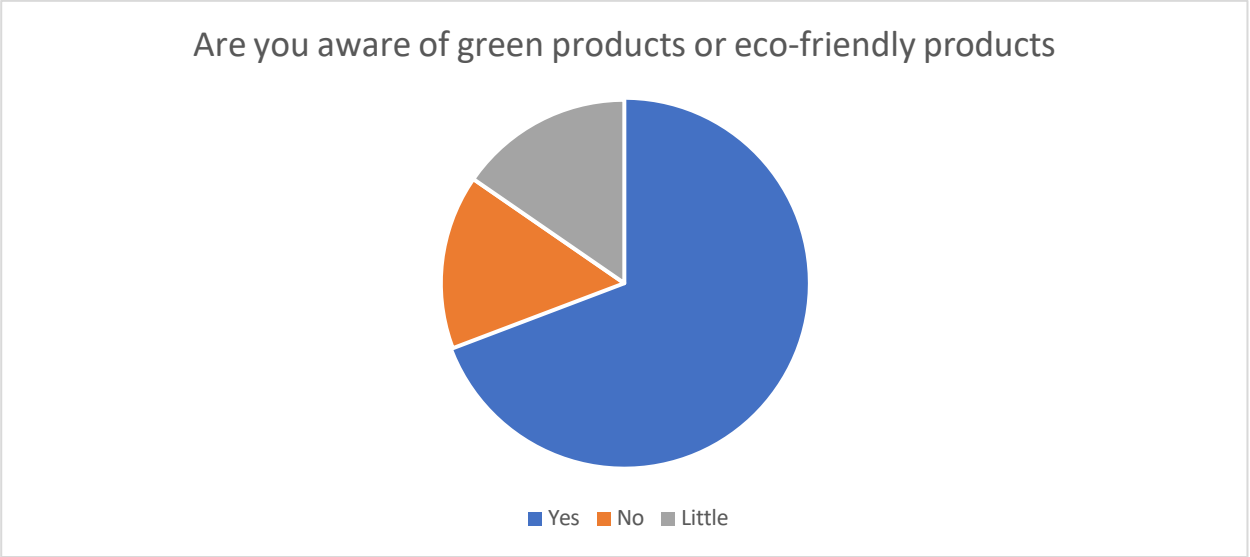
Source: Primary data

Inference: The above table shows that occupation level of the people. The selected respondent among selected group of 26 members. 13 respondents are students, 8 members are employed, the unemployed respondents are 4 and the retired respondents are 1.

Analysis: The above table illustrate that the all respondents use green product it replicates that every respondent knows about the green product but it shows the more attracted occupation level is 50% belongs to students.

Table: 3.6: Respondents of awareness of green products and eco-friendly products

Are you aware of green products or eco-friendly products		
Particulars	no of respondents	Percentage
Yes	18	69.23
No	4	15.38
Little	4	15.38
Total	26	100.00



Source: Primary data

Inference: The above table shows that the awareness about green product.the selected respondent belongs to 26 members and the members aware of green products are 18. The 4 members are not aware of green products. the respondent who are less aware of green products are 4 respondents.

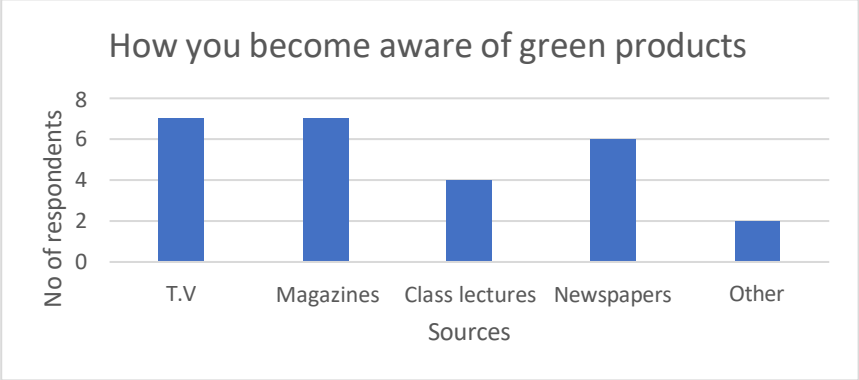
Analysis: The above table illustrate that the all respondents use green product and attracted to green products. But it shows that the 69.23% of people are more aware of green products. the less aware about green products are only a few members.

Table: 3.7: Respondents of awareness of green products from various sources

How you become aware of green products		
Particulars	no of respondents	Percentage
T.V	7	26.92
Magazines	7	26.92

Class lectures	4	15.38
Newspapers	6	23.08
Other	2	7.69
Total	26	100.00

Figure No: 3.7: sources of awarness of green produts from various sources



Source: Primary data

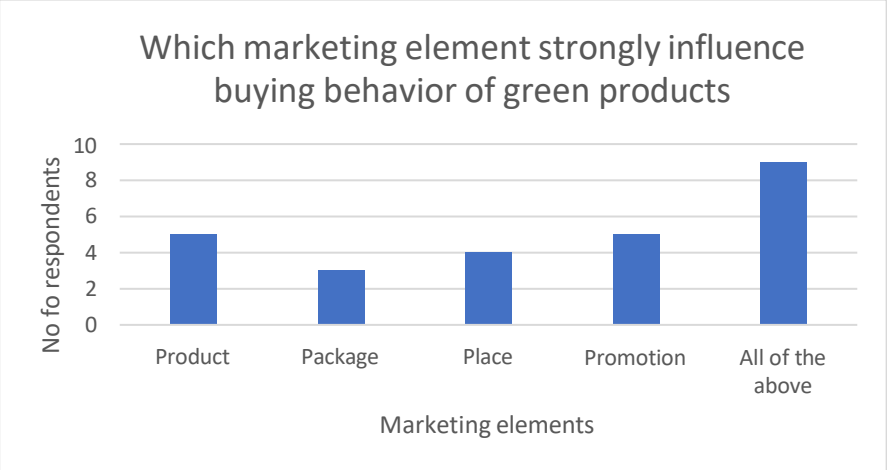
Inference: The above table shows that the sources of awareness about green product. the selected respondent belongs to 26 members .in that the respondent who are aware from tv is 7 members, the other 7 members are aware from magazines, the class lecturer awareness will be of4 members, from the newspaper 6 members are aware of green products and the others consist of 2 members.

Analysis: The above table illustrate that the number of respondents from the source of television will be more compared to the othersources. As the television spread the information faster than the other sources of media.

Table: 3.8: Marketing elements strongly influence buying behaviour of green products

Which marketing element strongly influence buying behaviour of green products		
Particulars	no of respondents	Percentage
Product	5	19.23
Package	3	11.54
Place	4	15.38
Promotion	5	19.23
All of the above	9	34.62
Total	26	100.00

Figure No: 3.8: Marketing elements strongly influence buying behaviour of green products



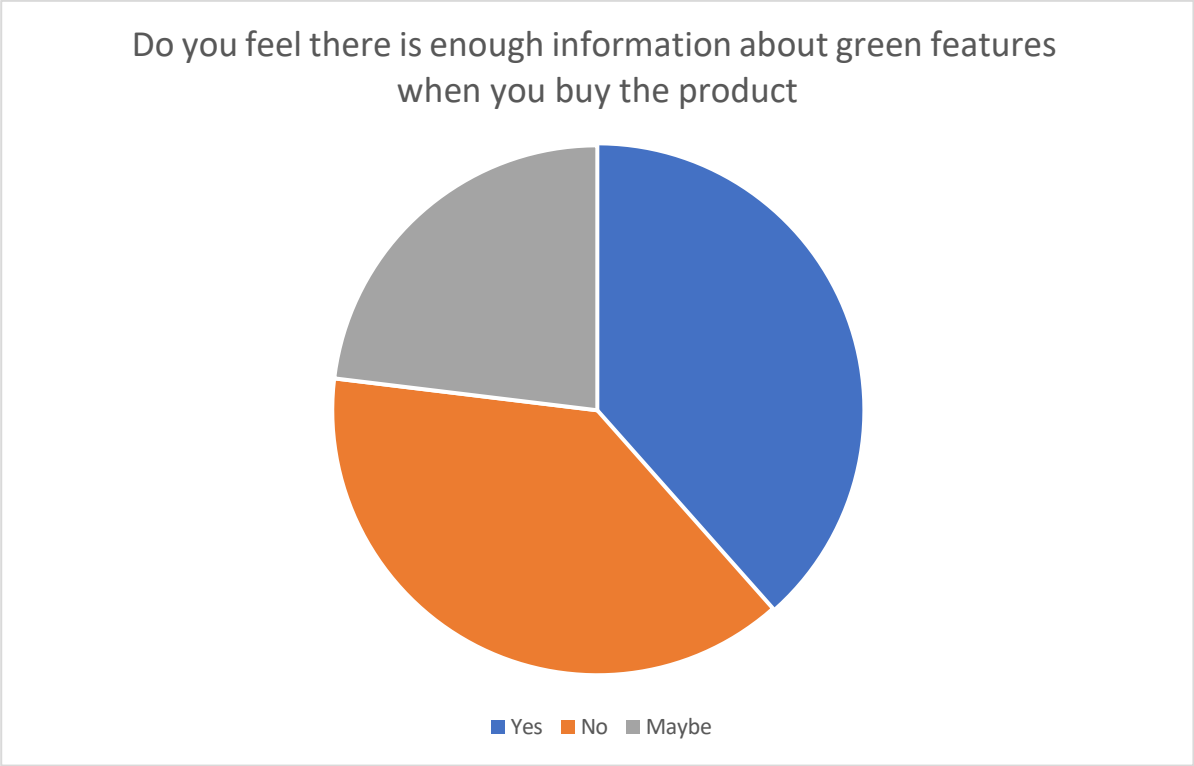
Source: Primary data

Inference: The above table shows that the marketing elements strongly influence buying behaviour of green products. The selected respondents belong to 26 members. among that 5 members are influenced by the product,3 members are influenced from the package of the product,4 members are influenced by the place and other 5 are from promotion of the product, remaining 9 members influenced by all above strategies.

Analysis: From the above table we can come to the conclusion that instead of influencing individual marketing elements likes product, package, place, promotion. The more respondents influenced by all the above types of marketing elements for buying of green products.

Table:3.9: Information about the green features at the time of buying the product

		Do you feel there is enough information about green features when you buy the product	
Particulars		no of respondents	Percentage
Yes		10	38.46
No		10	38.46
Maybe		6	23.08
Total		26	100.00



Source: Primary data

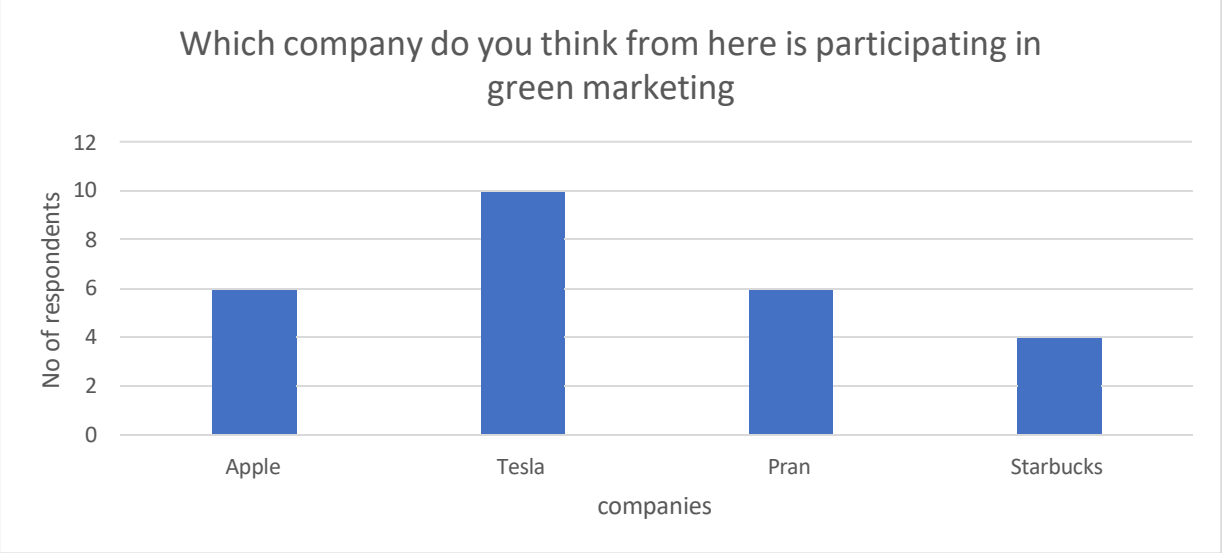
Inference: The above table shows that the respondents have got enough information about the green products at the time of buying the product. The respondent selected is 26 members.in that 10 respondents have replied yes and other 10 also responded yes, the remaining 6 members they re in dilemma in which they replied may be.

Analysis: From the above diagram, we can conclude that 20 respondents replied they use to get enough information about the green products, but 6 members still they are in confusion of getting information about green products.

Table: 3.10: companies participating in green marketing

Which company do you think from here is participating in green marketing		
Particulars	no of respondents	Percentage
Apple	6	23.08
Tesla	10	38.46
Pran	6	23.08
Starbucks	4	15.38
Total	26	100.00

Figure no 3.10: companies participating in green marketing



Source: Primary data

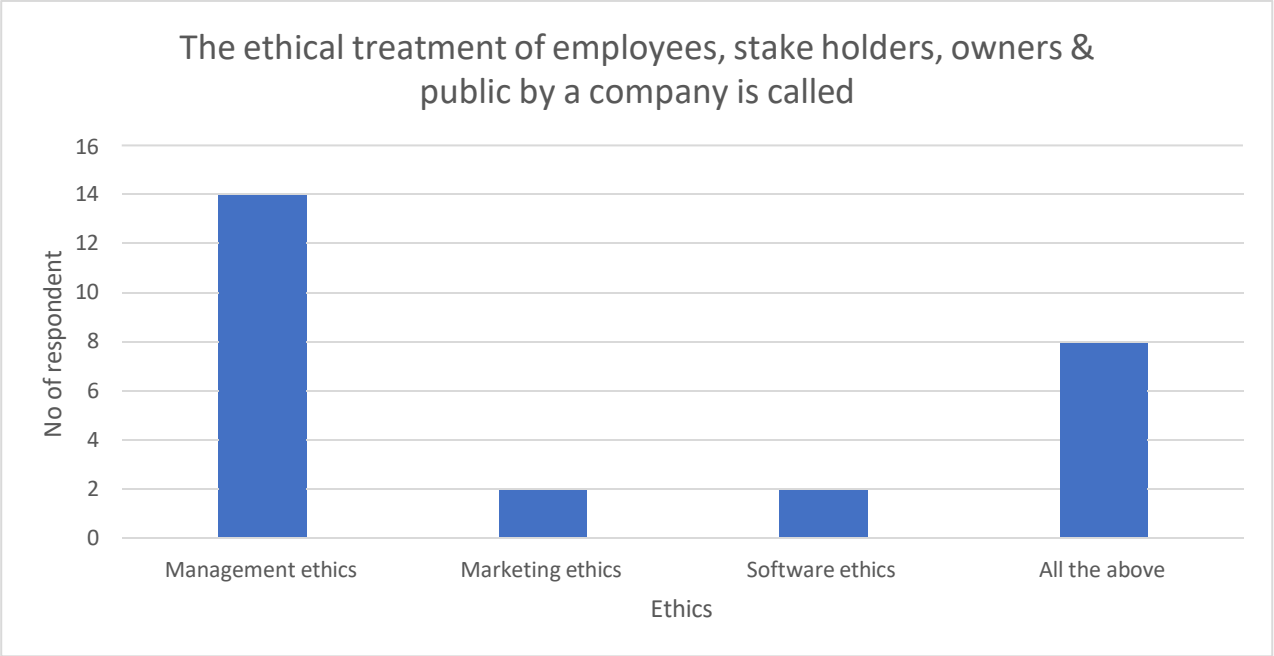
Inference: The above table gives information about the company participating in green marketing. The respondents selected are 26 members. Among them 6 respondents are replied that Apple company has taken initiative in green marketing,10 respondents replied Tesla company participating in green marketing,6 members replied that pran using green marketing, and other 4 respondents said that Starbucks are participating in green marketing.

Analysis: From the above table, we can illustrate that all the companies are participating in green marketing but the awareness of their participation in green marketing known to consumers is depends upon how they promote their products by using green marketing. In above table 10 respondents replied more for tesla company for participating in green marketing when compared to other companies.

Table: 3.11: Ethical treatment of employees, stakeholders, owners, & public of a company

The ethical treatment of employees, stake holders, owners & public by a company is called		
Particulars	no of respondents	Percentage
Management ethics	14	53.85
Marketing ethics	2	7.69
Software ethics	2	7.69
All the above	8	30.77
Total	26	100.00

Figure: 3.11;Ethical treatment of employees, stakeholders, owners, & public of a company



Source: Primary data

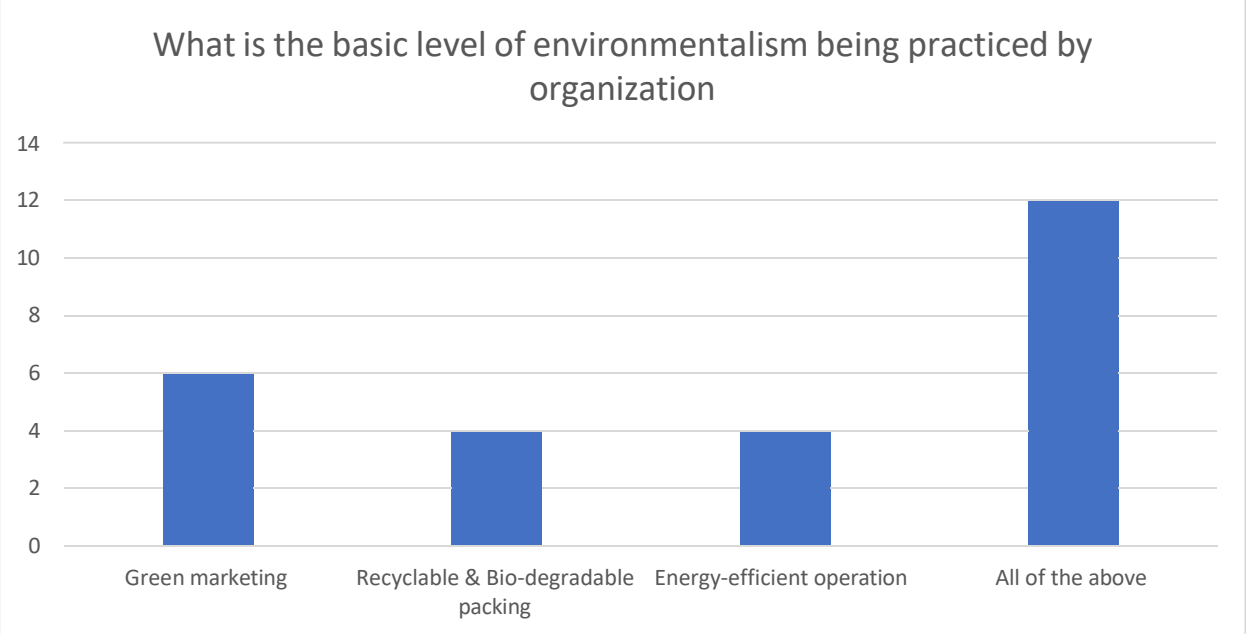
Inference: The above table gives information about the ethical treatment of employees, stakeholders, owners public by a company. The selected respondents are 26 members. In those 14 members responded for Management ethics,2 members responded for marketing ethics, for software ethics only 2 members have responded, other 8 members responded from all the above.

Analysis: From the above table, we can illustrate that the more people have responded for management ethics, compared to all other type of ethics like marketing, software and others etc. The management ethics is considered as more important.

Table: 3.12: Environmentalism practised by an organisation.

What is the basic level of environmentalism being practiced by organization		
Particulars	no of respondents	Percentage
Green marketing	6	23.08
Recyclable & Bio-degradable packing	4	15.38
Energy-efficient operation	4	15.38
All of the above	12	46.15
Total	26	100.00

Figure: 3.12; Environmentalism practised by organisations



Source: Primary data

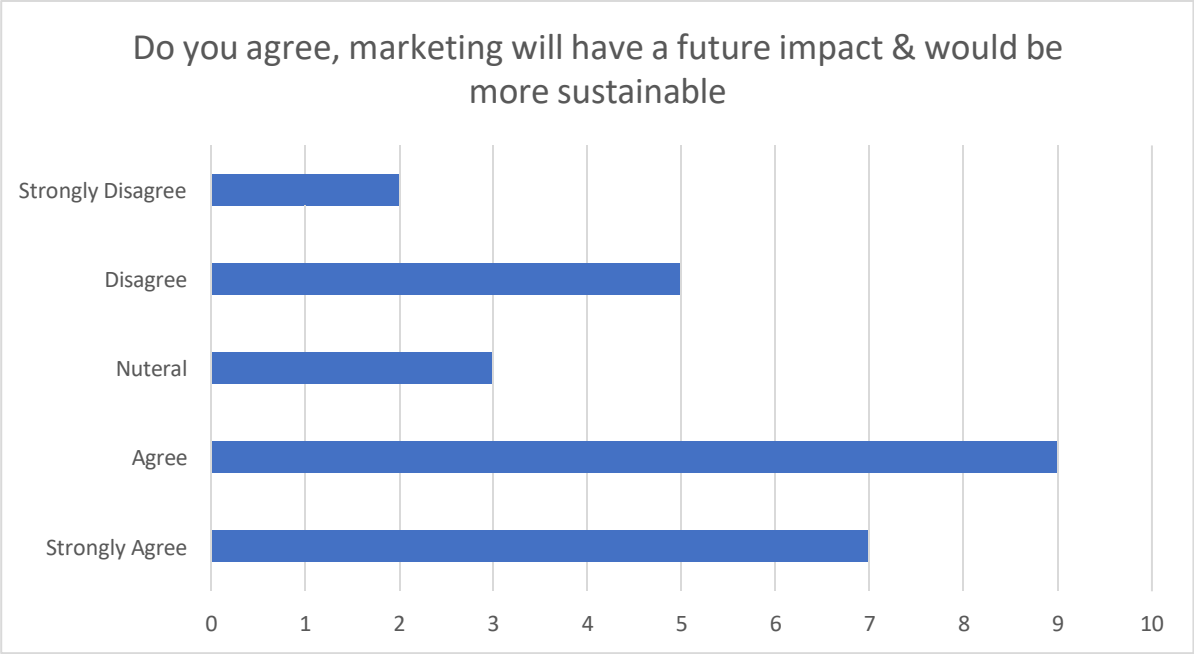
Inference: The above table provide the information of basic level of environmentalism practiced by an organisation. The number of respondents selected is 26 members. Among those 6 members voted for green marketing,4 members replied for recyclable bio degradable packing, the other 4 replied for energy-efficient operation and last 12 members opted for all the above.

Analysis: From the above table, we can illustrate that the basic level of environmentalism practised by an organisation. More respondent givestheir opinion for all the above factors like green marketing, Recyclable & Bio-degradable packing, Energy-efficient operation etc.so we can conclude that company is practising environmentalism in an organisation.

Table: 3.13: whether marketing have a future impact & would be more sustainable?

Do you agree, marketing will have a future impact & would be more sustainable		
Particulars	no of respondents	Percentage
Strongly Agree	7	26.92
Agree	9	34.62
Neutral	3	11.54
Disagree	5	19.23
Strongly Disagree	2	7.69
Total	26	100.00

Figure: 3.13;whether marketing have a future impact & would be more sustainable?



Source: Primary data

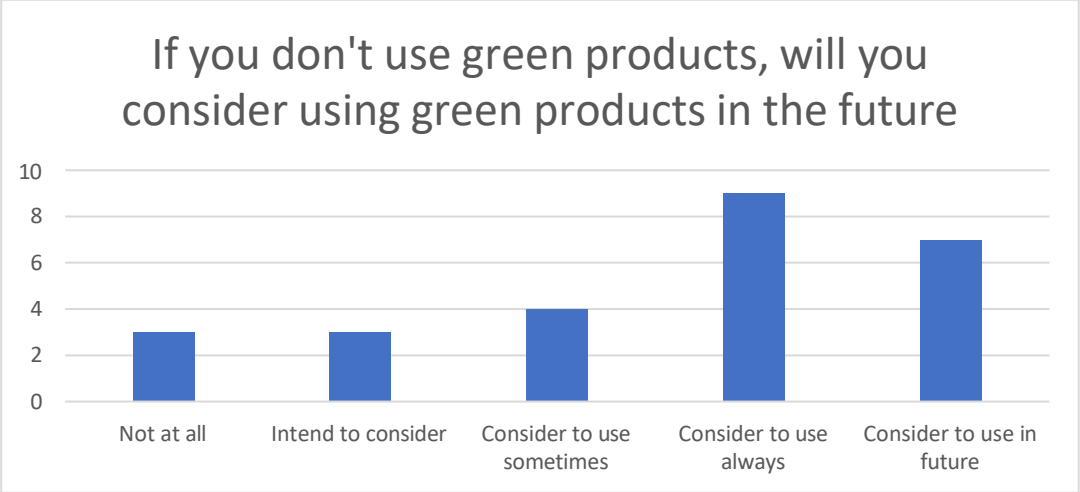
Inference: The above table gives the information that whether marketing will have a future impact & would be more sustainable. The respondent selected is 26 members. In that 7 members they said that strongly agree, 9members replied only agree, the other 3 members goes for neutral,5 members are disagreed and last 2 members replied strongly disagree.

Analysis: From the above table, we can illustrate that 9 members agreed for future impact of marketing, and only 2 members responded for strongly disagree.so we can conclude that the marketing will have future impact & would be more sustainable.

Table: 3.14: consider of using the green products in future?

	If you don't use green products, will you consider using green products in the future	
Particulars	no of respondents	Percentage
Not at all	3	11.54
Intend to consider	3	11.54
Consider to use sometimes	4	15.38
Consider to use always	9	34.62
Consider to use in future	7	26.92
Total	26	100.00

Figure: 3.14;consider of using the green products in future?



Source: Primary data

Inference: The above table is questioning to the respondents to consider using of green products in the future. The selected respondents are 26, in that 3 members replied not at all of using the green

product, other3 replied they may intend to consider of using green produts,4 members replied consider to use sometimes,9 members said consider to use always and last 7 members replied to use in the future.

Analysis: From the above table, we can come to conclusion that among 26 respondent,9 members replied that they consider to use green products in the future.so in the future more no of peoples go for using the green products which is good for individual and the country.

Findings of the study

- It is found that among 26 respondents only 18 members are aware of the green marketing.
- When compared to other media only television influenced the customer more about awareness of green products.
- Only 38% of the respondents have information about the green products at the time of buying the products.
- It is found that only less companies are participating in the green marketing.
- Only 53.85% of Management ethics followed in the company. Neglecting other types of ethics.
- 34.62% of people replied of future impact of marketing and sustainability.
- Only 26% of people replied to use green product in future.

Suggestions of the study

1. It Improve consciouness about green products and its effectiveness.
2. All types of Medias have to play a very important role in spreading awareness of the green products to the world.
3. The participation of companies in green marketing is very important.
4. Companies must adapt the ethics in an organisation.
5. The intense efforts should be made by government for implementing green marketing for wellbeing of next generation.

Conclusions

It is clearly evident that the majority of the consumers still lack green knowledge. The firms should work constantly to find out the green material, methods of making green finished products which are commercially viable. Most of the people are ready to accept, but the entrepreneurs and government has to take initiative for promoting and implementing the green marketing and green products. Every organisation must also follow the ethics.

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The Usage of Artificial Intelligence within Classrooms is a Boon to the Future of Education in the Digital Age

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Abstract

The present study explains that using artificial intelligence (AI) within classrooms is a boom to the future of education in the digital age. Teacher-student communication has also come a long way since the dawn of formal education. Teachers are becoming more careful in their classroom practices to help students achieve better and more lasting achievement. The widespread nature of technology influence is largely to blame for this change. Education has benefited greatly from the incorporation of AI into computing. AI has benefited classrooms and classroom learning in numerous ways. Among these are the development of a robotic teaching system and a method for automatically grading student response sheets. In order to present a thorough review and show the significance of AI in teaching and student analysis, we studied the many analysis enhancements implemented worldwide, such as computer science approaches used in the education sector. AI can improve education in low-resource situations by increasing teachers' use of available resources, as discussed in the first half of this paper. After showing the comprehensive character of AI, this paper looks into how governments and educational institutions are reassessing and retooling educational programs to better prepare students for this future. The study also examines the challenges and regulatory concerns when preparing students for a future when AI is widespread. Finally, it anticipates the future of AI in classrooms and encourages new discussions on how to best utilize such innovative tools in the future of education in the digital age. Our study shows that information science is the backbone upon which all intelligent teaching solutions built on artificial intelligence rest. Systems of this kind help persons improve their self-awareness, question-answering abilities, conflict-statement partitioning, creative question generation, and decision-making skills. AI is a rapidly growing field that could completely alter the way people interact with one another. Various educational institutions are presently piloting recently developed AI-generated educational solutions. This working paper aims to provide policymakers in the education sector with information they can use to get ready for the possible effects of AI on modern teaching-learning methods in the digital age.

Keywords: Usage, Artificial Intelligence, Classrooms, Boon, Future, Education, and Digital Age

Introduction

The educational system is essential to the success of a community. The networks it has established have a profound impact on every other sector. This is why, despite our differences, everyone needs access to high-quality education. The fast-expanding science of AI has the potential to transform human interaction drastically. AI has been studied in depth since it is the effect it has on individuals and society. It covers a wide range of relevant topics, including AI's future and current state in education, the tools and applications already used by various AI in education applications, academic developments, and the risks and constraints currently faced by AI in education. The progress of AI is changing every aspect of human existence. AI can model a system, estimate its complexity, and make solution recommendations based on information that is causing a paradigm shift in education by shedding light on topics such as how students learn, how to personalize students' educational experiences, how to obtain more data to aid decision-making, and how to model the complex interaction between student learning, the knowledge domain, and the tools that allow students to interact with the domain. Today's educational system needs to be simplified and taught using conventional techniques. All of these and more are explored in the study, from grading and evaluations to retention and attrition prediction models, sentiment analysis to intelligent tutoring, classroom monitoring, and the generation of suggestions. Recent AI-generated instructional solutions are being piloted at several educational institutions. What about the need for complicated facilities and a strong ecosystem of inventors in developing countries to accommodate AI? Is the affordable use of AI a realistic possibility, and if so, when? Should we put off addressing AI until we close the gap between the digital and social spheres? Whether the education sector has had an exceptionally rapid adoption of AI. AI has many potential applications in the classroom, including facilitating better two-way communication between teachers and students. The ability to tailor lessons to each student's prior knowledge, learning style, and course objectives has transformed how we educate.

Instead of relying on one-time assessments of strengths and weaknesses, we continually track each student's learning history to identify areas for growth and offer suitable courses (Ahmad et al., S. I, 2021). Now is the time to put AI to good use. The explosion in online education is generating a tidal wave of data that AI may one day examine to help decipher the knotty problems currently plaguing academia and

usher in more efficient technology solutions. Academics, teachers, lawmakers, and the private sector have all been keeping a careful eye on the use of AI in schools during the past decade. Experts estimate that the US AI market in education will expand by more than 47% between 2018 and 2022 (Ahmad et al., 2020). In recent years, AI has emerged as a paradigm shift in several fields, including academia. The positive effects that AI is having on the classroom, for both students and teachers, bode well for the future of education in the digital age.

What Does Artificial Intelligence Mean

AI is the ability to absorb external information successfully, learn from this information, and apply such lessons toward fulfilling stated goals and activities through flexible adaptation (Kaplan & Haenlein, 2019). Poole and Mackworth (2010) created the term AI to describe the study of developing and accessing intelligent computer programs. Agents ultimately bring about changes to the status quo. AI is the capacity of computers to mimic intelligent behaviour in humans and other animals. This technology makes uses like speech recognition, education, planning, and problem-solving possible. AI is essential in robotics because the field concentrates on linking perception and behaviour. There are fundamental questions at the heart of AI, such as: What kinds of knowledge are necessary for different kinds of thinking? How should that knowledge be represented?

Moreover, how should that knowledge be used? In robotics, AI is put to the test since it must learn to control and manage things that are real. The ability to tailor lessons to each student is one of AI's most potential contributions to education. AI-powered learning platforms may evaluate student data to determine each student's unique learning preferences, skills, and weaknesses. AI may look at each student's test results, attendance records, and other data to see where they excel and where they could use some extra help. From its early days of exploration, AI has developed into a field with far-reaching implications. There has been some shift in the definition of AI. Many professionals in AI joke that the definition of AI is everything computers still cannot do.

Despite the humorous nature of the expression, the fear that something entirely new could be created as an outcome of advances in AI and robots is not. Defining AI, a thought process that has developed and evolved, is challenging. One of the most ground-breaking innovations of the last decade, and likely the next, is AI, and will

likely be one of the most significant technological advances of the next ten years. This research aims to facilitate in-depth assessment and constructive discussion of AI by providing easily accessible information on current and predicted AI approaches and their implications. It also outlines various legal, technological, and societal activities that could be mobilized in response. It is based on the European Commission's latest (2018) and most thorough definition of AI. AI enables machines to learn and make decisions without human input. Since AI could mean many different things, we need a clearer one. In conversations regarding the ethics of data-driven approaches that make their judgments about individuals, it is crucial to distinguish between arguments about basic expert systems in advising positions and those about more complicated ones. The potential impacts of AI need to be addressed openly. The expert panel decided to look into how AI could alter the classroom dynamic. Since the significance of the story and framework for evaluating AI emerged from the fieldwork, the experts focused on management, education, and training. Items like computers and machines have intellect on par with people thanks to the combination of discoveries and improvements in domains like cognition, learning, adaptation, and decision-making with the study of artificial intelligence. The outcome was supported by prior studies showing widespread AI use in educational settings, particularly at the university level. Following embedded computer systems and other technologies, the most recent AI deployments are web-based chatbots and AI humanoids that execute the roles and behaviours of teachers, either independently or in combination with teachers. The technologies let teachers assess and grade student work faster and more accurately. Teachers may rest easy knowing that their students will pay attention and retain the material offered to them because these systems rely on AI and adaptability in the digital age.

The Importance of Artificial Intelligence in Education

One of the most ground-breaking innovations of the last decade, and likely the next as well, is AI is rapidly invading every aspect of our lives, from the way we shop and learn to the way we connect with others, and is one of the most revolutionary innovations of the past decade and, most likely, the next as well. Due to the rapid development of technology, students must obtain AI education as part of their legally binding education. This underlines the need to remember

underprivileged schools, whose students are typically the last to gain access to new technology. One of the most ground-breaking innovations of the last decade, and likely the next, is In the past decade. The next revolutionary development was one of the most innovative innovations of the previous decade. The next, as well, is One of the most ground-breaking developments of the last decade. One of the most revolutionary inventions of the last decade and, most likely, the future is the supercomputer, which comes to mind when most people think of AI. These robots can act and think like humans because of their advanced artificial intelligence, ability to learn and adapt, and other features. The temperature in smart buildings may change depending on the mood of the people within, as depicted in one of the numerous films designed to demonstrate the promise of AI. One of the most ground-breaking innovations of the last decade, and likely the next as well, is AI is one of the most game-changing technologies of the previous decade and will continue to be so in the next. It is still in its infancy. However, it has already begun transforming educational materials and long-standing structures, making it one of the most revolutionary advances of the past decade and, very likely, the future. The educational sector recommends that students always have easy access to qualified instructors. Teachers now play a different and arguably more important function due to the advent of AI. To calculate an individual's velocity about the group's average velocity, the AI significantly utilizes complicated analytics, deep learning, and machine learning. New and improved AI solutions are shining a light on where schools may be made better, inspiring pedagogical changes in the classroom. Perhaps teachers will have more time to focus on helping kids learn and adapt to new conditions, two areas where computers now struggle if AI can improve efficiency and personalization and eliminate administrative processes in the classroom. The highest results for children have been seen when state-of-the-art resources are used with competent teachers (Kengam, J., 2020).

As the capabilities of AI go beyond those of a supercomputer, embedded computer systems and other forms of AI are becoming increasingly popular in schools. With the help of computers, AI, and other supporting technology, educational robots have been developed to assist students from kindergarten through college. M. J. Timms (2016) claims that robots already offer personalized instruction in basic skills like spelling and pronunciation. Chassignol, M.

Vaismoradi, H. Turunen, and T. Bondas (2013) argue that AI should be incorporated into all facets of education to improve these processes. Since these questions are central to the AI education paradigm proposed by Chassignol et al., (2018) they will be the primary focus of the analysis. AI is becoming increasingly pervasive in our daily lives, making it one of the most revolutionary innovations of the last decade and one of the most innovative technologies of the upcoming decade. This is why schools keep working, constantly churning out new students to power AI's exponential rise. There has been progress in STEM (science, technology, engineering, and mathematics) education, but students still need more help preparing for classrooms in the digital age.

Artificial Intelligence Support for Teaching-Learning

Future developments in education have an inherent connection to the rising processing power needed to create smart machines. Regarding recent developments in AI, teachers in higher education may be presented with both an opportunity and a challenge: the possibility of significant change in the structure and administration of today's educational institutions. The fundamental motivation for this research was to provide policymakers and educators with a better understanding of these revolutionary technical developments. We need a clearer understanding of what AI is and what it is capable of before we can evaluate its impact. The current assault of AI makes this harder to accomplish. Many schools and regulatory bodies are still in the learning phase of AI. It is tempting to get swept up in the happiness around recent advancements in AI, such as self-driving cars and robots that can pass for humans by mimicking human speech. Of course, there is a better situation. Due to technological, societal, scientific, and conceptual limitations, AI is still in its infancy. Surprisingly, cutting-edge approaches and ideas from the study of human learning can provide insight into the future of AI. Since modern AI systems rely on simplified representations of learning and biological intelligence, learning theories help understand their abilities (Ilkka, 2018). AI can greatly enhance the condition of education by facilitating more efficient classrooms, boosting teachers, and expanding students' access to personalized learning experiences. Teachers should have access to the resources they need to integrate new technologies into their lessons effectively. In many areas, including progress, adaptation, diversity, language, games, and immersion, AI is already having a tremendous

effect on the educational industry. In personalized education, AI-enabled systems analyze each student's learning profile and adapt the curriculum appropriately. If a student is using a tailored learning platform, they may find it simpler to study and remember the material. With AI taking over every day administrative duties, teachers will have more time to focus on student learning and individualization. Access to AI-powered virtual tutors on-demand is incredibly helpful for students with special needs. Several aspects of AI's potential to improve education are investigated here. AI has the potential to advance the field of education significantly. This could lead to more effective school administration and evaluation of teachers, as well as the development of innovative classrooms and educational resources. The AI age has brought new standards to education, and it is advised that schools adopt these practices to support the use of AI to advance the transformation of teaching and learning in the digital age.

Artificial Intelligence in the Classroom

AI depends on computers' innate abilities to identify visual and auditory cues, engage in two-way communication via built-in Language modules, reason using computer programs, and store and recall enormous amounts of information. Education is not immune to the far-reaching changes brought about by AI. The ability of AI to adapt lessons to each learner has significant implications for the field of education. The concept of AI has always intrigued people from all walks of life. Many groups have proposed various descriptions of AI in today's classrooms. It is worth living in the insight it provides on the potential applications of AI in the classroom. This review is also motivated by the question of whether and how AI could be used to make better use of educational inputs.

- In the 1970s, experts began probing AI's potential in machine learning and natural language processing. It paves the door for intelligent systems for tutoring that may comprehend student feedback and adapt their instruction accordingly.
- The AI of the 1980s is used to enhance teaching and tutoring. There has been an increase in exchange for integrating expert systems into educational settings.
- Since the 1990s, AI has created smart learning environments and adaptable educational systems. AI-based lesson preparation ponders students' expertise and learning styles.

- In the 2000s, data mining and learning insights saw major developments, making information-driven pedagogy an achievable aim for teachers. AI drives virtual classrooms and tutors.
- 2020s, as an outcome of the COVID-19 pandemic, schools are increasingly relying on AI, particularly for things like distance learning and testing. Chatbots using AI allow students to get help whenever and wherever they need it. Virtual and augmented reality are now being studied to determine whether they may be utilized to improve the educational process (Adair, A., 2022).

Benefits of Artificial Intelligence in Education

As the number of uses for AI grows, experts will have to assess its worth. To advocate for AI, justify investment in AI, and assess the outcomes of deploying AI, one must be familiar with the benefits of AI. Several aspects of education have benefited from AI. Quality and efficiency rise, expenses fall, knowledge and wisdom grow, opportunities emerge, and the satisfaction of both students and teachers rises. Before the full potential of AI in the classroom can be realized, much more study is needed. The quality of information, problem complexity, neural network and model choice, human knowledge and involvement, biases and ethics, computational resources and infrastructure, and so on, should all be considered before committing to an AI solution (Umer Sultan, C,2023). Young adults and teenagers who did not grow up with cell phones quickly become a minority. Using AI, even only a few minutes of study time can be more productive. In the future, AI might utilize gesture recognition to measure students' degrees of anxiety. Human emotions and body language are being taught to artificial intelligence so that it can assist sleepy students. With AI, computers could provide individualized lessons to each learner. Recent advances in AI have made it possible for students who are deaf or hard of hearing to participate fully in classroom debates. A sick child who cannot attend class will be eternally grateful for this. In most schools, grading students' work is a major time commitment.

The use of AI could greatly increase output. Filling in any knowledge gaps is also covered. Those who have trouble connecting with others due to language or other hurdles can

now choose from a variety of options based on artificial intelligence. The presentation translator is a software program powered by AI that can provide real-time presentation captions. When students do not comprehend the target language, Google Translate is the only tool to help them catch up with the rest of the class. Virtual assistants provide free learning resources for students outside of the classroom. These voice assistants can save the school money by answering common queries about the campus and a specific student's schedule and classes without the need to print and distribute handbooks, which are only used briefly at the beginning of each student's acceptance. Over the next few years, we anticipate a steady but slow rise in the application of this AI technology.

Challenges for Artificial Intelligence in Education

AI is advancing rapidly, which could have profound implications for human interactions and collaboration. Numerous educational institutions are now investigating the use of AI-generated pedagogical solutions. This study examines the development of AI education worldwide, focusing on programs that help children from families with poor incomes. Since AI could significantly change education, there are many unanswered questions. As AI is developed further and implemented into the current educational system, experts and programmers must work together to address potential challenges (Umer Sultan, C,2023). Finally, the challenges and policy implications of integrating AI into classrooms and preparing students for a society ruled by AI are discussed, as they should be a part of global and local discussions on both the advantages and the risks of doing so. Most existing apps are created with firms in mind, which is an enormous challenge to the wider use of AI in classrooms. However, only some people involved in the development of AI have the expertise in education and the learning sciences necessary for the technology to be applied effectively in the classroom (Luckin & Cukurova, 2019). It draws attention to issues like AI's inaccuracy, limited capabilities, and limited applicability when implementing AI in the classroom. These results highlight the need for further investment in the study and creation of AI systems with the technical and pedagogical expertise to contribute substantially to education in various settings. To achieve this goal, it will be vital for the developers of AI tools to collaborate with teachers and students. However, the needs and desires of educators should be more noticed in favour of AI progress (Cukurova & Luckin, 2018; Luckin

& Cukurova, 2019). It is important to consider the opinions and goals of educators before implementing AI in the classroom (Holmes et al., 2019). As per the work done by Seufert et al. (2020), teachers will play a pivotal role in developing AI in schools. More research into the pros and cons of implementing AI in the classroom is necessary. However, educators' perspectives should be considered when addressing the implementation of AI in the classroom. Teachers have yet to contribute to artificial intelligence research, and the academic community has paid scant attention to their suggestions for improving the educational use of AI in the digital age.

Artificial Intelligence in the Digital Age

It will take significant effort and time from many people across academia, government, and society to create an AI platform that can be accessed on demand. It examined the evolution of the concept of AI and defined it as closely as possible. Integrating the provided concepts and applications, a proposed proprietary classification of AI services was created. Common AI system development models now include support for model-based control. The design for an immediate AI platform that could support the presented model was also proposed. Numerous place a premium on AI exploration, creation, and application today. The success of any nation depends on its people and their access to and use of knowledge. Its main focus is AI and how it could be deployed in business by creating appropriate frameworks and models. This effort aims to lay a foundation for further study and development of AI in the digital age (Stamova et al.; M., 2020). There has been a dramatic shift in advertising strategies since the advent of AI. AI-enabled marketing strategies are replacing more traditional methods. This piece analyzes the pros and cons of using AI in online advertising efforts. We also discuss the importance of balancing socially responsible advertising and modern AI developments in the digital age (Mazur, N,2023). The usage of AI technology to generate ongoing internet money has grown in contemporary schools. With integrated hardware, recurrent processing, and advanced techniques, AI develops software that adheres to pre-existing patterns. It allows management the discretion to exercise wise judgment, which improves the institution's financial performance and can be applied in various ways in the digital age. It enables businesses to reach out to existing clients more successfully and draw in new ones. Many schools will employ chatbots to assist students in a few years. The decline in the need for human beings across various fields, including content

creation and management in a digital age, has impacted higher education.

Conclusion

AI represents a big improvement in education. The use of AI in education at the next level is still being developed. As an outcome, individuals creating AI applications should appropriately notify policymakers and teachers. Given that AI is the future of technology, schools should begin introducing it to their students despite its flaws. Starting at the primary stages of education, the effects of AI will gradually move up to higher education. It will take some time before it is obvious how AI will affect schooling in the long run. The potential, profit, tools, applications, research trends over the next five years, limits, and hazards of implementing AI in the classroom are discussed. Strategies for grading students' work, methods for keeping students engaged, online classrooms, data mining for student feedback, artificial intelligence-driven tutoring, and classroom observation were all covered. Career options for AI researchers and software engineers were addressed as well. The most well-known methods for teaching AI are also explored. AI seeks to simplify the work of teachers rather than replace them. Personal computers and later advances that improved processing and computing capability and the ability to embed or integrate computer technologies in machinery, equipment, and platforms stimulated AI development and deployment in many fields. Teaching in studied institutions employs AI. AI's impact on education administration, instruction, and learning was investigated. Computers and systems preceded online AI education. Together or alone, robots and chatbots may teach and solve problems. Tools help teachers work faster and teach better. Personalized content from AI improves student learning. Digital school management and learning have altered with AI in the digital age.

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Augmented and Virtual Reality in Intelligent Systems

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Abstract-Augmented Reality (AR) is defined as a combination of real and virtual worlds. It must be interactive, and it must be registered in 3-D. A common definition of Augmented Reality is Ronald Azuma's definition about a decade and a half ago. By the information about the real world, this information can be manipulated, analyzed, and filtered in many ways. The information related to the region of interest can be extracted and visualized in-situ with the combination of Virtual Reality (VR) technology and visualization methods. Virtual Reality and Augmented Reality are a part of a new type of Human-Computer Interface that enables scientists to see and manipulate a universe of information about their world in 3-D . Virtual Reality is defined as a computer-generated 3-D world, wherein the perception, rendering, and simulation of depth use context-appropriate representations. In the forests of the future, and combination of AR and VR technology supports Mixed Reality (MR) systems, where the user can see both the original world and a virtual world. However, all of this requires a powerful computing system with high efficiency and speed. Some researchers propose a networked-based architecture to MR systems to acquire, distribute, and render a vast amount of data.

Keywords - Augmented Reality (AR), Mixed Reality (MR), Virtual Reality (VR), Artificial Reality (AR)

2. Historical Development of AR and VR Technologies

Inspired by Morton Heilig's vision of a sensorial theatre, beginning from the 50's there was a lot of research in VR aimed at creating multisensory 360-degree environments. The first attempts in the application of tailored images and sound to pain reduction in burn patients were conducted by the University of California at Los Angeles and the University of Virtual Reality and Cyberpsychology sites were created. In the same years, Professor Igor P. Pavlov of the Russian Academy called the idea of a multisensory telecommunication for the perception of a sense of presence. Between the 60's and

the 70's, The Sword of Damocles, the Augmented Reality, by Myron Krueger, and the Related Systems of the Artificial Environment of NASA for the development of large-scale control and training applications were introduced. Between the 70's and the 90's, Personal Computing and Mainstream of Desktop CGI resulted in a radical change of context, conditions, general dimensions of the VR/AR field and related hardware devices. An explosion of research in VR began, including cultural heritage applications. Starting from 2000, several travel agencies proposed virtual visits to archaeological sites. Still, there have been technological developments in statistical rendering, the use of Geographical Information Systems in Cultural Heritage Site Information systems, and Historical Reconstruction in Virtual Reality through Geometric Modelling. Recently, low-cost telepresence devices like the Oculus Rift headset have drawn back the focus on depth-enhanced data visualization and teleconference applications. Since the beginning of the past decade, AV devices and interaction systems have spread into home and personal use and at all resolution levels. This opens to broader scenarios of use and brings strong importance to applications for individuals and social groups. At the same stage, powerful multi-user and multi-sensor resources became available for business and training applications. A graphic metaphor is thus emerging as a trend to be explored in Controlled Interactive Authentic Virtual Environments. But while beautification has been evidenced as a completion desideratum, consistent improvements in affordability and applicability have to date been developed in motion simulation and gesture interface technologies.

3. Core Concepts of Augmented Reality

During the last decade there have been remarkable advancements in technology, which made possible numerous applications of Augmented Reality (AR). The growth in the quality, size and cost of AR system components such as camera, screen, tracking devices, computing power and fast and flexible data links to databases made AR available to the general public. Future expectations can be that virtual layers will be indistinguishable from the real ones. It is relatively easy to expect that future applications may easily become complete reality-based virtual environments. On the other hand, the popularity of social networks made possible easy combining of AR with the web. Thus, new communication and marketing channels are opening each day. The AR technology seems to be the technology of the future which will find its use in almost every segment of our life. AR is, at present, according to many market analysts, one of the top ten most disruptive new technologies.

For providing AR experience to a user, a number of parties have to carefully cooperate. A part of

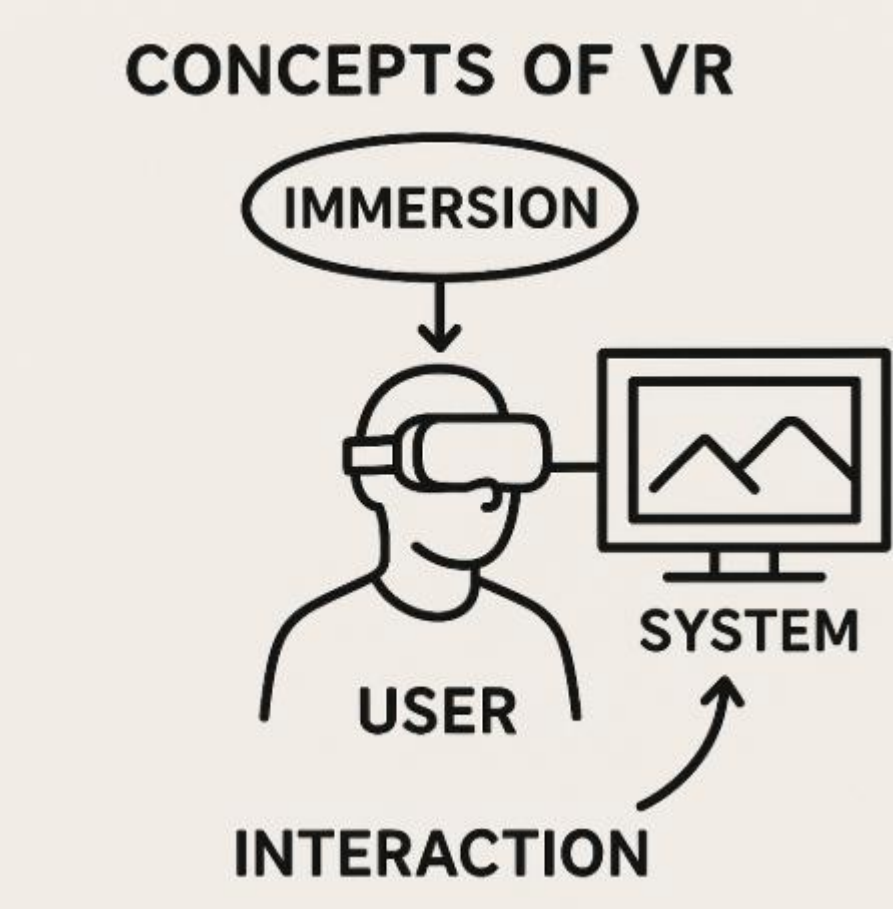
basic knowledge should be explained to understand the magnitude of this task. The main definition might be that AR technology, along with gigabyte IPS LCD for rendering on two dimensions, integrate 6DOF movement tracking for validating the explorability of much bigger data space in a natural way to the human. Because of showing a timeline in the usual panorama layout, it sometimes works better to add a third judge to explore data in the third dimension. Words might do not taunt the other parts of AR to garden the datasource, if the following graphical user interface used is for pastel color dots sketching. Proposing a new show and full of interaction between these intents, the demo itself of AR in a conference should be something very interesting. AR may combine with senses of space, in the shows through hand signals to move around, in the millions of last year's geographical data, by touch screens on a flame of windmill, or by moving with a smartphone to see the satellite view through points of interest . More possibilities are open.

4. Core Concepts of Virtual Reality

Next to augmented reality, virtual reality (VR) is one of the key concepts that is most often referred to and associated with immersive technologies. Where augmented reality enhances real life by adding digital augmentations to the real world, virtual reality equals the real world with a digital environment, to which all the senses are rendered accordingly. This means that any reference to VR will include the shaping of environments based on computer graphics, to which a person can be immersed into. However great research starts with definitions, so it is important to clarify the term before addressing the design and implementation of such systems. Virtual reality (VR) is trying to immerse a user in a virtual environment. Such a virtual environment is commonly wholly computer-generated 3D environment but can be a controlled real environment, where interactions within the environment and the reactions of the environment are computer-generated. For the sake of clarity, the term commonly referred to as VR will be used in this report to denote the class consisting of augmented reality and virtual environments.

There exists a huge variety of systems classified as VR applications. New concepts and directions in VR are constantly sought and proposed. In the perspective of someone trying to implement a new system and make choices of sensors, actuators and practices, it is convenient to have a generic picture of VR systems, describing such systems in a top-down approach, allowing to categorize these choices. To this end a reduced number of core concepts are preferred over a huge number of aspects. Here core concepts that capture the essence of VR are presented. The concepts put emphasis on a general

perspective on human-systems interaction, describing a user is immersed in a system . The degree of immersion related to presence experienced within such systems depends on the symmetry of the system and the task being performed.



4.1Introduction to Augmented and Virtual Reality

Virtual Reality (VR), which is used by scientists to visualize huge amounts of data, is a computer-generated 3-D world with the simulation of depth. A user can enter this world and explore the computer-generated data. By manipulation and free navigation in this world, knowledge about the augmented data may be gained . A network-based VR visualization system works in real-time with Global Information Systems (GIS) data acquired from sensors using new visualization technology. As the data coverage is limited, sparse points are visualized by a combination of ray- and polygon-tracing methods. A 3-D visualization system with arbitrary geometry can be composed in real-time using a new structure as a generalized container. New combination visualization methods have been developed for both surface models and volume data in an interactive manner over limited bandwidth.

5. Technological Framework for AR and VR

Augmented Reality (AR) is a technology that mixes a real-world environment with computer-generated information in real-time or non-real-time for different purposes. The generated information used in AR can be video, audio, text, even smell and touch sensations, or a combination of them that can enhance real-world experiences . In recent years, companies have conducted significant research on AR, indicating its importance or necessity for the future and its potential to change the way people live. Despite being a hot topic for research and development for several decades, AR technology has not yet come into people's daily lives as expected. The aim is to find the reasons behind the challenges in commercializing AR technology. The main design and operational principles are presented first because a clear understanding of these concepts is essential to comprehend the discussions of the next chapters. AR systems consist of three main components: input, AR engine, and output, where the AR engine is responsible for tracking and augmented content. The input components, computer vision and non-computer vision-based trackers, and augmented content generators, depending on the target platform of an AR system, are introduced in detail.

A clear understanding of the invoked challenges is very important to find possible prescriptions against each challenge. In order to ease understanding the discussion, challenges are first grouped into operational challenges and design challenges. In the subsequent chapters, each challenge is discussed in detail. Publicly available AR systems are considered in most cases; however, the concepts are applicable to non-publicly available systems as well. The main focus of augmented reality research is on visual AR. Nevertheless, almost all components and systems developed for visual AR are extendable to other modalities. Generating a broader definition of AR that covers richer modalities, such as audio AR or those encountered in everyday life that cite all human senses since there are no such benchmark works in the field and to stimulate more AR system developments in other modalities are among the contributions made to the field in this thesis .

AR is a technology that has great commercial potential and can be used for many applications. The quality, size and cost of AR system components such as camera, screen, tracking devices, and computing power made AR available to the general public. Technology of the future which will change the way of living in education, medicine, entertainment, advertising, and more. One of the top ten most disruptive technologies of the future according to many analysts which can potentially create a multi-trillion dollar market and millions of new jobs around the world.

6. Applications of Augmented Reality

Recently, augmented reality applications have been proposed to increase productivity and efficiency in industry. In modern factories, screen-based information systems are widely used to supply textual information on tasks to be performed. However, observation of two-dimensional screens is cumbersome or impossible when a factory operator needs to manipulate objectives with both hands during assembly. Just-in-time assembly instructions displayed in situ on an operator field of view (FoV) have therefore been proposed as an alternative, implementing data glasses and AR software. A model of an AR browser was developed to test AR hardware and software capable of forwarding visual data to the operator's vision as soon as it was available. As a result of this effort, data glasses controlled by Java software were purchased, and an open source AR display was selected to work with the glasses .

AR systems by using data glasses are currently designed to be modular, reflecting modular architecture of the operator's work environment. In its initial experimental stage, only one modular unit that contains one instruction database and one video camera was implemented. When sufficient operating capacity is achieved, more sophisticated components like multi-input signal processing, video streaming, or complex databases will be added. Ultimately, a fully functional AR monitoring system that covers the entire operator's workspace will be constructed and implemented. Recent research on applications of AR in marine technologies described peer reviewed AR systems. The aim of this work is to present a survey of AR applications designed for shipbuilding industry and marine technologies .

More complex applications like monitoring of marine equipment and underwater settlements and exploration of wrecks are also included. They are often supported by professionally made digital visualizations, which is not the case for most industrial applications. State of the art of AR applications was researched and analysed in related areas. Most of the work is conceptual and suggests R&D to develop AR effects and visualizations for industrial designs. Nevertheless, there are also some implementations of AR systems and consumer AR applications.

6.1. AR in Education

The impact of Augmented Reality (AR) on education is the potential of a novel approach to learning in formal education. AR is defined as a mental conceptual framework where the real world is used as a context upon which computergenerated elements can be overlaid in real-time. Computer-generated virtual elements can be of various types including pictures, sounds, 3D models, and video. An AR environment is an active environment that responds in real-time to user actions and is able to

update the display including both the real and virtual elements displayed. Primarily, AR applications use video-based tracking to determine the position, orientation, and identity of objects in the real world. Often the applications make use of prior knowledge of the positions of the real objects relative to the basic coordinate system of the AR system. The digitally augmented objects may be immovable relative to the real objects, or they may be moveable and hence able to control the interaction that is imbedded in the AR environment .

The positive benefits of using AR in primary education should focus on the uses from both teacher and student perspectives rather than a focus solely on the attributes of the technology, not only for the field of science education but to inform the design of future educational AR applications. This study investigates the effects of using AR applications to teach about the earth, sun, and moon in a primary school science unit on both teachers' and students' dialogic teaching and learning processes. Data is provided as to how the content of the unit is perceived by teachers and students and how AR might be beneficial for more facilitative and collaborative forms of learning.

6.2. AR in Healthcare

Most training programs in the field of medicine that are now using augmented reality (AR) can be categorised into treatment programs and training programs. The focus of this review article will be on AR training programs used in the field of medicine. This review paper will also explore how AR training programs have helped improve knowledge outcomes, learning outcomes, and skill outcomes in the field of medicine. Before the use of computers in medical education, some of the most common pedagogical tools available for medical education were textbooks, lectures, cadavers, and anatomical models. As the popularity of computers exploded in the 1980s and 1990s, basic computer-assisted anatomy programs began to appear. These programs often provided anatomical learning resources accompanied with multimedia approaches. Continuing advancements in hardware during the late 1990s allowed for a great expansion of presentation software from blackboards to Interactive Whiteboards. The invention of the World Wide Web made possible web based programs such as the Visible Human Project. The mid-1990s saw the use of computer-based stereoscopy, often through the use of Glasses Polarized or shutter glasses, giving the illusion of three dimensional depth (3D) . Virtual reality (VR) was tested in surgical simulation in the late 1990s, with demand-driven development of dedicated systems by commercial entreprises. It was also during this time that the use of cheaper computer-based learning was ubiquitous in anatomy teaching. However, the early adoption of VR in the field of medicine required developments such as modern head-mounted displays and projectors. As

with VR, these technologies required modelling on a computer using expensive software and development environments.

Immersive virtual environments have not yet found wide acceptance in medical education. From a technical perspective, the hard- and software necessary for a fully immersive experience were unavailable until recently. Moreover, the demonstration of a positive effect on knowledge gain is arguably a requirement for investing into such technology. Once video cameras on handheld smartphone and tablet devices became more accurate and convenient, augmented reality (AR) began to emerge as a medical tool, in part to route around the limited availability of immersive VR technologies. It is easy to see why AR, a method of displaying virtual three-dimensional (3D) content on the real world using a video camera and a video screen, became particularly popular. The accessibility and diffusion of smartphones and tablet devices into the hands (and pockets) of learners provided a channel for such devices on which AR could be developed with limited technological resources, hence greatly increasing its exposure and public awareness. This would prove to be an important feature of AR as tight university and departmental budgets became even tighter because of the current global pandemic.

6.3. AR in Retail

The retail industry is characterized by a particular challenge. While consumers shopping online are mainly exposed to the flat and two dimensional sensory system of a desktop or mobile screen, they visit physical stores to experience the three-dimensional and spatial stimuli of the presented products. In contrast to the flat representation in online and mobile shopping, advertising tests show a much greater effectiveness of three-dimensional presentations in physical stores . This aspect is particularly interesting to physical stores because they operate under stronger space-related constraints in terms of information presentation than do online or mobile shops. AR opens up virtually unlimited space in the digital world for physical objects at the point of sale and avoids ambiguity between product type and sales channel. Therefore, it is a particularly fitting fit with the context and objects of the retail industry. A first group of AR functions of the proposed typology refers to the visualization function. These AR functions allow users to see a virtual 3D model of a product or visualize specific aspects of it or certain benefits. Users can interact with the model and turn it to view it from different angles or they might customize the size, colors, and shape. Products are also endowed with light and sound effects. A second group of AR functions of the proposed typology make up the virtual try-on functions. These

AR functions allow users to augment themselves with virtual objects. This AR function is frequently applied in e-commerce and m-commerce to allow consumers to try on products in the digital world. Such virtual try-on functionalities can be generally differentiated. A first type of augmentation refers to the physical surrounding of the user with virtual elements. Consumers can scan or click objects of the catalogue, website or app and place these elements virtually in their physical rooms. For instance, apps allow consumers to explore their catalogue and virtually arrange the selected furniture in their own rooms. Furniture planners support consumers in imagining how these pieces of furniture would look in their rooms.

7. Applications of Virtual Reality

Generally, virtual reality-based systems can be used in different fields, including medical, military, education, industrial, and so forth . As technology advances, a growing number of sectors come up with creative techniques to address their training needs using such systems. One possible industry that can respond to this opportunity is the vocation education and training (VET) sectors.

The VET is used to develop the profession skills of people. In numerous sectors that involve some potentially dangerous process, the VET is an important consideration to be taken care of. In those sectors, the workplace safety is generally low in value and the people new to the workplace are required to be trained before processing their work.

Safety training programs will have to be organized for new workplace entrants, and such programs can be numerous, tedious, and difficult in such changing environments due to factors, such as workplace diversity, availability of training resources, availability of trainers, uniformity of training contents, practicality of training, diversity of trainees and culture, adaptability of training programs to different capabilities of trainees and so forth. Besides, the implementation of safety devices such as mock-ups and simulator systems can be expensive, and the results from mock-ups are not sufficiently close to real environments. As such, it can be a difficult task to carry out a good safety training system in those work sectors.

7.1. VR in Training Simulations

The use of virtual reality (VR) technology in simulation-based training is not new. Some current examples of VR trainers are fully immersive dome or half-dome style trainers with a movable platform and a vibration input. Wearing a high-field MR scanner VR headset, participants are ringed with three

projectors with a virtual domain created by a series of two-dimensional (2D) photographs taken from a car. Another simple system comprised the scanning or a Electro-optical system that made the input of 3D 360-degree photographs usable on a browser. With mobile devices or computers, users can share an unlimited number of scenes being browsed from anywhere on the earth. Training simulations typically consist of a computerized replicated but simplified version of a real training environment and the simulation hosts sets of 3D objects. An instructor using a computer selects pre-made or interactive 3D objects to arrange in the simulation window. At setup in the simulation, participants are paired and can share a 100 or 360-degree viewpoint in the VR simulations, while their interactions with the simulation are sent and appear immediately at the other participant's sides.

While the simulated performance of tasks requires procedural knowledge which was claimed to usually be a simple input-output mapping without explicit representations, the acquisition of physical scenes from the perspective of an abstracted environment needs causal knowledge that was claimed to encode will-to happenings that assume possible outcomes based on possibilities. High-field MR scanners with operational skills such as object arrangement and VR devices with scene understanding were designed and developed for the matching of this knowledge. It accomplishes a two-track context scan and training design, including a specialized interface for the scanner layout configuration set up with the makers and a shared training task on the design of scan durations and slice angles. Augmented reality (AR) technology has experienced rapid evolution since the second half of the last century and has been widely and reasonably employed for training devices. Nevertheless, as far as widely-usable AR systems designed in the previous paradigm were considered for the effective search of training devices, in-person training giving rise to side-effects remains the technologies to be adopted.

7.2. VR in Entertainment

In the past decades, with the rapid development of computer science, VR technology has been widely used in various fields. Until today, VEs have been used in various applications, ranging from 3D computer graphics and games to architecture, engineering, medicine, and military training, including spatial training, tourist information systems, scientific visualizations, and art galleries . Breaching physical constraints, VR environments can be created to enable users to experience simulated physical reality and provide exceptional entertainment such as playing virtual games, shopping in detail, and "walking" through reconstructions of ancient cities or well-known works of art. When designing a VR-based entertainment application, there are many factors to be considered. People

naturally believe that VR applications are more complex than typical computer graphics applications.

VR technology constructs artificial environments to provide users with an immersive experience generated from their actions in a computer-based environment. VR has attracted a lot of attention from both research and entertainment fields and is one of humanity's most ambitious computing endeavors. Immersive distributed environments or VEs replicating the physical world can provide users with a sense of visual realism, spatial awareness, and physical presence. In such environments, users may be connected through high-end immersive projection displays or inexpensive head-mounted displays and equipped with input devices such as gloves or sticks to generate natural feeds to the environment. Although users can effectively "enter inside" virtual worlds constructed using 3D computer graphics, the 3D models and images generated for outdoor scenes still provide sensuous data and must be analyzed and pre-processed for a real-time navigation experience.

7.3. VR in Therapy

Research made in the last 15 years has documented the success of computer-generated virtual reality (VR) technology in augmenting exposure in the treatment of phobias, anxiety and panic disorders, post-traumatic stress disorder (PTSD), and psychotic disorders. As an adjunct to clinical therapy exposure in virtual environments has also been applied successfully, albeit with mixed results, to obsessive-compulsive disorders and body image disturbances. In the treatment of anxiety disorders, computer-generated VEs have generally been shown to be at least as effective, if not, more effective than real-life exposure and have several advantages. Chief among these is the safety and control they afford to therapists who can more exactly tailor stimuli to individual patients.

Protocol specifications in VR exposure other than exposure duration suggest that more sustained or larger bandwidth or intensity stimuli elicit larger responses. The effectiveness of computer generated conditioned stimuli in producing strong cr1 and recovery conditions has been documented. However, regardless of mediating variables, comparison of both types of stimuli has generally shown no differences in both reactivity and fear acquisition and extinction between VR (exposure in real-time VE) and real conditions (exposure to video or photo of VE). This suggests that VR exposure works, at least, by tapping direct reactivity mechanisms of the mind, rather than through higher order cognitive processes .

Several modifications to earlier protocols have been implemented to improve treatment effectiveness. These include scripted and therapist supervised exposure, real-time cellular modulations

in VR and adjunct non-VR therapeutic interventions delivered before or after exposure sessions. Very few studies are available in which both types of stimuli are compared within and between exposure types.

8. Integration of AR and VR in Intelligent Systems

One line of intelligent systems integration with AR and VR is the development of wearable AR and VR systems as auxiliary devices of a variety of mobile robots (cruisers, wheeled and tracked vehicles, UAVs) and of marine vessels . The system development using wearable AR and VR devices is illustrated in a platform integrating onboard and personal devices (smart glasses, smartphones, and VR goggles) with various mobile robot platforms (ground vehicles, UAVs, etc.) controlled via personal computers or mobile tablets and smartphones. A huge variety of application scenarios in industry and education are described. New aspects of intelligent systems designed for integration with AR or VR devices are underlined. AR applications related to mobile robotic systems, mobile robot teleoperation systems and related AR interfaces are described. Some of these applications are realized, and early field tests performed.

It has been observed that various intelligent systems could be integrated with AR & VR systems and vice versa. With the rapid development of AR and VR technologies, the number and range of integrated intelligent systems will significantly grow. The quality, size and cost of AR system components made AR available to general public. Moreover, the components of the AR system are expected to improve dramatically and bring at-present-unimaginable AR applications to the market in the near future . One can expect that virtual layers will be indistinguishable from the real ones, and the future applications may easily become complete reality based virtual environments. AR is definitely technology of the future which will find its use in almost every segment of our life and is, according to many market analysts, one of the top ten most disruptive new technologies.

9. User Experience Design in AR and VR

Although augmented reality (AR) and virtual reality (VR) technologies have existed for many years, their recent surge in popularity has led to a plethora of novel applications, experiences, and products. These inventions have expanded the scope of what it means to work with and design for AR and VR as application areas. With it, new Design and User Experience (UX) complexity dimensions arise, derived from spatial and sensory new affordances not found in other interaction paradigms

relevant prior to the XR surge. This chapter discusses the role of UX design practices, methods, and tools in creating high-quality AR and VR multi- and cross-sensory even more user-centred experiences, as well as some supporting design tools for this maturity level .

User Experience (UX) refers to the totality of experiences reactions made to a certain interactive artefact, concept, product, or service before, during, and after use. This includes both rationally and emotionally based perspectives, covering anything from usability, value, and satisfaction to feelings of enjoyment and fun. UX increasingly informs industries and sectors beyond the traditional tech industry, including automotive, smart homes, healthcare, and digital well-being. In the last decades, applications of UX design methods and processes have spread into non-traditional contexts. UX design processes usually consist of exploring what the product, service, or concept should do or be, how it will be used, and by whom (user research). This may include stakeholder discovery or user research methods to help map the user journey and pinpoint opportunity areas.

After having defined the problem-space, solutions are ideated, brainstormed, sketched, prototyped, and wireframed (ideation). This involves a mix of online and analogue means, moving from brainstorming methods to wireframes. Guided by the evolving design solutions, as well as earlier research in the process, design storytelling gives voice and a narrative to the outcome of the work before informing fidelity testing. Summative evaluations, often involving controlled settings with pre/post-tests & observations, are undertaken to evaluate how the product meets the requirements and objectives stated earlier.

10. Challenges in AR and VR Implementation

While Augmented Reality (AR) capabilities are rapidly improving and more AR applications have become available, there are significant challenges with AR implementation and execution. For AR to register well with the real world, AR techniques such as tracking, calibration and mapping need to be employed. It is also necessary to rapidly process and visualize the real-time stereo videos delivered by cameras with sufficient precision. Further, there are still significant limitations in AR's ability to support complex visual systems, as expressed by one of the potential users: "I'm used to looking at drawings most of my life, I'm not prepared for a revolution" . Also, the unnatural execution of actions with stereo cameras, such as garnishing dishes, truly hampers AR's acceptance by restaurant chefs. Application engineers also need good understanding of usability and efficient human system design due to development of visual interactive systems. Too often AR image processing techniques are based

on brute force and good results are not even close to real-time. Also, AR algorithms require careful tuning for their accomplishment in real-life applications.

There are also AR scenarios tag-teaming realistic 2D image presentations with 3D CAD systems. Unrealistic execution results, such as rendering 3D image segments selected and tagged by the user the next moment after the button is clicked, make the implementation of the real concept rather difficult. Requirements on hardware implementation of the unpleasant computation time make the usability of the interface low. Geometric projection of 3D vision onto a 2D screen cannot be measured as usual, under which projection preferable viewing angles for the users are well recorded on 2D visual surfaces. The error initiated by geometrically distorted viewing angles yielded from the absolute perspective method for projection is usually capped at less than 10%. This valuation of projection is also justified by user-view photographs captured on the projection display system configuration, and some AR testing cases are demonstrated. It is effective to use the projection error to identify appropriate viewing angles and parameters after improper viewing parameters in projection systems. Multiple graphics cards and installation of extra cameras for stereo displays and AR presentations become cost-effective hardware feasibility options.

10.1. Technical Limitations

Augmented reality (AR), a method of conveying additional information to the user's visual input, has recently gained traction as an immersive delivery mechanism. AR puts the real as background and adds a "virtual layer" of information on top of it. This external information is congruent with what the user sees, interacts with, or focuses on in the real environment, thus augmenting (additional) reality . While it is nonetheless used heavily within the military, healthcare, and training fields, its usage in manufacturing, product design, architecture, and entertainment is rapidly progressing . Many of these applications involve complex interactions between a user and one or more information layers. This evolving capability is reflected in the varied degree of augmentedness involved in recent AR research, which ranges from static objects superimposed in the real domain to richly interactive mixed-reality frameworks that enable pervasive interaction between real and virtual objects.

Beyond baseline understanding, research will require attention to perceptual and technical limitations of the human information processing system. Once the basic constructions of an AR experience have been established and implemented, future research could utilize more dynamic and adaptive information constructs that progressively reveal new information in response to users' level of

skill, focus, or curiosity. Particular attention to perceptual limits is essential in this instance, but there will also be performance and design tradeoffs. As the AR experience interacting with information becomes richer and more complex over time, the limits of the AR hardware, the expertise of the user, and the simple mathematics of spatial cognition will all adaptively entail errors. Thus, future research could involve considerations of errors and misinterpretations that complex modes of AR information interaction may instigate.

10.2. User Acceptance

User acceptance of AR / VR devices and applications is a very active field of research. While the underlying acceptance research is well understood, most of the classic Technology Acceptance Models (TAM) need to be adapted to the new device form-factors and their application domains. The extension of classic TAM models requires not only an extension of the theoretical construction but also a new items and measurement instrument.

Perceived ease of use has a significant influence on pragmatic quality, which, in turn, significantly influences perceived ease of use. Intention to use VR appears to be significantly influenced by perceived usefulness and severity of cybersickness symptoms. The severity of cybersickness symptoms significantly affects technology interaction enjoyment. VR POC has a considerable influence on intention of purchasing VR hardware. Such influencing factors include perceived social presence, perceived interactivity, and perceived stress. The severity of cybersickness symptoms significantly affects technology interaction enjoyment. A VR-centric model for understanding user acceptance of VR, including construct, items, and measurement instrument. In VR POC scenario user acceptance differs from traditional applications .

The aim was to explore the UX and social acceptability of AR gaming applications in different social environments and focus of interaction. An experiment with a public AR game taking place in a public square and in a private garden was conducted with two versions, one designed for single-player interaction and the other for multi-player interaction. Various metrics were gathered about UX and social acceptability. For public square, the strongest UX differences were observed between versions. Multi-player play was favored while single-player play was judged less immersive and attention-demanding. For both versions, participants reported tension and reception but were not concerned about people's perceptions. Different interaction focus and social environment can influence game UX and social acceptability with important implications for game design, technology development, and

involved stakeholders.

10.3. Ethical Considerations

The development of virtual reality (VR) and augmented reality (AR) has created new opportunities to affect the way we communicate and behave in the world. Much attention has been given to the potential positive uses of these technologies, such as user interfaces to wholly new capabilities of computers; educational and training tools in fields ranging from healthcare to aviation; high-quality entertainment; and immersive representations of spaces that provide access to locations otherwise difficult or costly to reach. However, as previous technologies of great social consequence have shown, new communications tools can also be misused with unintended negative consequences; thus, it is critical to examine the potential negative uses and impacts of any new technology, especially those with the potential to affect many lives.

Augmented reality glasses with facial detection and/or displays have the potential to be magnificent tools for transforming how we experience events and communicate with others. However, they also raise ethical concerns that affect individuals and groups, and society as a whole, and how these ethical concerns are valorized and prioritized is critical to their design. It is widely recognized that these devices can blur the distinction between public and private behavior and can affect perceptions of privacy and social interaction. Work has just begun in exploring the many ways in which these devices can be exploited for harmful purposes. They can enable new dimensions of social domination, isolation, and schadenfreude. People can picture a social situation in which they are perceived as infinitely ugly or naked in their own eyes. This can be accomplished in real-time or through the use of recorded footage. The misuse of these devices to create new untrustworthy video forms is already becoming known. They raise fundamental questions about the social and cultural value of human expression or how to create leveraged mediation for, say, the education of others. These applications will raise questions about what discourse, identity, perspective, and equality mean in such a world.

There is a need for careful examination of the means by which the ethical discussions of AR and VR are somehow becoming flattened or commodified and/or colonized by those justifying their development and computerization.

11. Future Trends in AR and VR Technologies

The last two years saw the first huge developments in VR and AR studies that focus on clinical

issues, particularly congenital difficulties, obsessive-compulsive disorders, traumatic memories re-living, and complex social behaviors' teaching and managing. The temporal slots analysis of the whole study period highlighted the presence of only one article in a neural degenerative disease environment and only one article focused on promoting health. AR research also highlighted a new neglected approach that, using 360° photos and video, could also overcome many aspects of the disabilities in enjoying VR and AR. The technologies used today heavily depend on what is available on the market. The last 5 years have seen the growing adoption of low-cost solutions that do not offer high levels of VR and AR. There has also been a gradual shift from off-the-shelf solutions to tailor-made developments. Hardware costs have rapidly decreased over the last years. Hardware dependence opens new problems for researchers who are now obliged to extensively solve technical issues and ensure robust systems that can be replicated and transferred to low-resource environments. From a hardware point of view, technologies are now a commodity widely available at low cost. However, this situation did not mean a decrease in innovation and research.

The gap between the past and the future of AR and VR research could be resumed in the key words "realism" and "interaction." The previous 30 years were characterized by continuous research devoted to the search for better resolution and the improvement of perception. Now researchers need to focus on realistic interaction and natural manipulation, not only on a great resolution. The Leap Motion device allows the use of the hands in the VR environment without the use of gloves or markers allowing natural interaction with virtual objects. Other forms of interactions include tactile and haptic devices to provide continuous feedback to users and intensify their experience by adding the feeling of touch and the physical weight of the virtual objects .

12. Case Studies of AR and VR in Intelligent Systems

Extended Reality (xR) is an umbrella term encompassing Augmented Reality (AR), Mixed Reality (MR), and Virtual Reality (VR) technologies, which are redefining human interactions with digital media. XR enables interaction with 3D virtual objects within the user’s own environment and the use of physical objects in the digital space. XR systems consist of installations that enable interaction with 3D virtual models inside the user's real environment. In the last few years, the dramatic growth in the field of extended reality has garnered interest in various applications. These include XR applied in education, design analysis, and visualization, professional training in health and medicine, architecture visualization, and museums and cultural heritage. While the impressive achievements of digital

technologies have won great accolades, the inquiry into testing and validating these emerging technologies has attracted less interest. To be suitable for industrial applications, the usability of the XR technologies needs to be evaluated and assured. Testing and validation should be performed before an XR system goes into production to avoid a final product that does not meet expectations. Tests can also be performed during implementation to control the quality of the XR content during the production phase. In addition to these quality control tests, acceptance tests are required when a new XR system is in operation to check that the system continues to perform as expected during use. There is a considerable lack of knowledge regarding effective approaches for the testing and validation of the AR and VR both to assess their usability and suitability for industrial purposes . Not enough is known about the factors affecting the usability of these technologies in industry, or how to test the usability in a proper way. Current usability guidelines are primarily based on web, and desktop applications, which differ greatly from AR and VR application characteristics. For the effective usage of AR and VR technologies to support production, their usability needs to be tested, and usability problems need to be identified and addressed.

AR, VR, and MR applications employ a mix of audio and visual rendering and interaction techniques to provide an immersive and interactive environment for the user. Commonly, the user wears a HMD, which is a display that covers the user's view. Not all HMDs are the same; they differ in the degree of similarity between the user's real view and what the HMD lets them see. This defines the level of immersion; the more a user sees the real world outside the HMD, the less immersive the experience is . In most of the application described, the user wears instead the HMD one or more 2-D monitors. While the experience is still very rich, the user has access to the environment, which makes it possible to perform other relating tasks aside to the experience. In this case, the user is less remote from the environment; hence, the form more sense of belonging to the place and tends to remember better all information. At the minimum, users interact with some input devices that may or may not be visible to them. They can be tracked by cameras as a point in 3-D space, having a set of buttons to click, or a simple mouse, or a keyboard. These input devices have a clear importance on the experience, and therefore on the results of any test. Some of the applications connect also a 3-D printer to allow the user to have a tangible physical object of a 3-D virtual model to improve experience. Provided there is no residual latency affecting the user's view, at least concerning the actual position in space and spectrum of the rendering, acceptance and satisfaction are usually very high.

12.1. Case Study 1: Smart Cities

Smart cities are cities with distributed intelligence or knowledge through the integration of advanced technologies such as IoT, cloud computing, big data analytics, and artificial intelligence. With the increasing amount of data from smart devices and sensors, the challenges of knowing the available services and using the services from anywhere arise. Two major solutions to these challenges are AR and VR. Both serve as human-computer interfaces/tools for smart city data visualization and user interaction. A smart city-based multimodal geo-portal for smart city services visualization and usage using AR through mobile devices is proposed in this invention .

A VR city-based geo-portal for smart city services visualization and usage using VR through Pentablets and VR headsets is presented. A phased action plan with the short-term, medium-term, and long-term goals for implementation of the proposed approach is indicated. The highlights on the novelty, significance of the proposal, and expected developments for future research are summarized. The smart city is based on the use of IoT and ICT for the effective management of city resources to improve the quality of life. Smart cities have massive distributed infrastructure smart devices and a huge amount of big data on city resources and services. With the proliferation of smart city services, there is a need for solutions for smart city user interaction and services usage from anywhere to improve the user knowledge and user experience.

AR on the top of web-based GIS is proposed as a novel approach for the visualization and usage of smart city services. This novel approach allows web GIS AR services usage from anywhere via mobile devices. Smart devices AR city-based geo-portal is proposed for detailed visualization and usage of smart city services. The user can visualize the detailed knowledge of smart city services such as near real-time selection of best bus stops, buses, and bus routes. The multi-user AR based on the mobile agents in the cloud computing environment is proposed as a novel approach. In the context of spatial data visualization and interaction with 3D virtual worlds, VR is gaining prominence as an important tool. Various applications of VR in a decentralized 3D Web application using WebVR and WebGL APIs are discussed. An application of VR smart city based on WebVRGIS viz smart city services visualization using 360-degree street view experience on a low-end web browser is examined. Usage of VR based on smart city based geo-portal for usage of city services with immersive knowledge experience is presented.

12.2. Case Study 2: Autonomous Vehicles

Autonomous vehicles rely heavily on radar, GPS, LiDAR, electronic maps, and other sensors to detect their environment and make progress. To improve performance in tasks such as scenario comprehension, lane detection, or localization, including augmentive approaches is valuable. The identification of barriers to involvement challenges via participatory co-design and Adjust Eyetracking designs shows promise in improving performance. Augmented Reality (AR) approaches may better enhance user compositional interaction, increases cognitive network understanding and acceptance of technical limitations over a pure control method . The design team successfully extended PAAR functionality to be a whole mechanism architecture, ensuring the proper distribution of dynamic interactions and visual enhancements. Also, it provided a way for non-expert designers to characterize common technical effects using doodles.

There is very little knowledge regarding how to best design augmented visualizations to improve explanation induction and reduction and understanding of highly dynamic situations. It remains difficult to develop new AR techniques to facilitate sense-making because of the unknown requirements. Current expertise is limited. Understanding experimentation is necessary to audit/redirect AR designs. A working definition and a constituted set of experimentation methods are drawn from cogn science on understanding and sense-making. Strengths and weaknesses of the resulting two-view investigative framework are evaluated. A visualization promise to positively impact sense-making in highly dynamic situations. However, there are some major gaps in experimentation knowledge that must be addressed before this promise is fully realized. (1) The design of how to best develop visualizations for explanation induction and reductions over highly dynamic situations is largely unresearched. (2) It is very difficult to develop new AR techniques to support understanding sense-making because the design requirements are unknown.

12.3. Case Study 3: Remote Collaboration

Remote collaboration tools are necessary to enable co-operation between people in different locations in the augmented reality or mixed reality (MR) environments. Although there are many existing remote collaboration systems that use MR technology, they rarely provide motion parallax to the remote participants. This case study presents a low-cost and easy-to-implement MR remote collaboration approach called the “Mixed Reality Remote Collaboration,” which lets remote users use ordinary monitors to view mixed-reality content showing an augmented view of the local user in real time. The local users can manipulate virtual objects, and their actions are reflected in the augmented

view displayed on the remote users' monitors .

An optical see-through augmented reality (AR) headset, a depth camera, and a depth sensor are used in the local environment. The local view from the AR headset is segmented based on the objects' depth. The view of the lower half of the screen shows only the manipulated virtual objects with a background of the real-colored depth, while the view of the top half shows a static point cloud of the local worker workspace. With this system, participants can see each other's tasks and communicate with each other. This approach can be easily implemented in any local stations with the existing commercial devices seen in cameras, projectors, or screens. The background view also makes it easy to notice the unintentional contact with the virtual scene. After conducting a comparison study of two configurations (background view on and off) in the desktop experiment, feedback from both configurations is obtained in terms of strengths and weaknesses.

Participants in the background view on feedback group think the static background view provides a sense of a 3D world and the whole scene of the workspace. This situation is helpful to know the long-distance work style of remote collaboration and to identify the occluded area. However, two participants feel confused about the background view depicting a static scene, being uncertain about whether it is just an old photo. Additionally, they cannot feel intimacy with the detected area, as it does not show the manipulation action close to the user but rather presents the assumption of what the focus is. It also takes longer for these participants to identify the spatial relationship of a virtual scene in the background view. At present, picture-in-picture is not used to put the two views simultaneously, which is expected to be implemented in the future request. However, this method likely suppresses the background view, and vice versa. Thus, the two configurations need to be simply replaced.

13. Impact of AR and VR on Society

Dissecting Augmented Reality (AR) and Virtual Reality (VR) allows for an understanding of both what they are and what they are capable of. The differences between these two technologies primarily stem from their presentation of the ghostly world over the physical one. However, these technologies have their strengths and weaknesses . On the one hand, AR is a technology both more visible in the public space and more established. This is partly due to its ease of access, requiring only mobile phone cameras instead of the bulky headsets intended for VR. AR can boost science knowledge retention and AR technologies can lead to their similar outcomes, although they have different strengths and weaknesses. Designing education for either AR or VR is important, as each has the potential to

enhance or detract from learning.

On the other hand, VR is a technology with the most promise in terms of user experience design. Due to its current limits in accessibility and anchoring design patterns to the physical world, design progress demands more ingenuity, leading to more space for advancement compared to AR technology. A poor AR experience is currently observable among mobile apps, due in part to an over-reliance on conventional mapping or 3D object presentation. With very few companies focusing on pushing VR into the market for wider audiences, educators interested in this technology should keep a watchful eye on the upcoming ideas for this technology. As XR technologies burgeon, a comprehensive understanding of their effect on social experience, interaction, and acceptability design is key to both user experience design and commercial success .

14. Conclusion

Today's life is full of smart devices and smart technologies. Computer systems play an important role in being intelligent. And also Artificial intelligence (AI) is widely used today to build machines that can think and operate in an intelligent manner. Computing is changing rapidly with the influence of systems like quantum computers, Augmented Reality (AR), Mixed Reality (MR), Virtual Reality (VR), Artificial Reality (AR). In the previous years, VR and AR were only the ideas of scientists, which are assumed to be present a long time ahead. But today AR/VR/MR are influencing many industries like automobile, military, health, engineering, e-learning, architecture, and design, gaming, sports, etc. augmenting or virtually replacing reality and has brought a huge boom to various economic sectors. The applications vary from sales and advertisement to social networking; weather forecasts and navigation; video games; e-learnings to futuristic and sci-fi movies . AR and VR devices are significantly being produced in recent times at affordable rates. Research on more intelligent and interactive systems is still being carried out by various scholars and companies. This chapter gives a brief idea about the AR, VR, MR, their applications in today’s world, and what could be achieved in the near future with more advanced development.

Different technologies are being developed and used by researchers in intelligent systems to make them smarter. Augmented Reality (AR) is one of them. AR is the hybrid of dependence on both AR and VR. Instead of completely replacing reality, this technology enhances the reality by adding certain virtual elements to the real world making it more convenient, efficient, and informative. There is a huge scope for using and implementing AR technology in smart systems, assisting to speed up the

process much more effectively. With the proliferation of mobile computing, the world is trying to capture every feasible opportunity to improve. Internet of Things (IoT), smart vehicle, smart home and smart city are some of the good examples of this advancement. AR provides a desirable opportunity to smart city development. Although the technology is common in the arena, its application in smart city services is still underdevelopment. The study focuses to understand how AR, in conjunction with other smart technologies, is influencing the smart services under the smart city domain.

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DATA BASE AND DATA WARE HOUSES – An Overview

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ABSTRACT

Data base is a collection of data about anything. College data base has the data about the departments, staff, and students. Student's database may contain the data about the student's register number, where about, phone number, e-mail address and marks etc.

There are many database software available to manage and manipulate the data. Data are stored in table format which is structured. There are different types of data bases, object oriented data base, Network data base, Hierarchical data base and Relational data base, NoSql Data base, Distributed Data base, Centralized Data base.

Data base is used to keep track of the data. For example, Business Organizations can keep track of their customers. College data base can be used to follow their students.

Before the advent of the first generation of computers, people used various methods to store data.

Now-a-days data availability gives hundred percent strength to the business and to the things in this world. Availability means that whatever people want, those should be on hand or has easy access to them (Something available and ready to use).

Data should be available with no time bounds, and continuously which delivers quality performance and may easily handle various loads of data. The role of Data Ware house exists here. It is a central repository. Data ware house stores huge amount of data and integrate data obtained from various heterogeneous sources. Historical data can be analyzed and make decisions based on it. Data ware houses increase the quality and enhance the Business Intelligence.

This article discusses and analyses the database, types of data bases and data ware houses with clear pictures.

KEY WORDS:

Data base, Distributed data base, centralized data base, NoSql, Object Oriented, Data Availability, Data Ware house, Heterogeneous.

1. INTRODUCTION

People are storing items for long-term needs. Similarly, digital data can be saved/stored in storage devices. People or users may store the data to retain it permanently or temporarily. Some of the storage methods are listed here.

Written Materials: Paper was used and the information written like text or accounts, manually. They maintain account books, Ledgers. Those written documents are organized in shelves or boxes.

Physical Devices: Some devices are used for storage and to process data. Basic mathematical calculations were performed using beads. Punched cards were used for storage. Attendance was made using punched cards made up of cardboard. The card had holes.

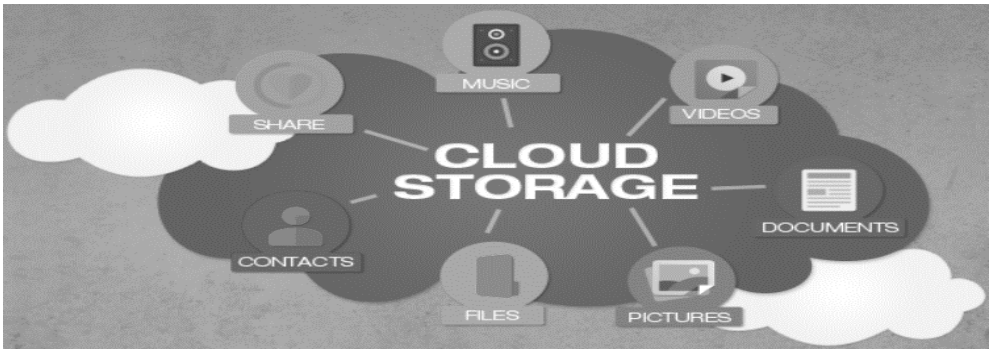
Similarly, people experienced Magnetic Tape, Drum and Mechanical hard drives etc. Gradually, generation moved and Microfilm and Microfiche were used. They were in film format.

From 1980, the data storage has drastically changed, so the speed and capacity of storage devices have been decreased. The size of devices is reduced.

The following list shows the list of various storage devices in chronological order.

1. Hard Disk Drives (HDD)
2. Floppy Disks
3. Compact Discs (CDs)
4. Flash Memory: DVDs
5. Blu-ray Discs
6. Magneto-Optical (MO) Drives
7. Solid-State Drives (SSDs)

And finally, Cloud Storage supports to store data at remote place and could be accessed over the internet. Cloud storage is scalable and very easy to store and access.



Current technologies support to store audio, video, images in the various formats. These multimedia files are inevitable for each and every domain. These are known as Multimedia Data base. Maps, satellite data and climate information can be handled by Geographical Information system.

Forest Animals Video Data base

IMAGENET DATABASE

2. Characteristics of Data Base System:

Data base system is defined as software which stores data in an organized manner and supports easy access and manipulation.

Management refers to management of data. Data can be retrieved and stored in an organized way. That data can be manipulated by doing operations like insert, delete, add, update and edit. Data Base Management System software provides all the functionalities.

Prior to modern data database systems, files with data were inserted into the apps. If the structure of the file changes, then the changes have to be made in all the related programs. In DBMS, structure is stored separately. This program-data independence property support accessing data and other programs easily.

There are four types of data bases: Object Oriented, Network, Hierarchical and Relational Data base.

3. Functions/Tasks of DBMS

1. **STORAGE:** The primary task is storage. DBMS creates structure and allows users to access data faster just by clicking buttons. DBMS also manages the Meta data by following protocols like validation.
2. **SECURITY:**Security is the main concern for everything around us. DBMS gives a higher degree of security measures for all types of access. Using access control, one can control what or who can view or use resources on a computer. Business or organizations rely on this concept to minimize risks.
3. **RECOVERY AND BACK UP**: Sometimes, users may delete TB capacity of data with no knowledge. Data may be corrupted. The data has to be recovered and to be kept safe, which can be done by DBMS. Recovery of data can be done with the automatic backup of data with the time interval.
4. **DATA DICTIONAY**: Dictionaries also store the data with its information and relationships among the data. Data structure is also kept in a dictionary. DBMS is responsible for the dictionary. DBMS clears the dependency of the data from the system.
5. **ACCESS CONTROL:** Many users can access the data base with some restrictions. Some users can have "read only" permission. Some users have "write and read" permission. DBMS can support these access controls. Another characteristic of DBMS is that multiple users can access the same data base concurrently. ACID property makes the DBMS carry out this task. ACID means Autonomous, Concurrency, Isolation and Durable. DBMS has to maintain integrity so that data redundancy can be avoided and consistency can be increased.

4. DATA BASE

We have an Object-Oriented Data Base, Network Data Base, Hierarchical Data Base and Relational Data Base.

4.1 Object-Oriented Data Base

The object-oriented data base works around objects, their characteristics, and actions. Object means anything around us. Example: Book

Object: Book

Properties: Paper Type, Thickness, cover type

Actions: flip, hold (in any orientation)

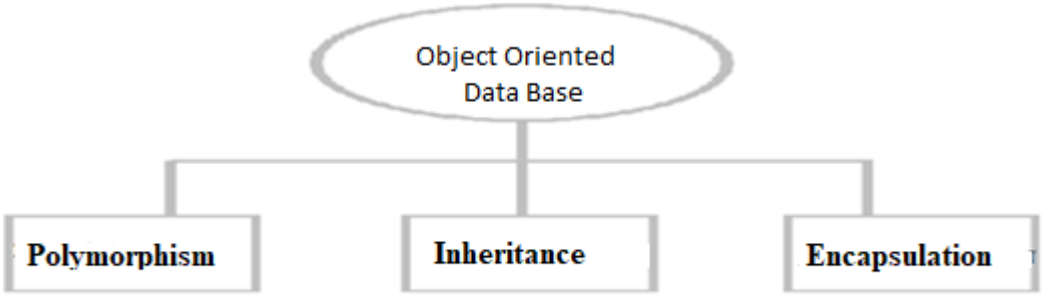


Fig1.1

Figure 1.1 shows the properties of OODB.

Polymorphism gives more forms for a single operation. For example, addition operations can add numerical values as well as strings.

The operator + symbol is used in numerical values 456 and 700

456+700 = 1156

The same symbol is used in the strings “I Love” and “INDIA”.

“I Love” + “ " + “INDIA” = I Love INDIA

We may pass different data types by using the same operation.

Inheritance inherits the property of a parent with its own property. There are different types of inheritance available.

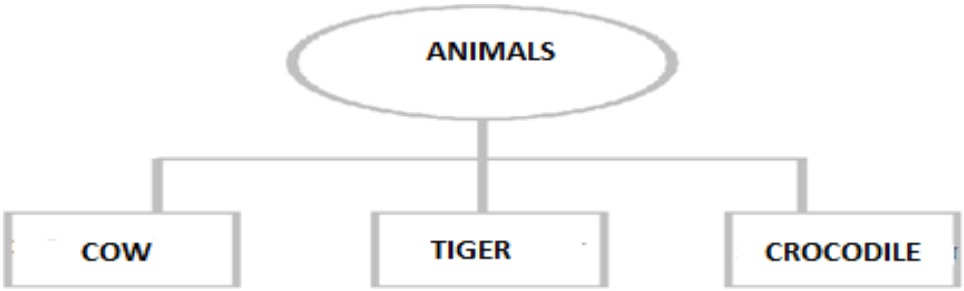


Fig : 1.2

Fig 1.2 explains the property of inheritance where a cow, tiger and crocodile are animals and have their own property.

Encapsulation encapsulates the important details by denying access from outside. It supports data hiding and reusability. Data and methods are encapsulated so that outside access cannot be done.

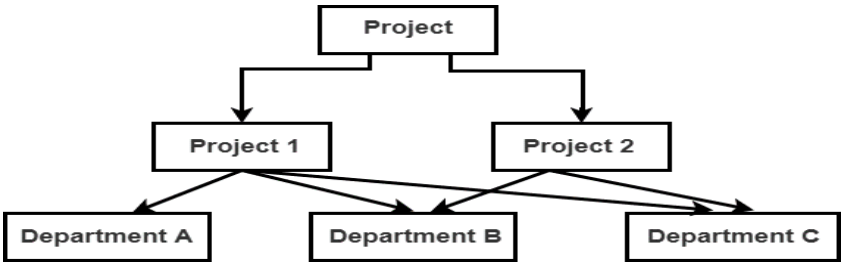
Example: **Car**

The car encapsulates machines, mechanisms, even drivers and people who travel in a car.

Abstraction means shows anything in simple view with necessary details. Encapsulation hiding the unnecessary details.

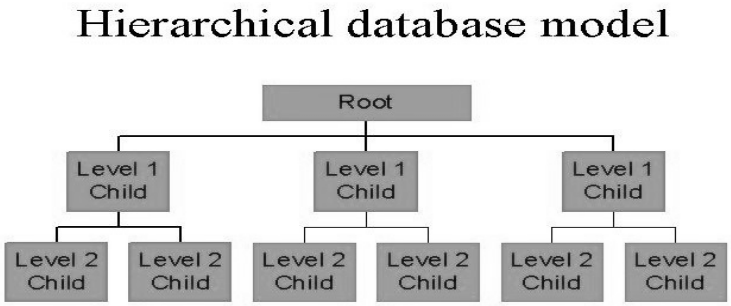
4.2. NETWORK DATA BASE

It is a network model in which one child can have multiple parents, i.e., multiple primary records.



Hierarchical Data Base: Hierarchy means different levels from lowest to highest. It is like a family tree.

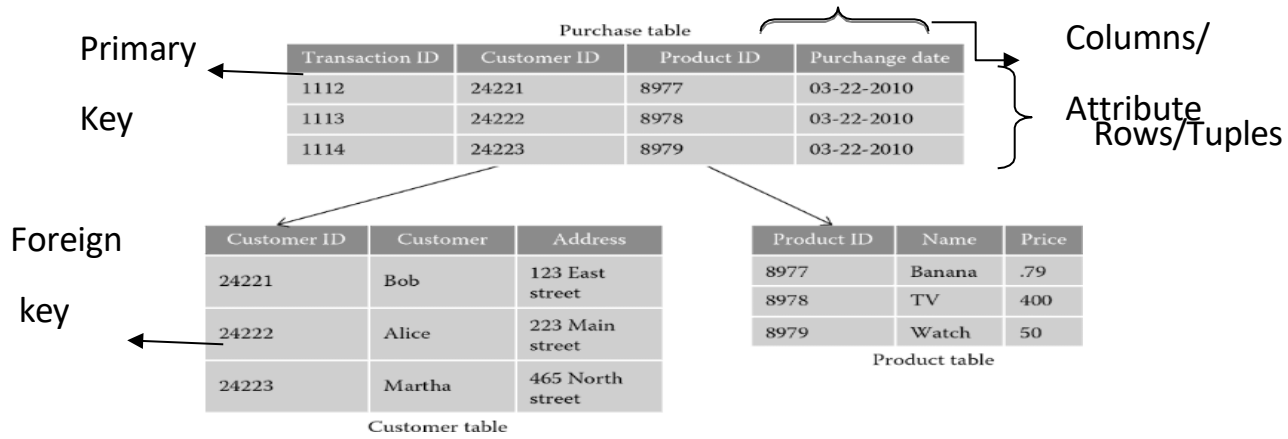
Data warehousing organizes and formats the data. Data mining retrieve or extract relevant data and predict the pattern by comparing data. There is no need to have data warehouse for mining purpose. Mining can be done with data bases. Data warehouse supports to mine the data well. Data warehouse has query optimization techniques for prediction.



4.3 RELATIONAL DATA BASE

Relational data base is organized as a table with rows and columns. Columns meant for attributes where rows for records. Table is also referred to as Relation.

Example:



4.4 ENTITY-RELATIONSHIP MODEL

It is an oldest semantic data model. It contains entities and relationships among them.

There are three types of relationships: one-to-one, many-to-one, and many-to-many.

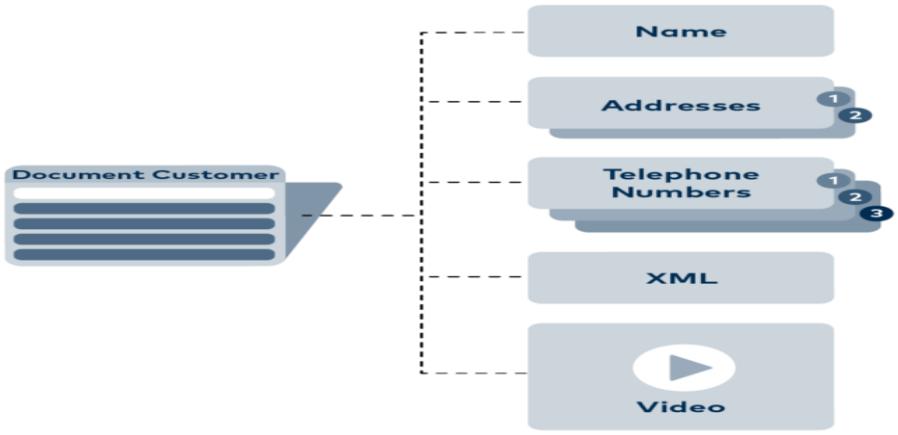
Examples:

- A Student studies a course – one –one
- 50 students study a course – many – one
- Many students study many courses – many – many

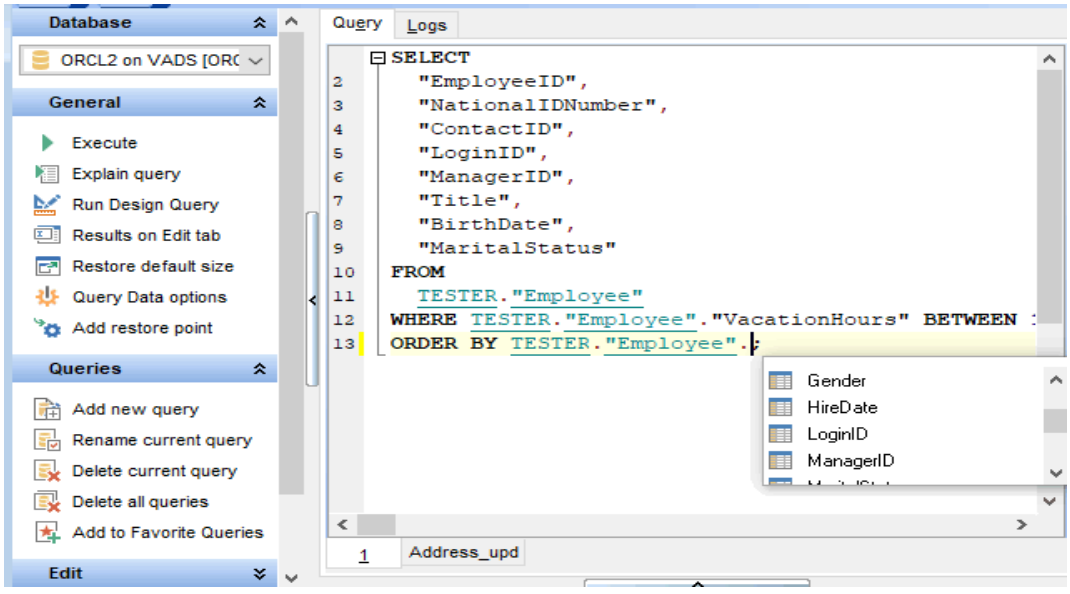
5. DATA BASES TODAY

RDBMS is basis for the entire data base currently used by the users in the whole world. Data base –today is collecting and storing huge amount of data from various and heterogeneous sources. Moreover, data bases now-a-days, managing current data. Data analysis is the primary goal of all the industries. By analyzing the data business make a good decision for the higher productivity and revenue gain. Historical data are available in data ware house. These data could be accessed by using queries. Example SQL, Structured Query Language Data mining techniques supports to understand the customer behavior, their priorities and preference, their timely need by segmenting the people into group. Management people may look into the customer database and may predict their wishes/like. Based on these, they may design new products or they implement new strategy or modify the strategies for delivering products as well as attract them.

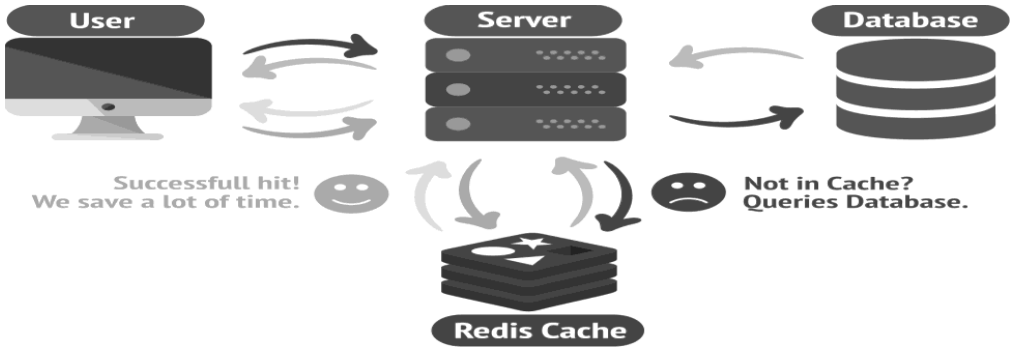
Business people need historical data for the comparison to take better decisions. Artificial Intelligence and machine learning also support business people to take better decision in current era. The data bases used the most by users are MySql, PostgreSQL, MS SQL Server, Oracle, Redis, Cassandra, MongoDB, DB2.



MongoDB –Stores data as document form and documents are turned in to collections.



Oracle Database – here the collection of data is known as unit. All in one solution for data mart, data lake, and batch



Redis

5.1 Data base for social science

There is a multidisciplinary bibliographic database that covers health, social services, psychology, sociology, economics, politics, race relations and education.

These data base may contain journals published in different countries. Some data bases are particularly useful for research at the intersections between social science and health information.

5.2 MACHINE LEARNING:

A machine that mimics cognitive human behavior is called an Artificial Intelligence machine. AI typically encompasses several disciplines based on the complexity of human behavior, such as planning, problem-solving, robots, NLP and machine learning, etc.

Machine Learning makes the computers to perform the tasks by learning with experience. Machine learning includes the techniques like neural networks, genetic algorithms and decision trees algorithms.

Machine Learning Database:

A large number of organizations around the world are currently using MLDB, a commonly known open-source database about machine learning. Using this system, you will be able to perform

all machine learning tasks. In this way, machines learn how to extract meaning and pattern from the data they collect by storing and analyzing it using this system.

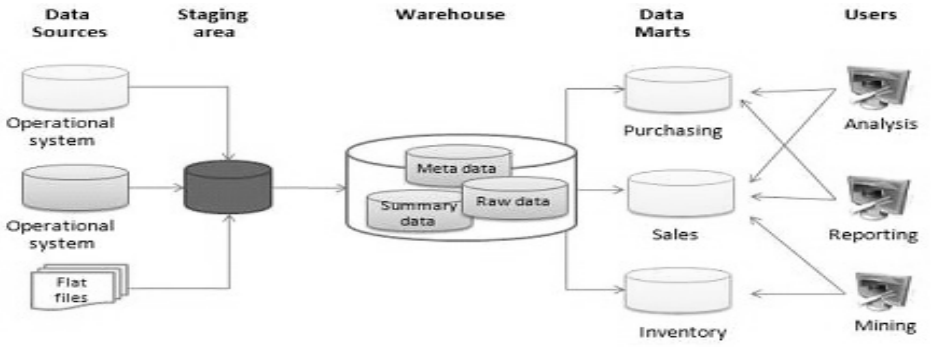
Example

Human language is analyzed using sentiment analysis models using machine learning. Some metrics have been used to identify the sentence or word type, i.e., whether the sentence is Positive, negative, and neutral sentiment.

Python provides support for a variety of databases due to its high-level nature. By implementing Python, we are able to connect to a specific database and run queries directly without having to write raw SQL in the terminal or shell. This database needs to be installed in our system.

Example Libraries: Tensorflow, SKLearn, pytorch

6. DATA WARE HOUSE



Data warehouse is simply a collection of data from various heterogeneous networks, platforms and databases and integrating data. For an example, Data warehouse can contain 2010-2011 passed out PG Student's data from Colleges, Universities, Social Media, e-mails and Employment office.

Historical data meant the data that happened in the past. It contains the data generated by the enterprises in the particular subject. It is subject oriented. These data can be analyzed by data scientists and analysts in the enterprises.

Data warehouses contain decision support technologies that can facilitate the use of the data. Executives benefit from these technologies since they can use the warehouse more quickly

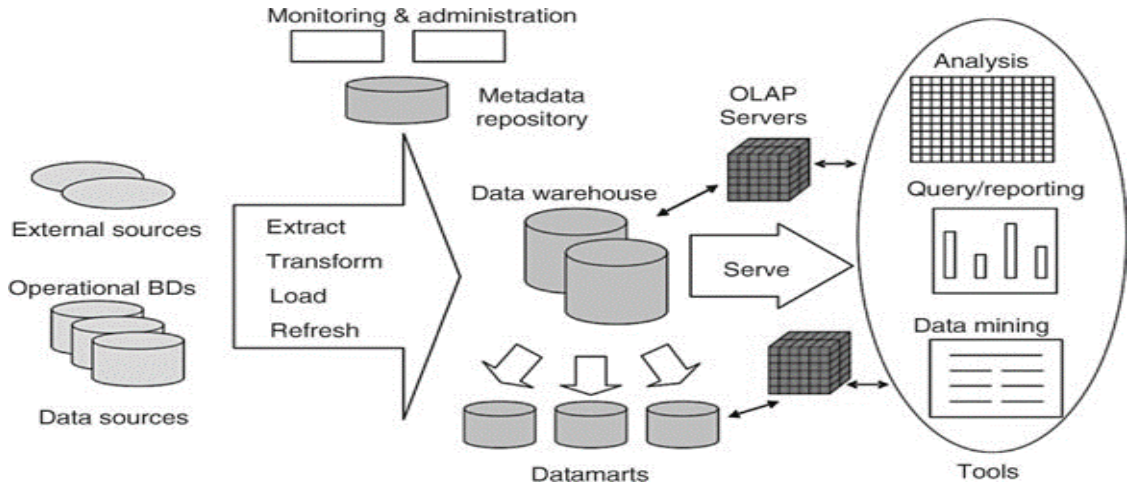
and efficiently. The warehouse stores data that can be gathered, analyzed, and used to make decisions.

We may retrieve answers for some of the following questions.

- ✓ What is the result of each department during corona period in college?
- ✓ Types of grievances received from the stack holders and parents.
- ✓ How often upgrade the software and hardware of the computers

6.1 TECHNOLOGIES OF DATA WAREHOUSE:

- Data Model
- Security
- Integration of data
- Distributed
- Indexing and methods of Access
- Admin
- High performance
- Data about data
- Query



6.2 OPERATIONS

Data warehouse is for specific subject and contains historical, past data. So it is time oriented. As data warehouse contains past data which cannot be changed. Once write or upload the data, data would be in read only mode. Data is integrated from various sources. These characteristics of Data warehouse can be described by the single terms like, Subject oriented, Time variant, non-volatile and integrated.

Data can be uploaded from currently operating data base or operational data. Data using at real time is operational data. Bank transactions doing at current are known as operational data. Example data base is given in the following:

Forecast Database:

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service
Current Location: Elev: 1518 ft. Lat: 33.4191° N Lon: -111.6444° W
Station: **EAST MESA, AZ US USC00022782**

Record of Climatological Observations
These data are quality controlled and may not be identical to the original observations.
Generated on 05/03/2021

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Observation Time Temperature: 1700 Observation Time Precipitation: 1700

Year	Month	Day	Temperature (F)			Precipitation					Evaporation		Soil Temperature (F)					
			24 Hrs. Ending at Observation Time		At Obs.	24 Hour Amounts Ending at Observation Time				At Obs. Time	24 Hour Wind Movement (mi)	Amount of Evap. (in)	4 in. Depth			8 in. Depth		
			Max.	Min.		Rain, Melted Snow, Etc. (in)	Flag	Snow, Ice Pellets, Hail (in)	Flag	Snow, Ice Pellets, Hail, Ice on Ground (in)			Ground Cover (see *)	Max.	Min.	Ground Cover (see *)	Max.	Min.
2016	01	01	65	30	60	0.00												
2016	01	02	71	47	62	0.00												
2016	01	03	73	51	64	0.00												
2016	01	04	64	50	57	0.13												
2016	01	05	59	48	54	0.26												
2016	01	06	58	47	55	0.71												
2016	01	07	55	45	48	0.67												
2016	01	08	52	40	50	0.19												
2016	01	09	57	34	53	0.00												
2016	01	10	55	35	52	0.00												
2016	01	11	60	35	54	0.00												
2016	01	12	65	31	60	0.00												
2016	01	13	67	33	60	0.00												
2016	01	14	63	33	59	0.00												
2016	01	15	60	37	55	0.00												
2016	01	16	61	33	56	0.00												
2016	01	17	66	35	60	0.00												
2016	01	18	70	37	62	0.00												
2016	01	19	67	35	64	0.00												
2016	01	20	68	39	65	0.00												

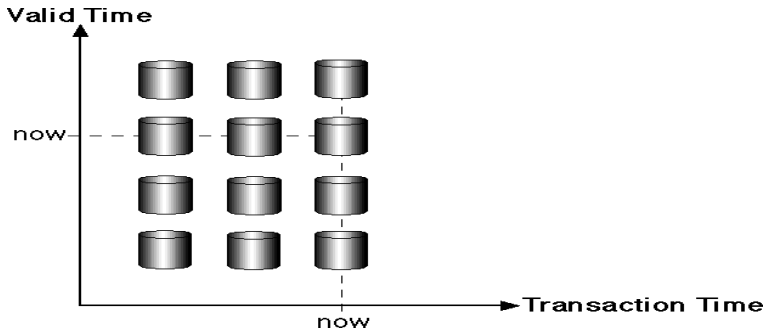
The above is Manual Data base for weather fore cast DATABASE - 1

	A	B	C	D	E	F	G	H	J	NH	NI	NJ	NK	NL
1	Zip Code	City	State	Historical Avg Monthly Temperature (in °F)	Jan 1988	Feb 1988	Mar 1988	Apr 1988	• • •	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018
2	01366	Petersham	MA	49.61	21.58	30.88	33.93	42.75		75.22	66.61	50.29	36.73	30.76
3	02196	Boston	MA	52.25	28.31	38.70	37.02	45.57		76.68	67.06	52.25	41.20	35.31
4	53132	Franklin	WI	45.73	19.58	22.53	32.58	35.96		71.17	63.95	47.39	30.16	28.27
5	04465	Cary	ME	40.51	12.74	19.24	28.67	36.48		67.33	57.04	40.26	27.52	15.30
6	12083	Greenville	NY	46.63	19.02	29.80	31.12	39.02		70.95	63.01	48.00	34.47	28.92
7	24945	Greenville	WV	53.76	27.32	41.23	37.99	48.61		73.11	71.62	56.08	40.62	36.05
8	76631	Bynum	TX	66.67	41.95	50.25	62.06	60.64		85.46	79.07	68.02	52.81	49.12
9	76653	Kosse	TX	65.41	42.22	50.65	61.54	60.30		83.75	77.70	66.60	51.60	48.43
10	25103	Hansford	WV	56.33	29.39	43.05	41.31	50.83		75.65	74.16	59.13	42.93	39.85
11	94067	San Bruno	CA	59.66	52.52	52.56	53.91	57.83		67.66	64.60	62.80	56.05	50.54
12	21289	Baltimore	MD	56.27	31.05	40.87	39.87	51.06		77.79	72.93	59.22	43.56	39.45
13	22185	Vienna	VA	54.32	29.70	39.36	38.16	49.93		75.33	70.45	57.22	41.40	37.53

DATA BASE - 2

This is Digital Forecast Database. These data bases are used at the time of emergency or for the prediction. Public can also be used. National Weather Service is generating forecast data.

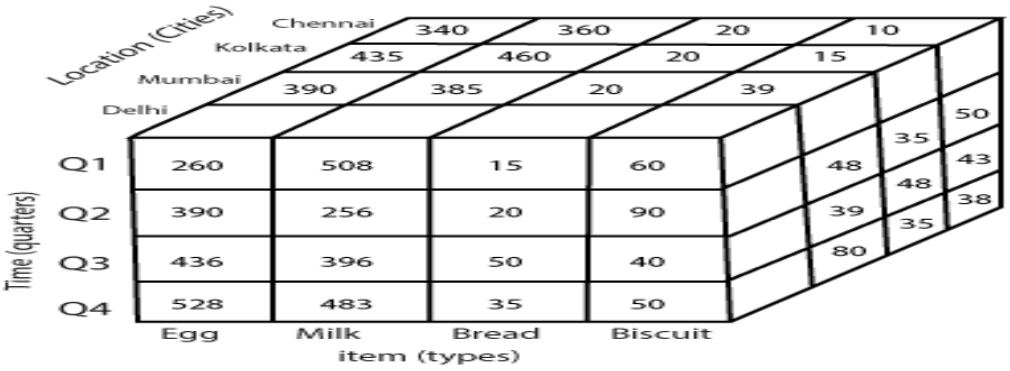
National Centers for Environmental Prediction provides real time data other than historical data. Data warehouse for weather supports to identify weather conditions of each season so that it could be useful for taking major decision particularly for agriculture and other major plans.



TEMPORAL DATABASE

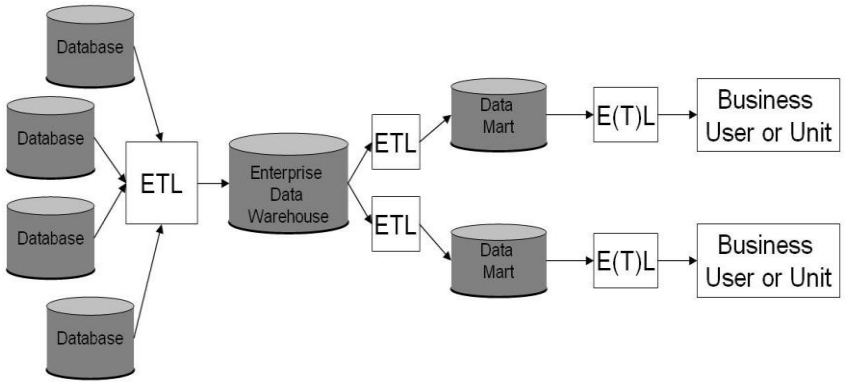
Rows or records are related with time

Data warehouse supports to view the database in a different view by different applications. Data can be viewed in a Multidimensional method.



6.3 ETL

The name implies Extract, Transform and Load. Data are to be extracted from the various heterogeneous sources. Data are to be transformed in the needed format and could be loaded to data warehouse. These three stages are iterative.



Extract

Transform

Load

Data warehouse has the repository of data, which supports Business Intelligence. Data ware house is Online Analytical Processing system i.e., query answering system.

Example: Weather forecasting, sales forecasting and Trend Analysis

While Online Transaction Processing System deals day to day transactions.

Example: Banking

On-line Transactional Processing contains operational data and On Line Analytical Processing contains informational data.

Data warehouse is of three types.

Enterprise Data warehouse

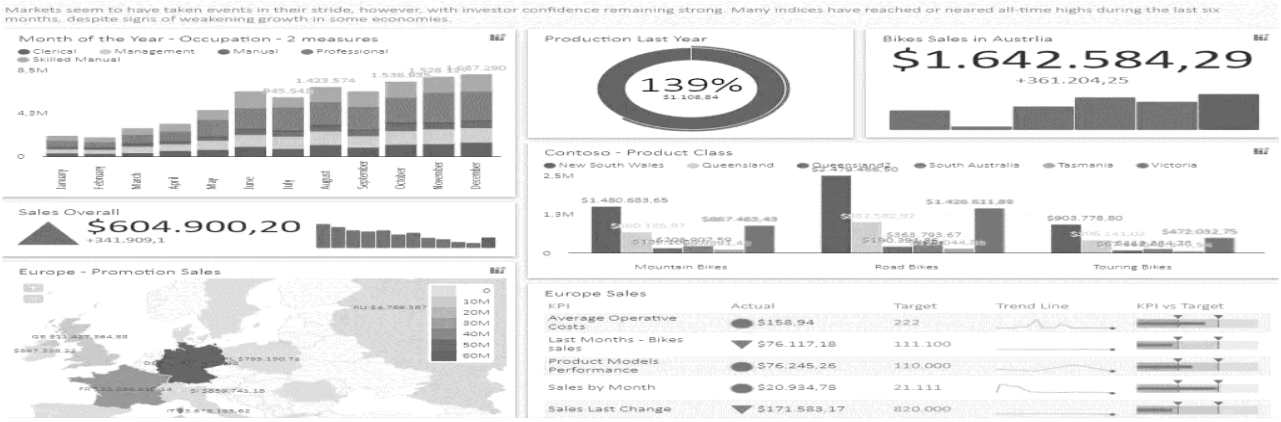
Operational Data Store

Data Mart.

The subset of data warehouse is data marts which maintain data for a specific unit, region or department. These data would be stored in the Operational Database and these will be received by Enterprise data warehouse.

6.4 OLAP TOOLS

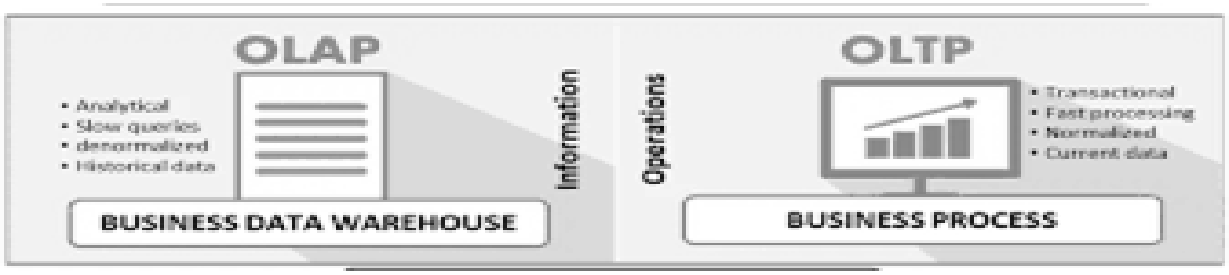
OLAP 3 types of tools ROLP, MOLAP and HOLAP.



The above figure describes reporting and analysis of sales with the help of OLAP tool.

OLAP tools is doing analysis in multi dimension at rapid speed on the huge volume of data available in data warehouse or data mart or any other data store.

OLTP does append, delete, insert and update actions. Generally, Finance, sales and Customer Relationship Management domains use the OLTP.

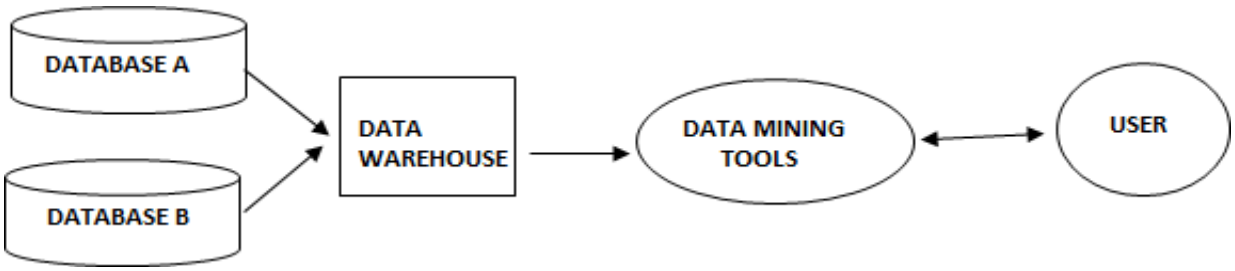


6.5 Data warehouse in real-world today:

Amazon Redshift –data warehouse services -a cloud based
IBM Db2 warehouse – a large scale warehousing
Google BigQuery – Bigdata Analytics – a cloud based.

6.6 Data Warehousing with Data Mining

Data warehousing organizes and formats the data. Data mining retrieve or extract relevant data and predict the pattern by comparing data. There is no need to have data warehouse for mining purpose. Mining can be done with data bases. Data warehouse supports to mine the data well. Data warehouse has query optimization techniques for prediction.



6.7 Business Intelligence:

By bridging the gap between data and decision-making, Power BI stands out from all the data visualization tools on the market. As a result of Microsoft Power BI, businesses have established a data-driven culture and transformed raw data into interactive dashboards and rich visualizations

that make it easier to make actionable decisions. This has ushered in a paradigm shift in Business Intelligence (BI) and Data Analytics.

Tasks of BI

- ✓ Mining
- ✓ Benchmarking,
- ✓ Process Analysis
- ✓ Descriptive Analytics.

Business Intelligence (BI) helps businesses achieve better results and increase their income through insights into strategic decisions.

Business Intelligence tools (BI Tools) assist companies in collecting, monitoring, analyzing, and predicting future business conditions by analyzing all of their big data centrally.

In **Business Intelligence reports, tabular data arrays can be transformed into digestible information, allowing you to analyze, draw conclusions, and make important business decisions using it.** Users should be able to interact with reports, sort them, conditionally format them, and drill down from each one.

7 Conclusion

This article gave an overview of conventional databases to current databases with data warehousing, data mining technologies. It also outlined Machine learning concepts. The sections 1 to 4 discussed the reason for storing data with various devices available in the computer field. This article described about the various data base systems with MLDB. The sections 5 to 6 gave an overview on Data warehousing, technologies, about data mining and Business Intelligence with example pictures. Now-a-days organizations work with real time data. Real time data contains time dimension (historical data). The wearable devices track and collect the human medical data like blood pressure, sugar and etc. The challenge is that for each and every data versions are needed to be stored separately. Faster Queries processing is required. These challenges are to be addressed and these are going on research area.

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A STUDY ON SUSTAINABLE MARKETING THROUGH SOCIAL AND ENVIRONMENTALLY RESPONSIBLE MARKETING ACTIVITIES IN THE RESTAURANTS IN UAE.

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Abstract

This paper investigates into the measures taken by the fast food restaurants in the UAE to promote sustainable marketing through socially and environmentally responsible marketing activities and analyse the extent to which these fast food restaurants have adopted sustainable marketing principles. The world population is facing problems like environmental pollution, increased carbon footprint, and unethical business practices. One of the causes of this pathetic state of affairs are the mushrooming fast-food restaurants which have contributed largely to the environmental footprint due to its wasteful packaging, inefficient waste disposal, and inefficient use of energy in its outlets. It was observed that the majority of the international fast food restaurants were implementing the sustainable marketing principles to a great extent. Though, a few small local fast food restaurants were aware of the sustainable marketing principles, however, they were finding it difficult to implement them in practice as these local restaurants were small business firms with low financial returns.

Key words: Sustainability, Carbon Footprint, Restaurant, Environmental Pollution.

1. INTRODUCTION

Responsible marketers take pains to understand the genuine and changing needs of the consumers and respond with goods and services that create value for the customers and capture value in return. A few companies use unethical marketing practices to grind their own axe rather than serving the consumers' interests. Therefore, responsible marketers must take into account if their market offerings or market actions are sustainable in future. Sustainability marketing calls for socially and environmentally responsible actions that meet the current needs of the consumers and businesses

while also preserving or enhancing the ability of future generations to meet their needs [1]. Sustainability is defined on the basis of a 'Triple Bottom Line' perspective i.e., people, planet, and profit [2]. The term sustainability was coined by The Brundtland Report in 1987. The term sustainability does not cover the environmental and social issues alone, but is also bound by ethical and moral issues under the broad umbrella of the principles of sustainability marketing. Therefore the purpose of this paper is to investigate the extent to which the fast food restaurants in Ajman abide by the principles of sustainability marketing. Every company should strive to implement the principles of sustainable marketing viz. consumer-oriented marketing, customer value marketing, innovative marketing, sense-of-mission marketing, and societal marketing.

2. SCOPE AND IMPORTANCE OF THE STUDY

This study assumes paramount importance and a wide scope in fetching benefits to companies like fast food restaurants, cafeterias, and other food and beverage firms by highlighting the importance of implementing sustainable marketing principles in a proactive fashion which in turn will bring value to both the customers and also to the society at large. It will help save the planet from environmental pollution, increased carbon footprint, and unethical business practices.

3. RESEARCH PROBLEM

The research problem of the study is to investigate into the measures taken by the fast food restaurants in the UAE to promote sustainable marketing through socially and environmentally responsible marketing activities and analyze the extent to which the international and local fast food restaurants have adopted sustainable marketing principles.

4. RESEARCH QUESTIONS

1. To what extent have the fast food restaurants in the UAE implemented the principles of sustainable marketing?
2. To find out if there is any significant difference in the implementation of sustainable marketing principles between the international and local fast food restaurants in the UAE.

5. REVIEW OF LITERATURE

Sustainable marketing has been studied across different perspectives. Many scientists have studied and deliberated on environmental and social issues. But there has not been enough study about the principles of sustainable marketing viz. principles of consumer-oriented marketing, customer-value marketing, innovative marketing, sense-of-mission marketing, and societal marketing. The previous studies have only evaluated and analysed the green or environmental marketing strategies. Therefore, there is an urgent need to throw light on the principles of sustainable marketing which will address issues related to environmental, social and ethical goals and objectives in an integrated fashion. Therefore, this paper focuses on the principles of sustainable marketing.

1. Andrea Bedek (2012) conducted a study on the topic 'Sustainable Marketing Strategies: Examples of Best Practices in Croatia'. The objective of this paper was to examine best practices among Croatian companies that distinct themselves from others by implementing sustainability in their everyday business practices and provide managerial suggestions that can help in sustainability implementation. The author concludes saying that quite often companies are guided with short term goals and by the desire to achieve immediate profit and companies usually neglect activities that have positive impact on environment and society.

2. Kumar, Vinod, Zillur Rahman, A.A. Kazmi & Praveen Goyal (2012) collectively conducted a study on the topic 'Evolution of Sustainability as Marketing Strategy: Beginning of New Era'. The objective of this paper was to review and understand concepts of marketing strategy and sustainability. They concluded saying that reassessment of the social issues resulted in evolution of green or environmental issues in marketing strategy and now the sustainability in marketing strategy has become the focus of attention of the researchers

3. Marek Seretny (2016) of American University in the Emirates published an article titled 'Marketing as an Agent of Sustainable Change'. The purpose of the paper was to highlight the vital role that marketing plays in achieving behavioural change among customers as well as emphasize the changes in marketing practice that are required to help business adopt more sustainable practices. He concluded that sustainable marketing promotes credibility and responsibility, leading

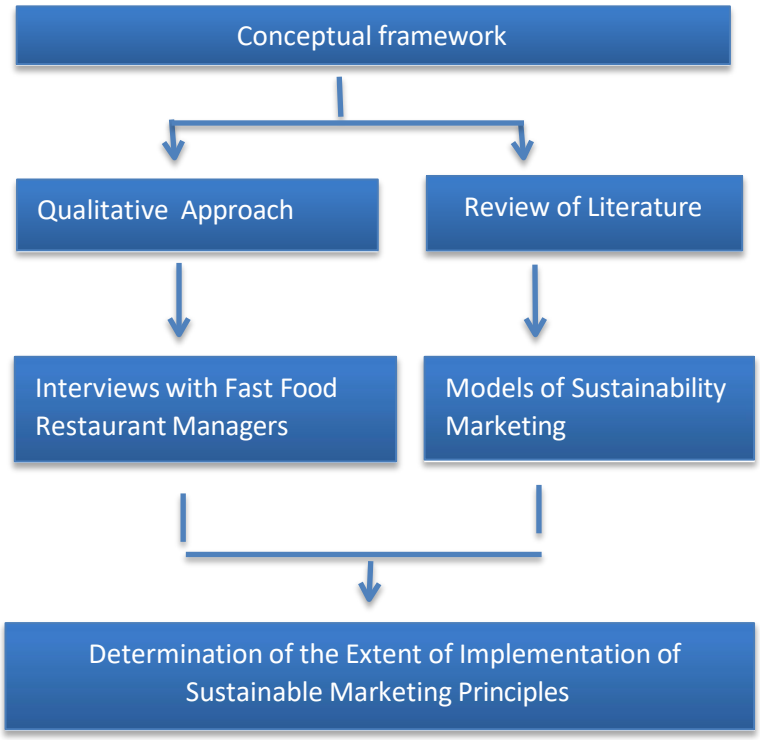
to better consumption, better relationships, and more responsible business, thus influencing the creation of a better world.

4. Mark Peterson et al. (2020) conducted a study on the topic 'Sustainable Marketing and Consumer Support for Sustainable Business'. The objective of this paper was to examine how consumer values and consumer perceptions of the marketplace practices of firms influence consumer support for those firms pursuing sustainable business practices. The authors conclude that 1) consumers' nature-based values have the most positive influence on consumers' support for sustainable businesses, 2) followed by attitude toward firm benevolence, and 3) concern about the ethicality of firms. Valuing social justice and recognizing business' contribution to one's own quality of life did not register as being influential on consumers' support for sustainable businesses.

5. Pierre Mc Donagh et al. (2021) conducted a collective study on 'Sustainability Marketing Research: Past, Present and Future'. This paper provides a synthesis and critical assessment of the sustainability marketing literature, from the period 1998–2013, building on a previous assessment from 1971 to 1998. It details research within major marketing journals and critically assesses this research in relation to the on-going conversation which focuses on marketing's relationship with the natural environment. Differences in the content and depth of sustainability coverage in marketing journals are considered. Potential avenues for future sustainability marketing research are proposed, with a particular call for theoretical and managerial reflections which tackle broader systemic and institutional issues within the discipline.

6. CONCEPTUAL FRAMEWORK

The conceptual framework has been developed with the help of major factors that have been derived from the review of literature and qualitative data. The framework consists of dependent and independent variables. The research aims to identify those principles of sustainability practices that are implemented in the fast food restaurants in the UAE. The below conceptual framework summarizes the aim of this research in which it intends to study the principles of sustainability practices that are implemented among the fast food restaurants in the UAE.



The following research hypothesis will be tested.

7. HYPOTHESES OF THE STUDY

H0: There is no significant relationship between the practices of sustainable marketing principles of the international and local fast food restaurants in the UAE.

H1: There is a significant relationship between the practices of sustainable marketing principles of the international and local fast food restaurants in the UAE.

8. METHODOLOGY

The researcher has adopted a descriptive research design to investigate into the research questions by conducting both quantitative and qualitative research among the fast food restaurants in the UAE. The researcher has developed a conceptual framework with the help of major sustainable marketing factors that will be derived from the review of literature and qualitative data. The conceptual

framework consists of dependent and independent variables. A research hypothesis has been evolved and clearly stated and is subject to testing.

8.1 Sample frame

The sample frame of the study comprises the international fast food chains and the local/regional fast food restaurants in the UAE.

8.2 Sampling Technique

A simple random sampling technique has been used to choose the sample units of fast food restaurants from the sample frame mentioned above.

8.3 Sample size

The sample size of the study undertaken was '6**0' sampling units** from the above sample frame. The sampling units referred to here are the 60 fast food restaurants in the UAE both International and local

8.4 Tools and Techniques used for Data Collection

The study was conducted using both primary and secondary data. The primary data were collected using interview schedules. The interview schedule was pre-tested on a small trial group comprising 10 respondents to ensure the validity and reliability of the research instrument. In response to the pilot study, necessary modifications were made in the interview schedule and the modified instrument was used for the collection of primary data. To fulfil the objectives of the study, the researcher has used both criterion (dependent) and predictor (independent) variables in the study. The primary data collected were consolidated to a Microsoft Excel spreadsheet for conducting the data analysis. The consolidated data were finally analysed by classifying, tabulating and applying statistical tools such as percentage analysis, coefficient of correlation, and Chi-square test.

8.5 Limitations of the study:

This study is not free from limitations. Following are the limitations that the researcher could find in the study:

1. Due to time, money, and energy constraints the researcher had to limit the sample size of the study to a small number.
2. A factor analysis could have also been adopted by the researcher so that the study highlights the important factors that will contribute in the achievement of sustainability marketing.

9. DATA ANALYSIS AND INTERPRETATION

After collecting the primary data through the interview schedules the researcher has used the percentage analysis and the Chi-square test for analyzing the data. The researcher was interested to know the number of respondents who recycled the waste, especially the food waste and the packaging waste. Majority of the respondents said that they don't recycle the food waste or packaging waste in their companies, but they either dump them in landfills or burn them in incinerators or dispose them in the municipality bins. The following Table No.1 highlights the percentage of respondents who dispose the food and packaging waste in the fast food restaurants.

10. FIGURES AND TABLES

Table No.1

Disposal of Food and Packaging Waste formed in Fast Food Restaurants

Opinion	**Respondents**	**%Percentage**
Dump them in landfills	15	25
Burn them in incinerators	6	10
Dispose them in municipality bins	39	65
Others	0	0
Total	60	100

Source: Primary Data

The above table No.1 highlights the fact that 65% of the respondents dispose the food and packaging waste in the municipality bins provided to them by the Municipality, 25 % of the respondents dump the waste in landfills and 10% burn them in incinerators. We could thus conclude by saying that the

majority of the fast food restaurants dispose their food and packaging waste in municipality bins provided by the municipality and are aware of reducing environmental pollution and improving sustainability marketing principles.

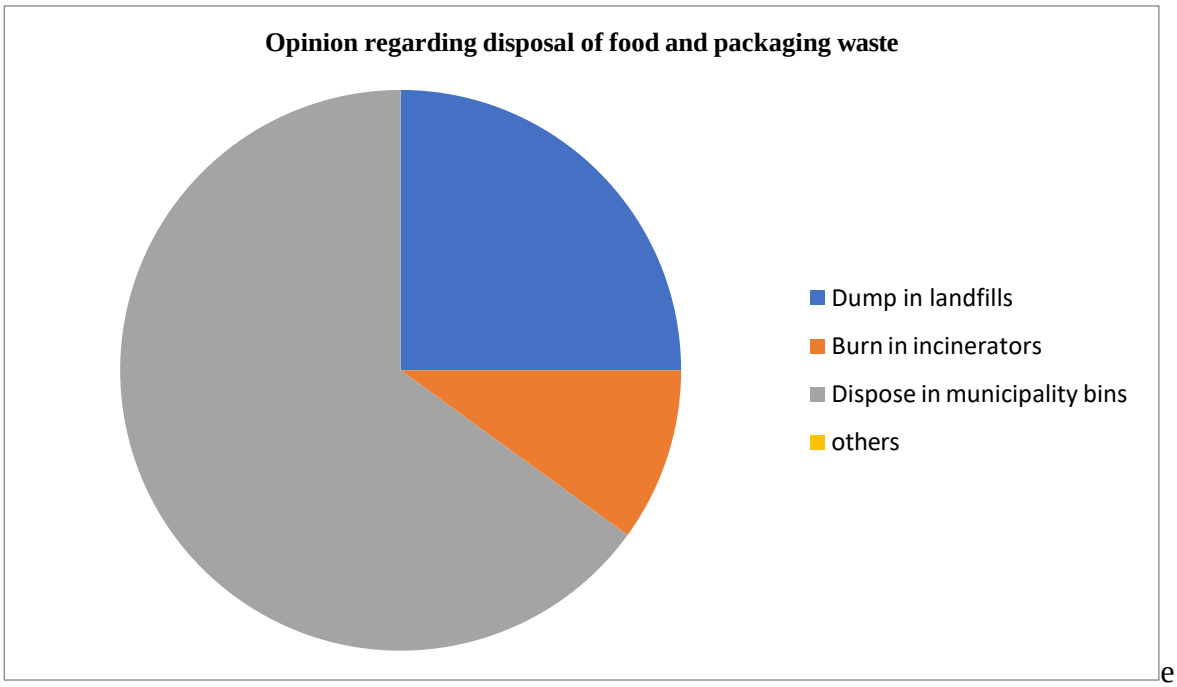


Figure 1: Disposal of Food and Packaging Waste in Fast Food Restaurants

Use of Energy –Efficient Lighting System

The researcher was interested to find out if the fast food restaurants were using energy-efficient lighting systems in their restaurants. The following Table No.2 shows its results.

Table No.2

Use of energy-efficient lighting system

Type of lighting system	Usage of respondents	Percentage
Incandescent light bulbs	12	20
LED lamps	18	30
CFL lamps	30	50
Others	0	100

Source: Primary Data

Table No.2 throws light on the fact that 50% of the fast food restaurants use CFL lamps, 30 % of them use LED lamps, and 20 % of them use incandescent bulbs in their restaurants. Hence, majority of the fast food restaurants use CFL lamps that are energy-efficient and energy saving causing less carbon footprint in the society and thus preventing greenhouse gas emissions.

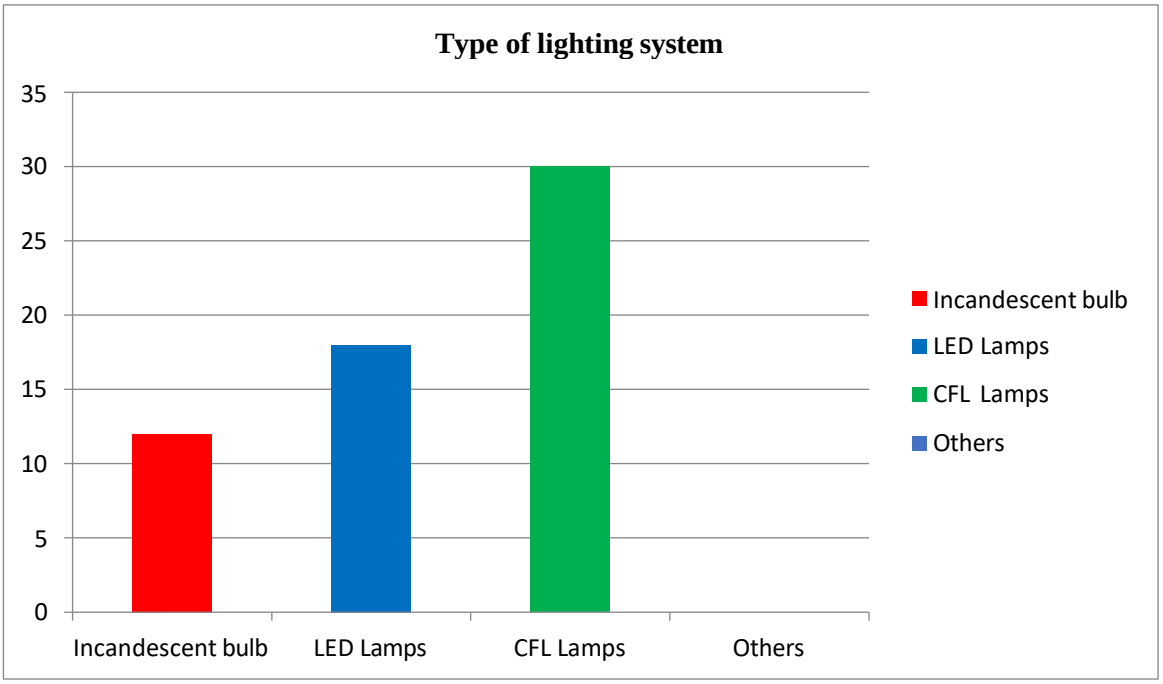


Figure 1 Type of Lighting System used in Fast food Restaurants

Food items on the menu 'below 400 calories' category

The researcher was investigating to know if the fast food restaurants were providing food to its customers in their restaurants in which its menu had food items 'below 400 calories'. The food items 'below 400 calories' was said to be healthier and environmentally sustainable. The following Table No.3 highlights its results.

Table No.3

Food items on the menu below 400 calories

Percentage of Food Items on the menu having less than 400 calories	Respondents	Percentage
Less than 50%	9	15
50% to 74%	21	35
75% to 89%	18	30
90% to 99%	12	20
Total	60	100

Source: Primary Data

Table No.3 throws light on the fact that there were only a few restaurants (20%) that offered food items which were below 400 calories (i.e. 90% to 99% of food items were below 400 calories), 35% of the fast food restaurants offered food items which were 50 % to 74% 'below 400 calories'. Hence, majority of the fast food restaurants can encourage responsible consumption among the customers by offering a healthy menu by diversifying into salads, fruits, grilled chicken, low-fat milk, and other nutritious food items thereby reducing carbon footprint in the society and encouraging environmental and social sustainability.

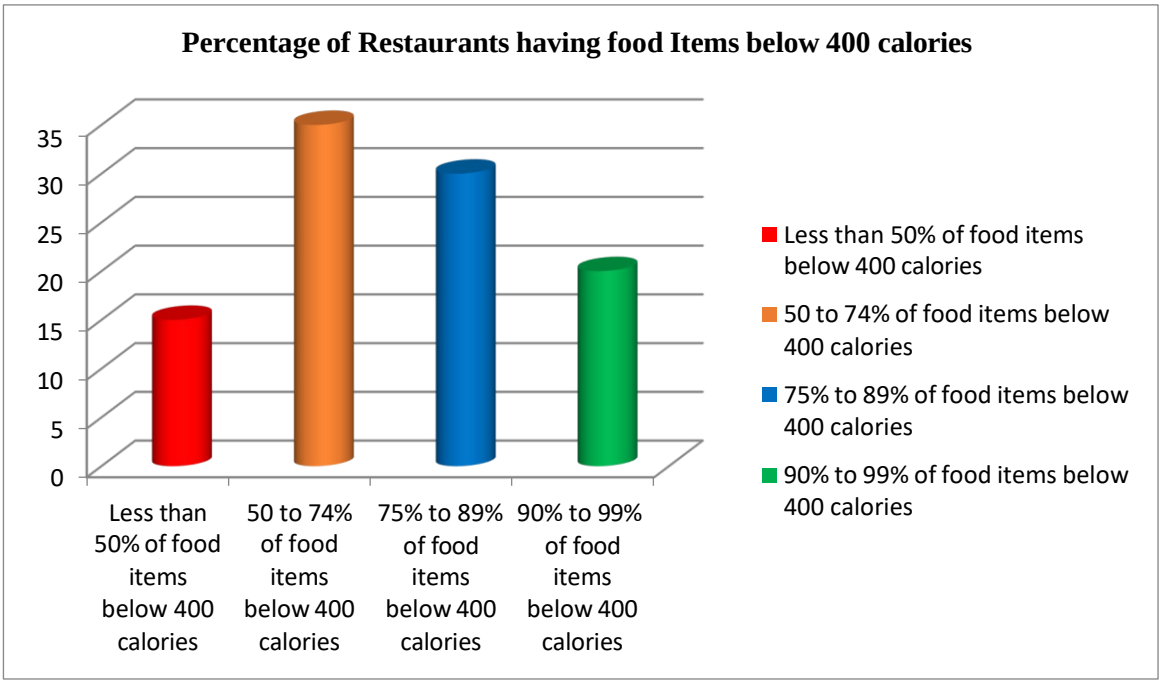


Figure 2 Percentage of restaurants having food items below 400 calories

Chi-square analysis

A Chi-square statistic was conducted by the researcher to test the statistical significance of the observed association in the cross-tabulation of the study. The researcher wanted to find out if there was a significant difference in the practices of sustainability marketing principles of the international and local fast food restaurants in the UAE. The researcher has formulated the null and alternative hypotheses of the study as follows.

H0: There is no significant difference between the practices of sustainability marketing principles of the international and local fast food restaurants in the UAE.

H1: There is a significant difference between the practices of sustainability marketing principles of the international and local fast food restaurants in the UAE.

Table No.4

Opinion of Fast Food Restaurants towards Sustainable Marketing Principles

Type of Restaurant	Opinion					Total
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
International Fast Food Restaurant	8	6	6	5	5	30
Local Fast Food Restaurant	6	6	6	7	5	30
Total	14	12	12	12	10	60

Source: Primary Data

The formula for the Chi-square statistic is as follows:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

Where: χ^2 is the chi square statistic.
Σ = summation symbol.
O = Number observed.
E = Number expected.

The observed frequencies and the expected frequencies were computed. The researcher now substituted these values in the Chi-square test formula and computed the calculated value of the Chi-Square test statistic.

The calculated value Chi square was: 0.619

The degrees of freedom= (m-1)(n-1), where m=number of rows and n= number of columns

The degrees of freedom=(2-1)(5-1)= 4

The level of significance=0.05

To determine whether a systematic association exists, the probability of obtaining a value of chi-square as large as or larger than the one calculated from the cross-tabulation is estimated. Now, looking at the chi-square tables, at 0.05 level of significance with 4 degrees of freedom, the critical value of the chi-square statistic is 9.488.

The calculated value being lesser than the critical value, the null hypothesis of 'no association' cannot be rejected. This indicates that the association is not statistically significant at the 0.05 level. Note that this lack of significance is mainly due to the small sample size (60).If, instead, the sample size were large, it can be seen that the value of the chi-square statistic would be large and would be significant at the 0.05 level of significance.

Since the calculated value is less than the critical value, we do not reject the null hypothesis. Thus we can conclude saying that there is no significant difference between the practices of sustainability marketing principles of the international and local fast food restaurants in the UAE.

Correlation Analysis

The correlation analysis intends to find out the strength of the linear relationship between two metric variables. In this study the researcher investigates into how strong is the relationship between 'readiness to implement sustainability marketing principles' *(dependent variable)* and the 'awareness of sustainability marketing principles' *(independent variable)*. The readiness was measured on an 11-point Likert scale. The awareness was also measured on an 11-point Likert scale. The researcher intends to explain this relationship by testing it among 12 respondents (fast food restaurants). The researcher has taken a small number of observations to make the calculations easier and simpler due to time constraints.

The Pearson's coefficient of correlation 'r' was calculated between the variables and found to be 0.9267.

As r=0.9267, a value close to 1.0, the respondent's readiness to implement the sustainability marketing principles is strongly associated with their awareness of the sustainability marketing principles. Furthermore, a positive sign of r implies a positive relationship; more the awareness of sustainability marketing principles, more will be the readiness to implement these principles.

The product moment correlation is then calculated for the population rather than a sample which is denoted by ṕ (rho).The statistical significance of the relationship between the above two variables measured by using 'r' are then tested.

The null hypothesis H0: ṕ=0

The alternative hypothesis H1: ṕ≠0

The test statistic is $t= r[n-2/1-r^2]^{1/2}$ which has a t distribution with n-2 degrees of freedom.

$t=0.9267[12-2/1-0.9361^2]^{1/2} = 8.329$

Looking at the t distribution table, with 12-2=10 degrees of freedom and at 0.05 level of significance, the critical value of t for a two-tailed test is 2.228.

Since the calculated value is greater than the critical value, the null hypothesis, i.e 'there is no relationship between the variables', is rejected. The positive sign of 'r' indicates that the respondent's readiness to implement the sustainability marketing principles in the fast food restaurants in the UAE is strongly associated with their awareness of the sustainability marketing principles and the high value of r indicates that this relationship is strong. Thereby, the research hypothesis has been validated.

The implication is that if the government of the UAE creates a strong awareness campaign about the sustainability marketing principles in the fast food industry then there would be a strong readiness to implement these sustainability marketing principles in the fast food restaurants in the UAE, thereby reducing carbon footprint and improving socially and environmentally responsible consumption among the customers.

CONCLUSION

This study attempts to investigate the extent to which the fast food restaurants in the UAE, both international and local, have been able to implement the principles of sustainable marketing. After a thorough analysis of the data collected from the 60 respondents through interview schedules, the researcher concluded that majority of the international fast food restaurants were implementing the sustainable marketing principles to a large extent. Though, a few small local fast food restaurants were aware of the sustainable marketing principles, yet, they were finding it difficult to implement them in practice. A few local fast food restaurants were finding it difficult to practice the principle of 'sense-of-mission marketing' and 'societal marketing' as these local restaurants were small business firms with low financial returns. It was noticed that there was no significant difference in the

implementation of sustainable marketing principles between the international and local fast food restaurants in the UAE.

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ROLE OF AI IN FITNESS

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"Reliance Chairman Mukesh Ambani on Monday (28/08/23) said that his company JIO will create AI models tuned for Indian Users. JIO promises AI to everyone, everywhere. And we shall deliver. "

INTRODUCTION

In every decade of women's life, they must take care of their fitness, mental and physical health. Women are special creation of God with extra fittings. They may face different types of health issues, mood swings, muscle aches, weight modifications and skin problems.

The secret to success in life lies in a healthy person. Having good and wholesome health will help to achieve success in life.

It is believed by many people that having a healthy and fit body will enable them to live a happy and active life with no major physical and mental issues. Health indicates the inner peace also.

Healthy living involves protecting ourselves from unwanted substances, doing regular exercises, consuming the right amount of food, sound sleep. Particularly women must take care of their mind and body by having awareness.

A survey conducted by the WHO showed that many females and teenage girls fail to meet their dietary and physical needs. Due to this many women suffered from iron deficiency.

A family's growth and wellness depend on women. Nowadays, women are participating actively in all sorts of activities. Technology rules the world while at the same time women are

doing many things over internet. This chapter discusses about the Artificial Intelligence in Fitness.

Our lives get busier, and we barely have time to practice on a regular basis. The challenge of maintaining a healthy diet is even greater! Women may have a lot of confusions: what diet works best? How should we choose a plan? All of these seem a bit scary. There's no need to worry; artificial intelligence has got you covered!

Artificial Intelligence

AI makes the computer or Robo think intelligently and act accordingly. Sometime AI takes important decisions in business also.

AI TRAINERS

Personal trainers with artificial intelligence would already be familiar with this new concept, but amateurs would also be intrigued. AI is doing wonders in collecting data accurately. Smart wearable helps to track fitness.

AI personal trainers behave like humans. They advise properly and accurately.

Women may interact with AI bots throughout their practice. It guides thoroughly. AI Trainers apps are interesting and motivational.

Computer Vision:

Computer Vision makes systems to retrieve the data from digital images and videos. So, computer vision supports in evaluating poses of human being. There are three analytical Methods.

1. Skeleton Modeling,

2. Contours Modeling

3. Modeling Volume.

Example: There is a **ZENIA app** for Y**oga Practice**

Clothes contain sensors which might be worn and it would assist correcting bio mechanic actions. The world is revolutionized highly.

Wearable Pants

Wearable pants are available for the fitness purpose.

Example:Asensei and Wearable X

Wearable X pants consist of two sensors. These have built-in speed meters and monitors. These pants produce vibrations. Measurement position are X axes, Y axes and Z axes with respect to earth's gravitational fields.

Microcontrollers

Microcontroller does the crucial task which delivers the data to Smartphone or any other device Bluetooth connected.

Microcontrollers are a battery-driven microcontroller delivers data to an app on a nearby Smartphone or Bluetooth-powered device over a Bluetooth wired connection. The batteries may be recharged through a micro-USB connection and are lithium polymers.

Diet Planning:

Diet is the most import part for one's health along with fitness. AI supports by predicting diet and suggest the wonder diet plans. People may choose vegetarian, non-vegetarian, protein rich food, carbohydrates and as their wish. AI produces the diet chart according to the need.

We have a number of AI powered applications for fitness and diet.

Example: Smart Wrist, Intelligent Foot wears , Yoga Suits/pants

CONCLUSION

Women or men can maintain their fitness and, in some way, achieve their goals. But in the future, AI apps will be used and people will enjoy with its benefits. AI is reliable for evaluating out fitness and modifies the suggestions and diets according to the daily needs. Income also be raised when the AI feature integrated with the personalized apps in fitness centers, and for physiotherapists. Physiotherapists may also take accurate prediction, make good decisions and suggest an effective fitness formula to the clients.

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Employee Retention : Invest more get more

Suresh Ramdas Suvarna, Ph.D.

Introduction:

Contemporary employees are cognizant of the contribution they make to an organization. They are consequently more likely to seek employment elsewhere if they perceive that their current employer is failing to capitalize on their abilities. In an era when many businesses struggle to retain talent, employers must invest in and provide active support for the growth and development of their employees to prevent them from seeking employment elsewhere.

Listed below are five advantages of investing in employee training programs for your organization, as well as implementation advice for said programs.

Considerations for Organizations to Make in Employee Training

Employee training offers numerous advantages for both employees and employers, including increased revenue, cost savings, and enhanced employee morale and talent retention. Employers who invest in employee training can anticipate the following advantages:

1. It facilitates the attraction and retention of exceptional talent.

Staff retention and the recruiting process could be considerably improved by implementing employee development programs that provide training for employees. To begin with, employees perceive training initiatives as a means of honing their skills, predicated on the notion that these programs impart knowledge. According to one study, 92% of employees whose participation in a training program was well-designed observed an increase in engagement.

By providing sponsorship for sales training programs, for example, your sales personnel can acquire fresh or supplementary knowledge that can enhance their selling capabilities, as well as cultivate their self-assurance and favorable work demeanor. Undoubtedly, you're standing as an employer who demonstrates concern for the professional growth of your staff will be bolstered. As you assist your staff in developing their abilities and achieving personal development, you are cultivating a talent pool of gold that will provide your company with a competitive advantage in the market.

We estimate that hiring a new employee cost an organization three to four times the salary of the position. Through the implementation of training programs that invest in current staff, businesses can ultimately reduce employee turnover and avoid recruiting expenses.

2. It is capable of determining which personnel merit promotion.

A reservoir of potential future promotion candidates may consist of trained personnel who have amassed specific levels of expertise through their tenure. When an organization possesses an established talent pool, it becomes unnecessary to conduct additional searches for qualified candidates to fill managerial or executive positions.

Frequently, these positions are most effectively filled through internal promotions. Given their familiarity with business operations and organizational structure, existing personnel possess the knowledge and skills necessary to effectively contribute to the achievement of the company's objectives.

3. Enhanced employee engagement may result.

Providing your staff with training is an excellent method to temporarily divert their attention away from their regular duties. When employees are deprived of opportunities to engage in additional beneficial activities, such as those provided through training courses, they are more likely to experience a decline in motivation and job satisfaction.

Employees who are offered learning opportunities and perceive that their employer is willing to invest in their attendance at conferences or enrollment in specialized courses are additionally inclined to exhibit greater loyalty towards the organization. This is supported by the findings of an additional SHRM study, which found that 76% of employees surveyed were willing to remain with

an organization that provided opportunities for continuing education and development. The outcomes illustrate the employees' aspiration to enhance their proficiency.

In essence, your employees will be motivated to exert maximum effort for the benefit of your organization when you demonstrate a readiness to invest in their training and growth.

4. It results in financial savings for the organization.

The most efficacious training programs enable personnel to acquire a diverse range of skills, thereby expanding their aptitudes in multiple domains.

Employers are subsequently in an enhanced position to recruit personnel with diversified skill sets and facilitate their transition to other relevant positions within the company. Employees experience a sense of empowerment as a result of assuming greater duties and responsibilities within the organization.

5. It shapes the trajectory of your organization's future.

When integrating employee training and development programs into an organization, it is imperative to consistently update the offerings. Anticipate the long-term implications of designing or refining training methods in order to enhance their alignment with the needs, interests, and objectives of employees.

Additionally, it is imperative that you ensure your organization remains updated on the latest industry trends and evaluate whether they necessitate a revision to your business culture or customer service brand. In such a circumstance, a novel training framework ought to be implemented as well.

Training and development of employees should be a collaborative effort between the organization, its administrators, and its employees. When meticulously designed and consistently executed, this program has the potential to stimulate substantial development on both the individual and organizational levels.

Training and development of employees should be a collaborative effort between the organization, its administrators, and its employees. When meticulously designed and consistently executed, this program has the potential to stimulate substantial development on both the individual and organizational levels.

Invest in the education of your staff to increase productivity.

When you engage personnel, you select individuals who possess the most advantageous skills for the position. However, with the constant evolution of the globe and your industry, it is easy for certain skills to become somewhat antiquated.

By providing routine training, you ensure that your team members remain current and innovative. Educating them in novel practices and methodologies enhances their efficacy in their respective endeavors. Furthermore, consistent and appropriate feedback is critical in order to ensure that these lessons are retained.

The research indicates that organizations that provide extensive employee training programs achieve a remarkable 300% increase in profitability compared to those that do not offer formal job training. Trained personnel exhibit enhanced capacity for innovative thinking, well-informed decision-making, and streamlined task execution.

You may also instruct your staff on how to participate in activities such as employee advocacy, which can generate additional sales opportunities for your organization. Training could also be utilized to transform senior staff into mentors, thereby reducing the amount of time supervisors expend responding to staff inquiries.

Providing employees with opportunities for training and development is a straightforward method of establishing trust within a team. Employees appreciate it when their superiors demonstrate a willingness to invest in their professional development through educational initiatives.

However, neglecting to provide your team members with education indicates a lack of concern on your part regarding their ability to accomplish their objectives.

60% of Indian workers, according to a survey conducted prior to the pandemic, would quit their current employer if training ceased. Thirty-one percent indicated that they had previously done so. In addition, given that it has been established that more than 80 percent would now leave for greater opportunities alone, that number is likely even higher at this time.

If an employee lacks confidence in their long-term prospects with your organization, they will be less inclined to remain when alternative opportunities arise elsewhere. Providing employees with opportunities for growth and development ensures they are not stagnating in their professional development.

Employees will respect and value the organization to a greater extent as you facilitate employee development. Through consistent training, you can demonstrate to your staff that you care about their welfare, which in turn decreases employee turnover and fortifies the corporate culture.

This results in stronger relationships among all members of your team. both among supervisors and subordinate personnel.

Disengaged team members exhibit minimal effort due to their lack of profound dedication to the organization. or to assist your organization in attaining its objectives. The converse is that consistent training reduces tension. It relieves boredom by providing opportunities for employees to attempt new things and break up the monotony of routine tasks.

A single error committed by a remote worker while connecting to a public network or by a member of staff by clicking on a hyperlink has the potential to cripple an entire organization. Alternatively, incur substantial financial penalties and sanctions.

Train individuals adequately to allow them to depart. "Be so good to them that they will not want to treat you poorly otherwise," said Richard Branson.

Many individuals contemplate pursuing professional certifications or additional education in order to improve their employability and skills; however, the financial burden of tuition and the challenge of securing sufficient funds to support their studies deter them.

In general, employers who provide financial support for professional development observe enhanced employee retention and satisfaction, as well as increased workplace innovation. Additionally, investing in your employees is one of the most effective ways to demonstrate that you recognize their potential and value them. Businesses are more likely to remain competitive and forward-thinking if they foster an environment that promotes learning.

Employers frequently inquire, "How will you manage to finish this course while maintaining your regular work schedule and devoting your full attention to your job duties?" Online education provides many students with the ideal remedy for this dilemma.

The flexibility of online courses permits you to engage in your studies at a time that is most convenient for you. Lectures are frequently made available on-demand and live (via the university's learning platform), so if you are unable to attend at the appointed time, you may rewatch them at a later time, perhaps while commuting to work via the train.

An important advantage that employers derive from allocating resources towards staff training is the infusion of fresh ideas, improved skills, and increased employee enthusiasm. Online courses at Sussex emphasize real-world scenarios and encourage students to apply classroom knowledge to their respective organizations and job functions, thereby progressively applying newly acquired concepts and resolutions in the professional environment.

By virtue of the fact that many of our academic teams provide consulting services to multinational corporations and direct project and research teams on an international scale, you gain direct knowledge from individuals who are shaping and informing industry practices. Additionally, we promote peer-to-peer learning; students collaborate on novel concepts and solutions.

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CI/CD for Microservices with Azure Kubernetes Service (AKS) and Azure DevOps

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Abstract- CI/CD stands for Continuous Integration/Continuous Delivery, is a software development practice that emphasizes frequent integration of code changes, automated testing, and automated deployment of software to production or staging environments. The CI/CD pipeline is a series of automated steps that take code from version control, run tests, and deploy the code to production or staging environments. Continuous Integration (CI) is the first stage of CI/CD. CI requires developers to integrate code into a shared repository several times a day. Each code integration is then automatically verified by building the application and running automated tests against the build. The main goal is to detect integration errors as quickly as possible, prevent duplicate work, and allow a team to develop cohesive software more rapidly. Since CI automatically builds and tests the application, often those build and test processes can be run in minutes, developers will have a shorter feedback loop and can resolve issues before they become larger problems.

Keywords- Azure Kubernetes Service (AKS), CI/CD pipeline, Docker IDs, Azure RBAC

1. Introduction to CI/CD

Continuous Delivery (CD) is a software development practice where code changes are automatically prepared for a release to production. It builds on Continuous Integration (CI) by deploying all code changes to a testing environment and/or a production environment after the build stage. The process of transitioning code into production is kept reproducible. The main goal of Continuous Delivery is to ensure that the application can be released at any time, but does not require that releases happen at all times. CD enables developers to make predictable releases on demand. When the CI/CD process is set up, just after a code change is merged into a trunk, the CI/CD pipeline automatically deploys the application to production or a staging environment.

2. Understanding Microservices Architecture

Microservices architecture is a style where multiple small autonomous services are built and maintained to create an application. Each microservice focuses on a small group of related business capabilities. A business capability is a concept that is essential for the business, such as creating an account or making a payment. Each microservice could be deployed, updated, exemplified, and written in different environments. Although microservices architecture is seen as a trend for developing an application, it's established on the architectural business ability. Business ability indicates what the software is supposed to do. An application created using microservices architecture can be assembled by combining various business ability groups. It makes sense to be relatively autonomous and independent of each other. Each group of business ability is developed and maintained by dedicated teams. Each team builds its solution on top of tailored technology.

Microservices architecture is a true service-oriented architecture. However, it has some features that distinguish it from the previous SOA patterns. Microservices architecture is designed to deal with small autonomous services. Progress in Internet and microhardware and abstraction make it feasible and exciting to move from the typical monolithic application to the microservice style application. Microservices architecture keeps the benefits of service-oriented architecture whilst avoiding its disadvantages. With microservices architecture, teams can focus on services by using multiple technology stacks with a quicker release cycle, thus realizing the benefits of service-oriented architecture in a more efficient manner.

3. Overview of Azure Kubernetes Service (AKS)

Microsoft Azure hosts a range of services, which users can call and interact with over a REST API. The Azure cloud provides a consistent API surface area, so users do not have to learn different APIs for working with different resources. This chapter discusses the Azure Kubernetes Service (AKS), which provides a deployment, upgrade, and maintenance solution for end users who are running Kubernetes on Azure.

AKS is a managed solution for deploying and maintaining Kubernetes, which simplifies K8s by offering complete installation and support. Users can simply create an AKS cluster using the command-line interface or some templates, and they will receive a complete K8s platform that is deployed and monitored by Azure engineers. This can take the load off of DevOps teams giving them more space to focus on applications and services rather than spending their time managing a currently running K8s cluster. While this is the most advantageous method of creating and managing Kubernetes

clusters in Azure, it is not always ideal – an organization may already be reliant on a legacy package that does part of the installation and configuration using custom scripts. In that scenario, the organization would not want to introduce extra packages into their deployment process, and they would rather spend the time deploying and maintaining their own solution.

While owning and operating a K8s cluster can be both taxing and tedious, running AKS has its own pros and cons. AKS is definitively the easiest method of utilizing K8s in Azure when compared to the alternatives. It is the most streamlined method for upgrading, scaling, and otherwise maintaining Azure's control plane. Configuration options are both straightforward and somewhat limited; Azure does most of the planning work for users.

4. Introduction to Azure DevOps

Azure DevOps is a Microsoft offering that provides a suite of tools and services to support DevOps deployment processes, including planning, development, build, testing, release, deployment, and monitoring of an application. More specifically, Azure DevOps consists of a combination of services that link and orchestrate the various steps within your custom development pipeline. The main Azure DevOps features are Boards, Repos, Pipelines, Test Plans, Artifacts, and Marketplace.

Azure Boards enables the management of software projects using the Agile or Scrum methodologies and includes useful project tracking features, such as customizable Kanban boards and backlogs, along with project generation capabilities. Azure Repos is a source code repository that consists mainly of Git repositories used to store and manage source code, along with a web interface that offers various capabilities. Azure Pipelines enables managing the automation of the building, testing, and deployment of project artifacts, whether they be code components or container images. Azure Test Plans allows for configuring the testing of project components by providing the tools for running manual and exploratory tests. Last, Azure Artifacts is an artifact repository that provides capabilities for managing feeds that store project components and dependencies, such as libraries and external packages and tools, generated by other projects or third-party tools.

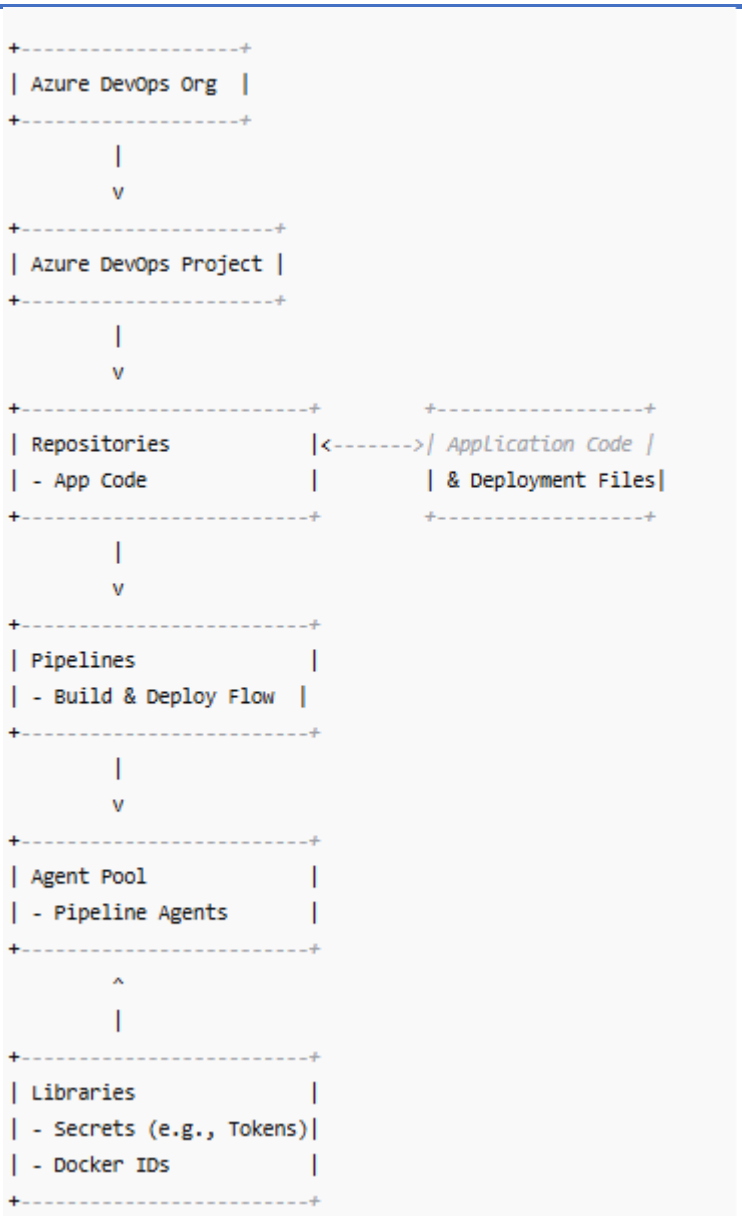
Azure DevOps is the successor of Visual Studio Team Services, which was itself the reincarnation of Team Foundation Service, the cloud version of Team Foundation Server. It is available as a hosted service in the cloud or as an on-premises server that you can set up yourself and corporately manage. Azure DevOps is free for projects with up to five users. While billed on a subscription basis, additional users need to pay for a number of Azure Pipelines build minutes and the storage of Azure Artifacts feeds.

5. Setting Up Azure DevOps for CI/CD

With our Azure DevOps project created, we're ready to set up our Azure DevOps project for CI/CD. Before we start building repos and pipelines, let's take a look at what Azure DevOps resources we'll need to create to support our upcoming CI/CD tasks. There are a few available resources we need to use to implement CI/CD. They are repositories to hold our application code and deployment files. Pipelines used to automate building, testing, and deploying our applications from code. Libraries hold associated settings for pipeline use, such as shared secrets and Docker IDs. Agent pools house our pipeline agents that will be used to execute the pipeline commands. We also need to create an associated agent pool as we'll need it to run our pipeline commands.

Let's get started creating our Azure DevOps resources. We'll start with a repository for our product catalog application. We'll then create a library to hold our shared Azure settings, and then create an agent pool and a few pipelines and share Azure secrets and Docker IDs settings. Managing our Docker image logistics is a key aspect of this Azure DevOps CI/CD process. The product catalog microservices will be hosted in Azure's Kubernetes Service and Docker images will need to be built and stored in either the Azure Container Registry or an external Docker registry. The deployed code needs to be the same tested code packaged in the Docker images so an effective CI/CD process should store all artifacts needed to deploy the specific version of code: the Docker images, the Helm Chart, and the Kubernetes' manifest files.

Azure DevOps CI/CD Resource Overview:



6. Creating a Sample Microservices Application

Creating a microservices sample application may seem difficult; however, it is much easier if we can reuse any already existing project. Fortunately, there are many applications that have already employed the microservice pattern. The application we will create in this chapter is a simple e-commerce web application with a web front end and multiple microservices on the back end. The web front end allows users to register and create a shopping cart. They can then select a book from the book roster and add the book to the shopping cart. Finally, they can Check Out to have the order submitted.

The web application is called BB8 because it allows users to purchase free e-book books. The microservices on the backend include Book, Cart, and Order. The Book microservice exposes

functionality to the Book database. The Cart microservice exposes functionality to the Cart database. The Order microservice exposes functionality to the Order database.

BB8 is a simple e-commerce web application with a web front end and multiple microservices on the back end. The web front end is able to register a user, create the user's shopping cart, select a book from a roster and add the book to the shopping cart, and finally Check Out to submit the order. BB8 allows users to purchase free e-book books. It was built using ReactJS and forgo authentication, so Internet users can toy with it; however, the application data will not be stored unless the user uses the Check Out functionality.

7. Containerization with Docker

Before building a CI/CD pipeline for microservices, we need to create their container images. In this section, we will go through the steps for creating, using, and pushing Docker images.

In the past, software was packaged and archived as a whole. For instance, JSP files would be compiled into WARs and uploaded to a server. If a small servlet were changed, the developer would likely need to redeploy the whole web application to see it in action. With microservices, inside the same software application, different pieces serve different functions — and those pieces can be edited and redeployed independently of each other. They communicate with each other then over REST APIs or over an event bus for asynchronous communications. When microservices are containerized, a developer can simply build a new image for the service that has changed and the CI/CD pipeline can redeploy it over the network without disturbing the others.

The first step in the pipeline is to create the service container images using Docker. To do this, we need to install Docker and write the necessary Docker files. At a high level, Docker works like this: it takes a file that describes which base image to use, what commands to run to install dependencies, what files to copy into the image from the host machine, what executable should be run when a container of the image runs, and whether the commands should run in the foreground or background. Based on that information, Docker builds a layered image and stores it locally. The container image is stored in layers. If a service depends on a library that is also used by another service, the library is fetched only once. The files can be copied into the image from the host or downloaded as well.

When an image needs to be deployed on an on-prem system, it is created on the on-prem host itself or transferred to the host over the network, which can take time. If an image was already created, it can be run as a container using Docker, or other container orchestration tools, and when it is executed or the orchestration tool runs it, the instructions in the docker file are executed. The first time those

instructions are executed, they can take some time as packages need to be downloaded, but the subsequent runs are usually much faster.

8. Building Docker Images

The first step towards packaging an application for deployment in Kubernetes is the creation of a Docker image. A Docker image is a compressed, portable file system that houses the application and dependencies, in an executable form referred to as a container. Containers offer the simplest method to run applications, while enabling the flexibility of infrastructure management without worrying about the application lifecycle. In an N-tier application, each layer can be a different container, or a single container can house the front-end web and back-end service. Building a container image involves specifying an image file system schema that includes the application code, followed by any dependencies, system libraries, environment variable configurations, and any other requirements needed for container creation. The image file system schema is stored in a special file named a Dockerfile.

The container image build process can be separate from the application deployment process within an integrated CI/CD pipeline. Two common approaches for the build process are available: one can trigger the image build and push commands using either a native Docker task as part of a Release pipeline stage or through the Docker CLI in a Command Line Interface task. Both of these commands use a container registry, the infrastructure service for the registry, the Kubernetes Service APIs, and/or the Docker APIs. The built-in Docker task uses CLI tasks to log into the registry before building and pushing the container image using the Docker CLI. Code changes to a microservice result in a pipeline build that creates a new version of the Docker image and pushes it to the registry. The CI/CD pipeline deployment stage is triggered when a new Docker image is created. This process helps in the quick and efficient deployment of changes.

9. Pushing Docker Images to Azure Container Registry

A containerized application can be packaged in a container image using Docker. The container image is then uploaded to a registry. A registry is a repository where images are uploaded and downloaded during development and from which container orchestrators grab images during deployment. For CI/CD purposes, the CI/CD tool needs to have access to the Docker daemon on the build agent. Azure DevOps Services uses hosted agents and does not provide Docker socket access on the hosted agents for security reasons. You need to run the docker commands in Azure Pipelines yourself or create a self-hosted build agent. This agent should be hosted on an Azure VM or a physical

machine at your location. To fully automate the CI/CD processes, you should use a self-hosted agent.

The Azure Container Registry service supports all common container image formats, and managed instances of its registry can be used to store images secured with personal organization keys. When developing microservices in the Azure ecosystem, it is a good practice to store application images in Azure Web Apps and push images that are used in Kubernetes to Azure Container Registry. By default, worker agents used in Azure DevOps are not able to push images to Azure Container Registry; you have to define a service connection that references the Azure credentials with permissions to write to the archive. Pushing an image in Azure DevOps is done by running the appropriate docker commands preceded by the command with information about the Azure Container Registry you want to use.

10. Configuring Azure Kubernetes Service

In this chapter, we'll configure an Azure Kubernetes Service (AKS) environment. The Azure portal is where we'll perform most of the Azure operations within this chapter. Before we jump to the Azure portal, let's review some high-level rationale regarding Kubernetes service configuration.

A typical Kubernetes service deployment workflow comprises the following steps:

- Create the Kubernetes service: This step creates the Kubernetes management and node components. - Set up networking for the Kubernetes service: This step creates the Azure Virtual Network and its subnets, which are used by the Kubernetes control plane and nodes. - Configure the service for workloads: Kubernetes services are configured to run workloads, such as the container images within Azure Container Registry.

In this chapter, we perform the first two steps. We cover workload configuration in a later chapter. During AKS service configuration, we have the opportunity to configure its core services according to organization policies. A Kubernetes service comprises a management component and worker nodes. The management service handles worker node configuration and workload distribution. Because the management component manages the worker nodes, the management service has elevated privileges. We use Azure AD to enhance role-based access control for the Kubernetes management service.

On AD integration, we'll use Azure RBAC management in combination with Kubernetes RBAC. Azure RBAC allows us to define the administration of the Kubernetes management. Kubernetes RBAC allows us to define resource access for individual Kubernetes users or groups at the Kubernetes API level and for all the resources under its management. The Kubernetes management component communicates with the Azure subscriber over a secure channel.

11. Deploying Microservices to AKS

Deploying each microservice is a critical task in ensuring the operability of the application. When deploying an application in microservices architecture, there are different sub-tasks to take care of. For example, all microservices might have their respective config maps and secrets associated with them. Config maps are the resources that allow you to decouple environment specific configuration from the container images, thereby making applications easier to manage. Secrets are similar to config maps, but are meant to be used for sensitive information like passwords, OAuth tokens, ssh keys, etc. These secrets are stored in base64 encoding and should not be used to store larger sensitive information like ssh private keys or service account tokens.

When working in microservices, usually there are more than one application associated with any deployment. For other deployment types, the microservices are deployed either together or by holding a dependency on another. When coming to microservices architecture, the evolution of each service is individually; meaning each service might have its own distinct deployment strategy. The platform allows you to leverage that by declaring two resources; Services and Deployments. Services are a temporary layer that can be used to expose your application either as an internal service in different ways or as a route to the outside world. The service should have the ability to automatically redirect traffic to your Pods. The services pillar is simple enough; just expose a single IP address for accessing one or more Pods. The other pillar of the model is Deployments that perform scaling, rollout new builds, rollback on failures, health checks and many other tasks for you; all defined imperatively or declaratively.

The platform was initially built to host applications, so you can imagine how important it is in delivering a fast and responsive interface to users. But is it what is best for you? The answer depends on the product you're developing, what it does, how many users you have, your expected growth, etc. Most of the features are reflections and solutions to common problems that organizations face in deploying and managing a great deal of different services. It performs great when you have a ton of services, or a ton of instances of the same service, but if you're just deploying a single application, you might want to keep it simple.

12. Implementing CI/CD Pipelines in Azure DevOps

The CI/CD pipelines for our microservices are built and released using Azure DevOps Services. Azure DevOps is a set of development tools to plan and develop, collaborate on code development, and build and deploy applications. With Azure DevOps, you can implement your DevOps processes

and support collaboration among your teams. Azure DevOps is composed of a set of services that can work individually or integrated with each other in stages of your DevOps process. This section starts with the Azure DevOps Build Pipelines that compile our microservices and package into container images stored in Azure Container Registry; and then deploys pipelines that deploy these microservice images, set the configuration, and prepare the Azure Kubernetes Service cluster for our microservices. For Azure DevOps Build Pipeline, we will standardize our pipeline files into the YAML template, which can be modified, reused, and simplified for various microservices. It is easy to create Azure DevOps Release Pipelines by using Azure DevOps Built-in Tasks and Azure DevOps Marketplace Extensions. In subsequent steps, we will create the shared Azure DevOps Build Pipeline YAML template in our Azure DevOps project to build our microservices and publish releases. Then we will use the Azure DevOps Partner Task to create the Azure DevOps Release Pipeline to deploy our Azure Kubernetes Service cluster. Finally, we will integrate GitHub Actions in GitHub or Azure DevOps Service Side Repositories with Pull Requests to trigger Azure DevOps Build Pipelines to compile the code into microservices and publish releases to Azure Container Registry.

12.1. Building Pipelines

CI/CD Pipelines implement build, test and release steps that automate deploying microservice containers into a Kubernetes cluster. The build is implemented in the build pipeline. Containers are built from Docker images stored in a container registry which are then used for deploying to Kubernetes. Infrastructure as code is utilized to deploy the services and infrastructure as Kubernetes yaml manifests in a Git repo or via modules with state in a storage account. This enables us to always have the desired state of the infrastructure maintained and versioned. The artifacts that will be output from the CI/CD pipelines are charts and manifests for each microservice that will be deployed.

For deploying microservice containers into an existing Kubernetes Service with ingress controller, we will configure both Docker build steps and create charts from the pipelines. A package manager for Kubernetes simplifies deploying, managing and versioning applications. Charts create a release of Kubernetes resources via templating and parameterization. In this example, we will be using a chart to deploy resources.

The CI/CD pipelines operate via Agent pools that create build agents at the task step with instance interaction. Deploying and running actual containers that are building source code and running security tests is resource intensive. Deploying these build agents onto a VM provisioned in a specified Region is the best approach. The VM size should be a Standard D4s v3 with 16 GB of RAM and 4 CPUs

dedicated to creating containers. Other Agent pool types will be Windows and Linux hosted agents that are essentially using provided cloud hosted build agents that are templated on a specific duration time. Since these hosted agents are temporary with a limited lifespan, they may not be able to complete timely or may run into quota issues. It's always advisable to use a self-hosted build agent for performance-intensive or lengthy pipelines.

12.2. Release Pipelines

Continuous Integration (CI) and Continuous Delivery (CD) are together known as CI/CD. CI/CD is a modern software development methodology. CI/CD automates many critical and error-prone steps in application delivery. Adopting CI/CD into your application delivery increases the speed of delivery. Apart from speed, it also provides many benefits, such as enhancing the quality of the applications, increasing the deployment success rates, and reducing the manual processes. In earlier days, CI/CD focused on deploying applications to Virtual Machines. Now, CI/CD is being implemented to build and deploy cloud-native applications, Microservices based on light-weight container images into Container Orchestration Servers.

Azure DevOps CI/CD supports many types of applications, hosting in different environments. On-Prem applications running on Virtual Machines, Websites running on Azure App Services, and Kubernetes based applications. In Azure DevOps, the Build Pipeline is done by the Build Pipeline, and other applications that are hosted using VMs or Docker Containers running in On-Prem or other cloud providers or Kubernetes clusters are done by Release Pipeline. Cloud-native Applications built with Microservices can provide security, portability, and scalability. They can be built and deployed using Azure DevOps Services or Azure DevOps Server. The CI Builds container images from the Source code, push them to Container Registry and waves Trigger event to initiate CD Release. The Release Pipeline uses the Azure Kubernetes Service to pull the Container Image file using the image tag to deploy the Microservices Application as a Pod with Deployments and Services. The Release Pipeline tracks the status of the Pod and updates the Deployment based on Pod status and routing the traffic to the Deployment.

13. Managing Secrets and Configuration

Secrets and configuration management is a default part of any microservices architecture. Managing connections strings, passwords, and other configuration is manageable in a monolith; however, as applications are broken down into multiple pieces, things get complex. How do microservices talk to each other? How do they trust each other? How do they pass secrets and authenticate? This is the

complexity we face.

In this chapter, we dig deep into configuration and secrets management for microservices deployed on Azure Kubernetes Service. Managing secrets and config in a microservices architecture is a broad topic and gets complicated very quickly. You can see the four layers of secrets management. Layer 1 is native to Kubernetes: Secrets and ConfigMaps. We discuss them in detail and when to use them for your needs. Layer 2 involves augmenting native Kubernetes types with policy and security provided by Azure KeyVault. At layer 3, you could go a step further with security tools and use those to protect your configuration and secrets. Layer 4 involves a service mesh and gives you native-to-the-microservices-builtin and transparent support for authentication, authorization, and trust amongst all your microservices.

Layer 1: Native to Kubernetes Secrets and Configmaps. Kubernetes has two native types you can utilize to support configuration and secrets: Secrets and ConfigMaps. Secrets is a Kubernetes native object to help manage sensitive data like passwords. What's in a secret is only base64 encoded, not encryption, so for anything that requires more security than that, you'll need to manage secure storage of any sensitive data.

14. Monitoring and Logging in AKS

Monitoring and logging play a crucial role in maintaining a healthy Azure Kubernetes Service (AKS) cluster and its workloads. When something goes wrong in an application or cluster, being able to see what actually happened at that point in time becomes critical to getting it back to a working state, and hopefully avoid the same problem in the future. In this chapter, we will explore how to implement monitoring and logging in an AKS cluster and export it to an external service for long-term storage. When you run workloads in a cloud or any other infrastructure, you need to be able to tell if an application or its components are healthy and functioning normally. Monitoring is the activity of seeing if the application is in a good state. Alerts are normally set on these monitoring solutions that will notify you when something deviates from the normal state. Logs are records of activity that happens in your application. They capture a moment in time when a specific event occurs like an error occurring or when an endpoint was accessed successfully. Logs are crucial in knowing what happened to your application when the monitoring solution told you something went wrong. When we think of a cloud-native application, we think of microservices that run in a distributed manner and are managed by Kubernetes. An AKS cluster running Kubernetes orchestrates and manages deployments of an application's components and their availability. The platform itself has a number of components that

control the regulations of the user-defined applications. All of these components need to be monitored, and their logs need to be stored externally for long-term purposes. Traditional monitoring solutions may not be capable of monitoring both these layers of the architecture at scale. Due to the sensing-enabled and smartphone-connected world we live in, the amount of telemetry data is large and has to be properly accounted for.

15. Scaling Microservices in AKS

Containers, and Kubernetes itself, provide an efficient way of working with microservices because their lightweight nature empowers application owners to spin up multiple instances of the services quickly and easily. However, the number of replicas of a single service running behind the Cloud Load Balancer is something the developer needs to think about on each of the different services. You may be eliminating a lot of unnecessary engineering effort by housing all your components under the Microservices umbrella, but that doesn't mean you're free from the scaling question altogether. Some services may need to be scaled out, while others need to remain sparse.

In Kubernetes, the job of managing the number of replicas for a microservice falls under the scope of Deployments. You can create Deployments in several ways: via raw YAML, through Helm Charts, via the Kubernetes CLI, or from your code by calling the Kubernetes API. Therein lies the flexibility of the tool; however, it's not always the best approach to manage Deployments manually, especially if you have a larger footprint and many services running in smaller configurations. You may find yourself scaling a Deployment multiple times a day, which can easily be done via the command line.

Kubernetes actually has a built-in concept of Horizontal Pod Autoscalers, which provides the ability to automatically adjust the number of replicas in a Deployment or ReplicaSet based on metrics like CPU usage. The intent of the Kubernetes Autoscaler is to relieve the burden of scaling these components and doing so in a way that takes away the pain of over- and under-spending on resources. Keep in mind that the HPA operates using scaling policies — for example, if your Base Replica Count is 2, the Autoscaler will only add Pods, not remove them, which you will still have some control over.

16. Handling Failures and Rollbacks

Failures will happen and you need to consider how to handle failures. The ability to respond to a failure can make the difference between a company being known for its product or service quality, and being known for frequent outages that interrupt everyone's work. There are some built-in protection and monitoring for problems, such as liveness and readiness probes. But you can also set up some of your own protection that will give you better insight into problems, and make the system more

responsive to failures. In this chapter, we learn about some additional tools for spotting failures, making improvements to the application and stopping corruption, then how to roll back changes both manually and automatically.

When you are using a deployment tool to deploy your applications, you can choose if the deployment should succeed or fail. You can also handle configuration changes during deployments. Not everybody wants to roll back an application when a failure occurs. Depending on the application and the reason for the failure, it may make sense instead to disable it. To do this, it is best to use feature flags. With feature flags, you can deploy the application code but turn the feature off while the application is gradually being turned on for different user segments. If there is a problem, you can disable the feature to minimize the impact while you fix the application code. The deployment tool also allows you to configure the release pipeline to only deploy to a testing environment initially, and once you have validated that the deployment does not have any problems, continue the deployment to production.

17. Testing Strategies for Microservices

Microservices based applications can require a variety of different testing strategies, depending on how developed and integrated the microservices are. Testing at all levels is important, and it is also important to know what dependencies are required at which point. This chapter describes types of testing for microservices-based applications, and what dependencies are required for each.

Unit testing Unit testing is the most granular level of testing; often these tests are designed to verify the logic of a single method or function call in a class or module. Unit tests run quickly, and are often written along with the code they are testing. For microservices, unit tests can be created just the same way they would be for a traditional, monolithic application; each microservice can define its own internal business logic, and unit tests can be created to test those definitions. In microservices, unit tests can use mocking or dependency injection mechanisms to replace any dependencies in order to speed execution and isolate the logic being verified.

Integration Testing Integration tests are used to verify that methods or functions in multiple modules – often different microservices – work together as expected. These tests often use the same infrastructure that the deployed application uses, and can involve actual network calls or deployments to a cloud environment. For microservices, integration tests can be run in multiple ways, depending on the state of the application. In the early stages of development, integration tests may depend only on the microservice being developed, and mock implementations of any other involved microservices. In

later stages of development, as more services are defined and deployed, complete integration tests may be run against real deployed microservices, either in a staging environment or perhaps even in the production environment itself.

18. Security Best Practices in CI/CD

CI/CD serves the purpose of allowing rapid software development cycles while still forcing quality throughput gates on the software. Everything should be automated, and security plays a pivotal role in that automation. As with cost, security is a cross-cutting concern, and it's vital to ensure that security won't be an afterthought, but a first-class citizen in your CI/CD pipelines. There are several steps throughout your CI/CD pipeline weaved with security.

While code is being developed, you should ensure that no trusted libraries containing known vulnerabilities are being downloaded and contained in the application; running a tool is a good step for this. Ideally, you should run this step on a pre-commit hook using a tool. Even then, you should ensure that the developer machines have bootstrapped the same trusted versions of the libraries, or the developer is whitelisted to only access libraries with no known vulnerabilities. Pushing the library versioning checks to a separate commit after the code is changed but before the actual commit can serve as a pre-validation check for this.

Whenever a developer commits code to a branch, it should go through a series of gates before it's merged into the main branch. PRs should be automatically validated using tools, and if these validations fail, the developer should be prompted to fix them before the merge is attempted again. On successful validation, an automated static code analysis tool should run to check for any security or code smell concerns. If the analysis passes, an approver—preferably a dedicated security expert working closely with the application team—should be notified to go through the code and approve it for merging into the main branch. Integration tests may run for the updated branch and notify the PR with the results. Merging the branch may trigger notifications to any microservices impacted on change but whose branches are not affected. The merge must trigger the build pipeline as a downstream process to make sure the merge does not break the build until the application goes into production.

19. Cost Management in Azure Kubernetes Service

In the previous section, we demonstrated how to configure autoscaling for your Azure Kubernetes Service cluster's virtual machines and Pods. In this section, we will explore the costs implicated by AKS and manage them. Deploying and running AKS and its resources costs money. However, AKS

brings solutions that can be used to reduce standard and unexpected costs. In this section, we discuss the standard costs of AKS, how to estimate those costs, dynamic nodes and their costs, how to scale down the AKS cluster when not in use, the unexpected costs with AKS, and reducing unexpected costs.

Your AKS cluster may have several associated costs depending on the configuration requested. You need to provision the Azure virtual machine on which the control plane runs. Creating a private Kubernetes cluster creates an Azure virtual machine that runs for the full length of the cluster's lifetime. After you create a public or private cluster, you can resume using the AKS managed control plane at no charge. You incur usage charges only for the Azure resources that make up your worker nodes and any network traffic to and from your cluster.

There's no example AKS resource. For example, if your AKS cluster has five Linux virtual machines in the Standard DS2v2 SKU running during a month with average utilization at 50%, at the end of the month you'll incur virtual machine charges for 0.5 x 5 x 720 = 1800 DS2v2 hours in addition to other Azure resource charges. Note that there is a minimum duration for which each VM is charged.

20. Integrating Third-party Tools with Azure DevOps

Azure DevOps provides a comprehensive set of tools to manage software development from beginning to end, but when enforcing a CI/CD methodology, it's not uncommon to leverage tools from other vendors. In the case of Microsoft Azure DevOps, it's particularly simple to integrate third-party tools within the platform. Microsoft offers Azure DevOps Extensions SDK to develop custom extensions for Azure DevOps and integrate services. When deploying applications in production, it's important to monitor their behavior and performance. If an APM tool is integrated into pipelines' execution, application performance is monitored right after deployment, and red flags are raised so that development teams properly act instead of waiting until customers start complaining.

In this chapter, we review the fundamentals for integrating third-party tools, present a simple example with a fictitious tool, and cover a more complex example with an Azure DevOps extension. Integrating third-party tools is pretty simple. Azure DevOps provides a REST API to control several resources. For instance, you can request changes to a build pipeline or a release pipeline, store files such as logs and artifacts, retrieve repository paths, branches, and file names, and get notifications regarding execution status and many other events. These APIs allow Azure DevOps to act and be acted upon, supporting external tools to monitor, control, and interact with artifacts and the underlying

process. As long as your pipeline agent has access to the third-party tool or its API, in YAML pipelines, you can invoke command-line interface commands, execute containers, and run scripts in the target environment. These are the different APIs you can access and the different resources you can interact with: Azure DevOps itself, Azure DevOps pipelines, Azure DevOps repositories, Azure DevOps work items, Azure DevOps notifications.

21. Case Studies of Successful Implementations

In this chapter, we take our keywords and present some successful case studies of other companies. As we have seen before, this is used as a reference for new implementations and is a part of the DevOps Ecosystem, only that these cases multiply and mix. There are also available stories that companies tell for marketing purposes or that are sanitized. What we will do now is filter out the best known ones and have a look at theirs and what technologies they deployed in other companies.

The case studies and testimonials included cover a variety of industries, technology platforms, solutions and sizes. These organizations are lead users of solutions and co-owners of the testimonials. The case studies express what they think, feel and do; they are a simple yet powerful methodology for companies to understand the “what” and “how” of different ways of adopting and leveraging users of products.

The case studies are classified by the providing organization and then split into categories according to either the technology involved or the methodology followed. The case study testimonials convey the value of the IT transformations they’ve achieved, including substantial benefits such as increase or acceleration of revenue, company evaluation or stock price; increased customer satisfaction; reduced costs or waste; increased or improved IT deployment quality; reduced IT support costs or downtime; and increased IT team productivity and morale.

From these companies, today you can become not only a technology requestor, but also a technology provider creating rich technology ecosystems offering not only technology, but domain knowledge and solutions to business problems.

22. Future Trends in CI/CD and Microservices

Microservices have revolutionized how applications are built since the dawn of the cloud, and CI/CD has helped automate the building and delivery of these applications to the cloud. What’s next in this automation pipeline? And where do microservices and CI/CD go from here? Does the evolution stop here? These are some questions we try to answer in this section and leave you with some thoughts and predictions on possible future trends in microservices and CI/CD.

Infrastructure as Code (IaC) is an important pattern in cloud-native development, enabling rapid provisioning and automated management of cloud infrastructure. With the advent of policy engine tools and budget gates integrated with cloud providers, the need for controlling our cloud spending is growing rapidly. The same way we build and manage applications using code, we will ideally manage our cloud infrastructure with CI/CD pipelines – built investing the same amount of care, attention, and legislative policies, like quality gates and compliance reviews. We see IaC tooling rapidly catching up to this CI/CD standard. Companies are reimagining IaC tools to help build repeatable, robust processes, revolutionizing the dogma of reusable modules.

As applications evolve, it's not uncommon that some static segments of an application, an authentication or logging service for instance, will remain unchanged and need changes only a small portion of the time. It's not uncommon that the API gateway, which authenticates and proxies requests to the various microservices in your application, will become a bottleneck, when it originates a new request to a microservice. If the request passes through your organization's firewall and there are transient errors while communicating with the service over the VPN, then your application can become unresponsive.

23. Challenges and Solutions in CI/CD for Microservices

A microservices architecture offers flexibility by allowing applications to be composed of independently created and managed elements; however, this flexibility comes at a cost. In a microservices architecture, the complexity of building and testing applications increases. Operations must ensure that many small containers are deployed in the correct environments, with the correct dependencies and configurations, and are able to accurately interact with each other and any resources on which they rely. This means that configuration management, dependency management, and testing all become more complex problems in this architecture than in a traditional monolithic architecture. These challenges can make CI/CD pipelines more complex, and require more thought to be applied to achieving success.

Fortunately, the experiences gained in many organizations adopting microservices have helped to develop solutions to these challenges. Organizations running multiple microservices in production have increasingly realized the importance of investing in developer and operations collaboration, a central goal of the practice known as "DevOps," in enabling them to successfully deliver products at a faster rate. Similarly, applying safety measures such as shields, compartmentalization, and redundancy have also been suggested. To explore some of these suggestions in greater detail, we enumerate some

of the important CI/CD challenges in adopting microservices below. The list is by no means exhaustive, but it covers most of the problems that organizations may face in their transition. Describing for each problem relevant suggestions based on experiences from industry is also part of this chapter's scope.

24. Best Practices for CI/CD in Azure

This chapter will provide some best practices you can leverage as you implement a CI/CD service in Azure for your microservices on Azure Kubernetes Service.

24.1. Set a Baseline with Example Pipelines

When implementing CI/CD in Azure, Azure DevOps offers several templates that get you started with the most common scenarios. Azure DevOps also offers a way to create your organization from any of these example pipelines. Using example pipelines reduces your development's operational burden by catching mistakes in the configuration of several common scenarios. Furthermore, GitHub and GitHub Actions is becoming a strategic way to deliver cloud services and may catch mistakes more often.

24.2. Use Task Groups and Templates to Implement Patterns Across Pipelines

You will most likely have multiple pipelines doing similar steps and tasks for different microservices. Task groups and pipeline templates are a great way to implement patterns across pipelines. Task groups are ways to group together a set of tasks you want to implement across multiple pipelines. Pipeline templates are your way to define a template that represents a pipeline that can be reused across other pipelines.

24.3. Use a Dev Test Stage Between Build and Deploy Stages

CI/CD in Azure is more than a build pipeline followed by a deploy pipeline to production. Service deployments typically impact application performance and availability. Considering the outcome of a deployment and infrastructure configuration is important to scheduling. Scheduling allows your teams to better prepare for the traffic patterns that determine resource utilization for your application workloads. Azure DevOps allows you to manage these considerations through manual approvals, work item queries, and security gate checks.

25. Conclusion

In this book, we have detailed how to implement CI/CD pipelines to enable an effective release process for microservices deployed to AKS. A placement decision was made to utilize Azure DevOps for CI/CD because it is the easiest solution to integrate with AZ CLI and because it supports the

technology stacks of all the microservices: .NET/C# for the Video Store microservice and as backend for the display web application, Python/Flask for the recommendation service, node/Express for the search service, and Golang for the geo service.

In addition to the Kubernetes-managed environment for deployment, the microservices share two other characteristics: They are containerized as Docker images and partitioned or distributed by business functionality. That is, the solution is created as a set of microservices, each of which exposes a small set of API endpoints. To assist developers with the security of exposed API endpoints, this solution implements customer identity management and authorization using the latest capabilities.

The implementation details made available to the reader should enable you to successfully implement a good release process for both new features and maintenance of your microservices solution, in addition to connecting it to the industry-standard security service. Thank you for your time and attention!

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Safeguarding Privacy in Big Data : Challenges and Solutions

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Abstract:

Individuals, corporations, and governments universally acknowledge the significance of data as a valuable resource. On the other hand, the growing collection and analysis of data has heightened concerns about data privacy. Privacy-preserving analytics is a discipline that aims to find a balance between the benefits of data analysis and the need to protect confidential information. Privacy-preserving analytics refers to a set of methods and protocols that allow for the analysis of sensitive data without disclosing the actual data itself. These strategies and methods are commonly known as methodologies. The objective of this paper is to enable data analysis while ensuring the protection of individuals' and organizations' privacy. Due to the widespread adoption of digital technology, several industries, such as hospitals, banks, e-commerce, retail, and the supply chain, are generating vast amounts of data. Both humans and machines generate data through activities such as streaming closed-circuit television, website logs, and other related processes. Social media sites and mobile devices generate an immense volume of data every minute. In order to facilitate decision-making, the vast quantities of data generated from many sources can be processed and analyzed. However, data analytics has the potential to infringe upon people's privacy. Data

analytics can be utilized for recommendation systems. As a result, the importance of data analytics that safeguard users' privacy has become very crucial. This paper examines various privacy threats, and privacy preservation solutions, along with their respective constraints. Furthermore, a cutting-edge privacy preservation methodology based on data lakes is suggested as a method for effectively preserving privacy in unstructured data in order to tackle the problem at hand.

Key Words: Data Piracy, Big Data, IoT, Data Management, e-commerce

Introduction:

When handling sensitive data within a corporation, it is crucial to safeguard the confidential information of individuals. Data processing and analysis involve specific techniques and procedures aimed at safeguarding data from unwanted access, use, or disclosure. By using privacy preservation measures, firms can conduct effective research and analysis and make ethical data-driven decisions without compromising the anonymity of the data owner. Methods and technology that protect and maintain privacy. Once an individual grasps the importance of safeguarding their privacy and becomes aware of the various regulatory entities that exist to ensure data privacy, it becomes crucial to comprehend the strategies that can be employed to preserve one's privacy. Commonly employed methods include:

- Anonymization of data involves modifying personal information in a manner that makes it highly challenging to identify particular individuals.
- Techniques like pseudonymization, where personally identifiable information is replaced with fake identifiers, and aggregation.

• Encryption techniques: Techniques like homomorphic encryption facilitate the computation of encrypted data, allowing firms to make data-driven decisions without compromising the confidentiality of the underlying data. Adding noise to data or queries is a technique used to achieve differential privacy. This strategy guarantees that the output of a database query only reveals a limited amount of information regarding any specific entry. Using this approach, firms can share collective knowledge about a dataset while safeguarding individual data elements. The objective of each approach is to mitigate the possible risks to privacy associated with the processing and analysis of data. Implementation Methods to Safeguard Personal Privacy upon commencing the implementation of privacy preservation, it is necessary to apply it at two distinct levels: the operational activities of the business and the existing systems. There are three main causes for this:

• Compliance with the specified legal obligations: Data protection standards are highly rigorous in numerous countries. Therefore, the integration of privacy-preserving technologies ensures adherence to these regulations and mitigates the risk of potential penalties and legal entanglements. By proactively addressing privacy issues, you can effectively mitigate the risk of data breaches and privacy incidents.

• Risk management: By securely storing your information, it remains inaccessible to unauthorized individuals, ensuring its confidentiality. Therefore, even if there is a violation of data security, your data will remain unintelligible, ensuring that your customer data is not vulnerable to disclosure. Incorporating privacy protections from the outset is an essential and fundamental action.

• Prioritize the implementation of privacy by design. This theory proposes that privacy should be prioritized and integrated into every aspect of a system, including its design and implementation. This facilitates the implementation of proactive measures, thereby ensuring that privacy is a fundamental aspect of the development process. Privacy impact assessments, commonly referred to as PIAs, must be conducted.

During the first phase of a project's development, privacy impact assessments (PIAs) are employed to identify and address any privacy concerns. They offer support to enterprises in comprehending the acquisition, utilization, and control of personal data, with the aim of ensuring that projects comply with privacy laws and principles.

• Promoting knowledge and consciousness: Provide employees with comprehensive information regarding the importance of safeguarding their privacy and the precise measures implemented by the company to accomplish this objective.

• Implementing technological measures to address the situation: Ensure the security of data when it is not actively being used, when it is being transferred across systems, and when it is being manipulated by utilizing measures such as encryption, access controls, and other technologies that safeguard privacy. The mere implementation of a privacy protection system within your organization is insufficient; there are still hurdles to surmount. Here are two major challenges that a firm may face:

• Complexity: The creation of technologies that safeguard individuals' privacy, such as homomorphic encryption and differential privacy, is a challenging and labor-intensive

undertaking. Furthermore, they exert a considerable burden on the existing resources. This can lead to a rise in computational burden, which might pose challenges to scalability.

• The charges: Enforcing measures to safeguard individuals' privacy is an expensive undertaking. To successfully adapt to the new technology, it is necessary to allocate resources for investments and provide training to your workforce. The cost of expenses can be a significant barrier for small and medium-sized businesses (SMEs).

Concluding Remarks : Safeguarding individuals' privacy is a crucial aspect of data governance. It ensures the confidentiality of your data while still allowing it to be used ethically for analysis purposes. Organizations can mitigate risks, ensure regulatory compliance, and build consumer trust by applying diverse strategies and adhering to regulatory frameworks. This enables businesses to guarantee the secure preservation of their sensitive data while also minimizing risks. Several prior surveys have examined privacy concerns in Internet of Things (IoT) contexts. These studies have extensively researched privacy concerns in the literature. The focus of these studies has mostly been on the analysis of risks and attacks targeting these systems.

A comprehensive examination is carried out from the standpoint of the Internet of Things (IoT) to analyze various threat models and categorize different types of attacks. According to the analysis, it was concluded that the training dataset used to build the machine learning model for the privacy protection system is the most vulnerable to assault. Other vulnerable assets include the model, its parameters and hyper-parameters, as well as the model's architecture. Conversely, the individuals who possess the data, own the model, and utilize the model are the actors who may have sensitivity to the situation. The research revealed that the ordinary least squares regression model, the

decision tree model, and the support vector machine model are the most vulnerable among the machine learning models.

A substantial proportion of surveys focus on examining the methodologies and frameworks employed to safeguard data privacy. Differential privacy, homomorphic encryption, and learning architectures and models are some of the challenges that humanity currently confronts. According to a study, the dangers and vulnerabilities associated with privacy protection systems on the Internet of Things can be categorized into four groups: attacks on authentication, attacks on the components of edge computing, attacks on the anatomization and perturbation schemes, and assaults on data summarization.

A further survey endeavor classifies the data generated at different levels to analyze the centralized privacy protection systems with machine learning approaches. The machine learning methodologies to ensure user safety, along with policy languages to establish user privacy preferences and negotiation strategies that enhance services while upholding user rights. They incorporated various alternative methodologies in their survey, including homomorphic encryption for training models, secure multi-party computing, and differential privacy. To protect the identities of users and the information they contribute, the author classified the models based on whether they were collaborative or aggregated situations. They conducted a study on the current tactics employed in federated learning environments.

Furthermore, the author note that differential privacy-based technologies are predominantly employed for training privacy models. However, this technique is hindered by the significant processing complexity of both the encryption and decryption procedures.

However, progress in creating privacy protection solutions for devices with minimal resources is still in its early stages. Reducing the latency and throughput of neural network training on encrypted data is a crucial challenge that must be addressed to ensure individuals' privacy. Most of the existing techniques rely on outsourcing their deep learning tasks to other entities that have ample computational resources and storage capacity. Additionally, these schemes guarantee the protection of user data, hence enhancing the schemes' exceptional computing efficiency. In order to enhance efficiency and accuracy, it is advisable to explore alternative implementations, such as quantum computing techniques, while developing systems. In light of future possibilities, there are ongoing endeavors to explore parallel learning and cost minimization, as well as network pruning and the interplay between different detrimental behaviors.

Furthermore, it is imperative for the relevant standardization organizations to exert significant efforts in order to provide standardized privacy protection measures. Examining and evaluating privacy solutions in real-world scenarios is a difficult task, especially when considering the balance between the quality of service offered by the Internet of Things and the protection of privacy.

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Enhancing Customer Retention through Big Data-Driven AI/ML Models in Retail

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Abstract

Big data analytics encompass multi-faceted capabilities of continuous reporting, sophisticated analytics, and advanced reporting that enable organizations in the retail industry to meet customer expectations, mark numerous opportunities, and make informed decisions. In particular, the challenge of retail customer retention is crucial. Given the recent surge in AI/ML techniques and strong incentives for customer retention in the retail sector, we propose a classification model that attempts to predict customer stays within the retailers' premises and can guide retail optimization efforts going forward. The proposed model combines customers' historical behavioral parameters in conjunction with weather information in a fusion approach. Our model has been trained on 120,000 data records obtained from a big luxury goods retailer to demonstrate its superior performance in comparison to state-of-the-art classification approaches. The model has also been deployed for the actual prediction of future customer stay behavior. The dynamics and challenges of the retail industry are motivating the adoption of big data analytics. Retail data sets are made up of sales records, records of items stocked, promotions, and customer information. Collectively termed big data, mining these data sets can help retailers address important questions such as risk management, customer retention, product assortment, and vendor management. In this regard, customer retention is one of the most crucial and costly aspects of the business, as once a retailer attracts a customer, it should attempt to continue to keep the customer engaged and spending. Bayesian historical data retrieval, predictive analytics, and sophisticated models outperform the state of the art in big data-driven retailer customer analysis, helping in profitable retention and acquisition of customers to optimize the retailer's business. In this paper, we will develop a model that delivers high predictive power regarding customers' stay, taking advantage of both customer transaction data and weather information, as well as employing advanced data mining methods, most notably those stemming from the fields of AI/ML. The stay duration information can help automate many of the firm's operational decisions, including staffing and scheduling tasks to maximize service levels.

Keywords: *Customer Retention, Big Data Analytics, AI/ML Techniques, Classification Model, Behavioral Parameters, Weather Information, Predictive Analytics, Retail Optimization, Data Mining, Customer Stay Prediction.*

1. Introduction

Competition in the retail sector is intense, and companies are constantly on the lookout to offer personalized services to their customers in a bid to retain their customers. Options include tailor-made product features to meet personalized preferences, lower prices through the offering of vouchers, reduction of marketing costs, and improvements to supply chain efficiency in anticipation of demand. In today's time, with cut-throat competition and high demand for a new product, there is a need to retain a customer base since it is cheaper to retain an existing customer than to acquire one. Hence, existing customers are of utmost value to retailers. Investing in acquiring a single new customer is not as prudent as investing in retaining the existing ones, considering the returns in some scenarios could be infinite. A company could end up selling its full inventory to a loyal, retained customer, potentially as we provide them with benefits. Moreover, it is plausible that highly engaged customers tend to be active standalone brand advocates too.

Customer retention in a retail business is a multi-faceted problem and could be approached by offering a multitude of incentives and discounts, having two-way communication, innovating their experience with improved offerings, etc., or just investing in customer engagement. Loyalty programs and reward redemptions are successful among retailers in driving both customer engagement and loyalty. Two methods commonly pursued to retain customers are either rewarding them for existing behavior or, based on predictions from historical data, rewarding them proactively in anticipation of upcoming behavior. However, little is understood about the actual contribution of these different drivers of customer retention, specifically from integrating several simultaneously into retailer data analytics models. The data analytics model, with numerous customer data points, can help to identify purchase behavior patterns of customers and infer customer-led retail strategies. Individualized shopping histories are stored in their databases and can be used to identify potential customers to encourage their visit. By utilizing enablement, our customers can have new business practices that help achieve profitable growth and enhance customer engagement.

1.1. Background and Significance of Customer Retention in Retail

Knowing what a customer will buy and when is critical information for the retail industry. It will determine whether a customer comes back to the same store or moves to a competitor. Thus, even small incremental gains in understanding customer behavior can lead to substantial financial benefits for retail businesses. This fundamental data challenge has been transformed over the years, particularly due to the rise of the Internet and social media, which have changed how consumers shop. Furthermore, the increasingly consumer-centric use of technology in this digital age has made brick-and-mortar retailing more

challenging than ever. Today, businesses want you to be their customer, whether it is a discount app on your mobile phone when you are walking past a store or when you are browsing on the web. This effect has created a fundamentally competitive retail market.

Most retail businesses make profits on a high percentage of repeat customers rather than largely through first-time buyers. There can be substantial costs involved in acquiring first-time buyers, and they might not always generate large net positive profits. The repeat customer, on the other hand, will likely spend more per visit and is also cheaper to engage. Secondly, an existing customer is also more likely to recommend that store to a friend, generating positive purchase social proof effects. Finally, a recent surge in research has demonstrated the existence of a substantial retention benefit from using customer data to create personalized communication strategies. In this new consumer environment, personalization is a crucial consideration in the development of these strategies. However, addressing these issues is not straightforward. Many businesses maintain little or no long-term transaction data on their customers. Along with the inefficiencies of actually merging enterprise database systems that can handle big data, these suboptimal outcomes can result in substantial losses of possible customer value.

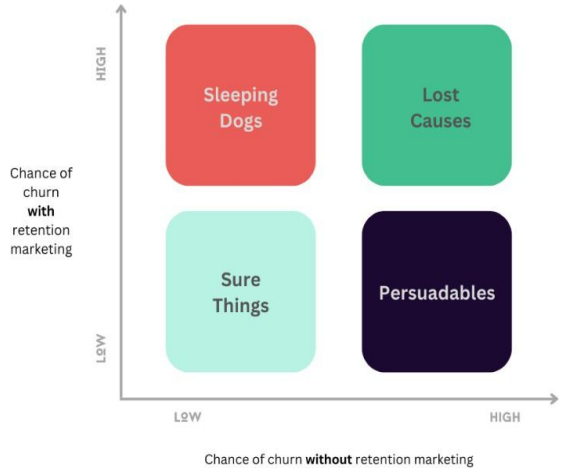

Fig 1 : Customer Retention Model

2. The Role of Big Data in Retail

The retail industry has been the face of business and the destination for consumers for a very long time. Information gathered through the daily activities of the business or information collected by the organization's relationship with its various stakeholders are examples of the data that a company has or collects. However, the data of a retail organization is almost always offline and consists of purchase history, store visit details, and other transactional details of a retail customer. With online shops gaining momentum and every physical store having an online presence, retail organizations have been increasingly converting offline business into online sales and returning customer transactions. This characteristic has made the data collected by retail organizations increase rapidly, and the volume has become very high in total. A high volume of data assets or big data in this particular industry provides a platform for digital transformation initiatives and

investments that leverage data to achieve the strategic goals of the organization.

Retail data is unique and provides different intrinsic characteristics and challenges when compared to the customer data collected within the organization's operations or other business models. Customer data generated through online shopping platforms, search engine activity for online price comparison, digital advertising activity, and data collected externally provide insights or behavioral data specific to a certain customer group, region, category, product, or unit of the product sold. Retail data analysts are required to analyze and model this data to understand customer behavior and preferences to create customer retention strategies that allow the organization to attract customers increasingly and lift customer spending from the resting state. Big data that is created and used in a retail organization provides a total view of the customer in addition to operational functions such as categorization, space allocation, product management, pricing, and risk management, and as a result, is the focal point for data-driven transformation programs that help the retail business enhance customer experience and operational efficiency.

2.1. Definition and Scope of Big Data

Big Data technologies and practices are evolving at a dramatic rate, with potentially huge implications for the retail industry. However, there is continued vagueness in what precisely Big Data is. While some researchers favor the traditional 3Vs definition, Big Data experts have lately started to question the adequacy of that definition, including the relevance of the three Vs composition (volume, variety, and velocity). Key notions such as value and causality relations with smartness must also be factored into how Big Data is distinct from traditional data storage technologies. The scope of Big Data can be supported by the following brief outlines. The volume forms the backbone of Big Data technology, harnessing storage technologies in the zetta- and container-byte scale. Variety boosts the significance and business value of Big Data, aiming to plug in diversified data streams from social media, images, voices, and natural language texts that cover structured and unstructured compositions. Velocity brings in the temporal-spatial perspectives, which determine both the "when" factor and the geo-coding intelligence in some data science applications. The veracity factor addresses the noise and uncertainty of data, as well as the trustworthiness traits and biases to be identified for delivering reliable inferences. The important value notion elevates "ecology thinking" that represents the entire business value chain and its stakeholders who can realize the social, business, and environmental benefits of analytics strategies.

Equation 1 : Customer Lifetime Value (CLV) Prediction

CLV is crucial for understanding the potential value of customers over their

entire relationship with your brand.

$$CLV = \left(\frac{\text{Average Purchase Value} \times \text{Purchase Frequency} \times \text{Gross Margin}}{\text{Churn Rate}}\right)$$

Where:

- **Average Purchase Value** = Total Revenue / Number of Purchases
- **Purchase Frequency** = Total Number of Purchases / Number of Unique Customers
- **Customer Lifespan** = Average Duration a Customer Remains Active
- **Churn Rate** = Percentage of Customers Who Stop Buying Over a Period

2.2. Benefits of Big Data in Retail

Retail is a fast-paced industry largely dependent on customer behavior. There are millions of different customer profiles, but the main difference is loyalty, i.e., repeat visits. If retail companies could identify what drives users to come back and create models to simulate those actions, they could build better products and services to retain clients. Big Data, AI, ML, and computer science in general offer a unique opportunity for retailers in broad internal operations and customer-related tasks. One general characteristic of retail trade is that it is common to have large amounts of data from client behavior, such as which items are bought, the hour and day in which an item was bought, credit card provider, etc. These are named the 3Vs: volume, velocity, and variety, in the Big Data field due to the large amount of retail company customer information being generated and stored as daily operations. With this information, some interesting solutions could potentially emerge for an advanced or newly created retail company, so there is a natural drive for the implementation of AI/ML models for retailers in this data-driven society.

For retail-related AI/ML models, generally, supervised learning is the major data analysis approach for models that predict customer lifetime value, churn, and customer lifetime value. However, in retail, there are so many different ways data can be interpreted, and interesting new outcomes, missing labels (e.g., when clients cancel a product, this means churn), and ensembling predictions. Associative learning or unsupervised machine learning models are very commonly used for generating clusters of customers, and in the majority of big retail stores, the two main unsupervised learning algorithms used are k-means and self-organizing maps. The main drivers of retail-oriented models are predictive capabilities, and they are used for internal price, operation, and inventory management models to customer personalization, influencing, and guiding customers toward specific goals. The real power of AI/ML models for decision-making is that they obtain predictions best in processes of learning from data, not rigidly following the prebuilt decision models to fulfill specific objectives. A clear example is forecasting; the best method is to rely on a growing amount of data rather than on a predefined model when you have to forecast a growing amount of detailed

information.

Fig 2 : Retail Big Data Analytics

3. Introduction to AI and ML in Retail

AI and ML are not only transforming how businesses operate through advances in multimodal NLP, computer vision, interactivity, and data integration and retrieval processes, but also transforming customer engagement and experiences via AI techniques for conversation, speech, social listening, and human graphics. The retail industry has been at the forefront of AI and ML applications, especially since it is data-rich and can monitor customer actions. The retail industry is increasingly using AI to leverage customer data to perform many activities that were earlier impossible or too costly. Descriptive analytics reports predict future purchases and prescriptive analytics provide specific recommendations or actions to meet customer satisfaction and needs. Retailers use AI to improve the customer experience in multiple ways. For example, they personalize product selection and store layout for each customer and provide personalized recommendations. They use AI to monitor customers in stores, perform behavior analysis, and more. Beyond enriching the omnichannel customer experience, adding AI to the customer engagement model offers the scalability, efficiency, and price point that retailers require to maintain their margins. Retailers in a wide variety of formats will come to rely on AI not just to energize engagement but to power the price/risk/sales-rebalancing process.

3.1. Overview of Artificial Intelligence and Machine Learning

As we live in the consumer age, acquiring and maintaining customers play huge roles in retailing. This study presents a research design of big data-driven artificial intelligence and machine learning in the context of retailing to enhance customer retention. This chapter begins by explaining background information organized in 3.1 and continues with detailed information related to research steps in 3.2. The chapter ends by providing research contributions in 3.3.

Artificial intelligence (AI) is a technology and computer science that attempts to replicate or simulate, in the form of a machine, rational behavior such as deducing, induction, classification, etc., along with some of the activities associated with human intelligence. Machine learning (ML) is a subfield of AI and a data mining technique. The aim is to develop systems where algorithms learn and make predictions based on historical data. AI/ML is important for both academia and industry because it is used in various industries such as automotive, robotics, healthcare, and so on. Furthermore, AI/ML can support companies in accomplishing specific goals such as increasing customer retention.

Recently, companies achieved these goals using AI-driven models.

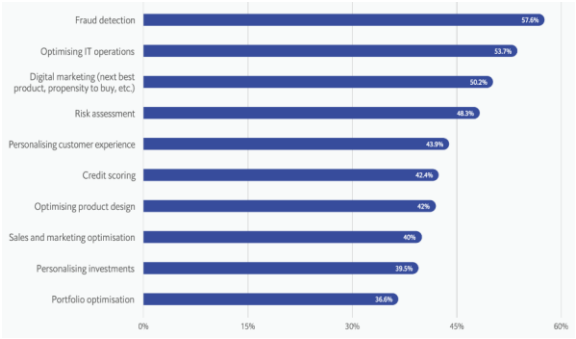

Fig 3 : To What Extent does your Organisation use AI for the Following Business uses

3.2. Applications of AI/ML in Retail

In the present era of data, AI/ML has become an inherent part of many fields. The application of inductive reasoning and iterative model-based learning holds the potential to extract vital inferences and predictions through the utilization of large and varied sources of available data within the complex business environment. Numerous companies have adopted AI/ML because of its ability to improve business outcomes through the real-time availability of both consumer preferences and emerging patterns in consumer behavior. Retail is one such business sector where the vast potential of AI/ML can be realized by computational analysis of big data. The retail ecosystem has seen a massive transformation due to the onset of the era of big data. AI/ML has successfully been shaping and predicting consumer behavior, automating processes for enhanced efficiency, reducing the possibilities of loss and theft, and delivering a personalized customer experience, which is practically indispensable for any retail business to thrive.

AI/ML has come a long way from simply being a tool for product recommendations. Various business functions such as e-commerce, demand forecasting, inventory optimization, back office and loss prevention, pricing, and marketing, manufacturing, and OTB are relevant and challenging problems in retail: 1) Recommendation systems entail the recommendation of items, typically one of two types: (a) personalized recommendation for individual consumers, (b) non-personalized recommendation for a set of consumers. 2) Forecasting demand is the problem of predicting the number of each item the merchants will sell, typically at the product/store level, over a future period. The accuracy of inventory demand forecasting has an enormous impact on stock availability and out-of-stock rates. 3) Price optimization refers to the act of setting price levels to improve all important metrics simultaneously. AI/ML for personalized pricing assumes that each customer has a willingness to pay, which creates an opportunity to maximize revenue. 4) Personalized advertising refers to the personalized display of product advertisements to customers based on their recently made purchases, their current shopping cart, and specific individual buying history. It involves displaying the right product ad to the right customer at the right time over the right channel.

4. Customer Retention Strategies in Retail

The retail industry has been evolving rapidly due to significant changes in customer behavior and preferences, primarily due to the sheer amount of data available and advancements in technology. Customer retention has always been one of the most important strategies for retailers. They cannot afford to lose their customers, especially now, in this age of cutthroat competition. The moment a product is out of stock and the customer's immediate need is not met, the customer will look at another platform where it is available and make the purchase. This would result in a missed opportunity for the retailer. This is one of the typical examples where retailers need to make the stock available for their customers, or they need to be ready to face the consequences. Furthermore, when customer retention rates increase by about 5%, profits can rise from 25% to 95%. So, customer retention is crucial to improving retailer performance. It's always said and proven that the cost to acquire a new customer is higher than the cost to retain an existing customer. Hence, retailers should retain customers and keep them happy rather than using that money to attract new customers.

Equation 2 : Customer Segmentation

Segmenting customers helps tailor marketing strategies and improve retention.

K-Means Clustering:

$$J = \sum_{j=1}^{k} \sum_{i=1}^{n} \left\| x_i^{(j)} - c_j \right\|^2$$

Where:

- J = Objective function to minimize (sum of squared distances)
- k = Number of clusters
- x = Data points (customer features)
- **C_i** = Cluster i
- μi = Centroid of cluster i

4.1. Traditional Customer Retention Strategies

Customer retention strategies exist on different levels, such as product or service features, pricing, transaction functioning, and relationship-based strategies. When it comes down to customer-retention-centered features in products or services, providing high-quality products or free additional services that complement the primary product may be applied. Additionally, pricing and transaction structure-based features can be used; these are referred to fundamentally by special pricing models, volume or frequency discounts, and loyalty or club membership programs. These membership programs usually aim to enhance customer loyalty by providing additional services, discounts, or reward mechanisms when customer expectations are met. Besides product and service level features and reward models, relationship-based strategies such as personalized announcements or friendship management can be exploited.

Loyalty programs are widely used to retain customers and to develop long-lasting relationships with customers in the business world. In general, from a consumer perspective, loyalty programs refer to a

structured marketing strategy designed to attract and retain customers by encouraging them to prioritize specific brands in terms of purchases. A variety of methods, including discount coupons, utility bonuses, and special items, can be included in the structure of loyalty programs to increase the customer's preference for one brand over another. Most consumer behavior experts agree that rewards are very important in the design and implementation of a successful loyalty program. Businesses typically launch a loyalty program to retain customers and encourage repeat purchases. Some customer relationship management platforms provide multiple solutions specifically focused on creating and maintaining effective customer loyalty programs.

4.2. Challenges Faced in Customer Retention

The major challenges faced in retaining customer information and preparing the model are as follows.

Poorly maintained customer data: Some of the company's customer data is being poorly maintained. The design of the models might have a major impact due to the customer data generally being outdated and incomplete.

Unavailability of purchase records: In the case of fraud protection, the company maintains all of the old purchase records. These records help the company design better models. However, to retain customers with proper insights, the company must store the data with proper security and privacy policies.

Mining the factors that are responsible for customer abandonment: Understanding the sales trends and actively engaging with the right and reliable insights yields numerous benefits. Using the model that best fits the customer retention problems in financial savings sectors, sales that proactively retain more loyal customers can be properly identified.

Optimal campaign: In promotional strategies, it is important to understand the right factors and conduct the right sales when consumers are fully engaged. In conclusion, being prepared with the right information and accuracy is beneficial for addressing customer abandonment problems and maintaining appropriate customer retention models.

Fig 4 : Customer Retention Strategies for Sustainable Growth

5. Integration of Big Data and AI/ML in Customer Retention

Big data analytics allows both raw and structured data to be combined and interacted with in a much faster cycle compared to traditional database management. Together with AI/ML models, big data is processed in acceleration and synchrony in a synergistic combination. The AI/ML models aim to

predict the future with the help of data, and the value generated impacts the business either qualitatively or quantitatively. This results in more efficient process execution and time savings for all tasks. The footprint of big data is more substantial in retail; alongside other sectors such as finance, telecommunication, and energy, the retail industry exploited the potential of big data first. The spectrum of the retail sector, including online and offline, ranges from internet-only businesses to large multi channel superstores. An increasing number of companies either already use AI/ML to leverage their data or plan to do so shortly. AI/ML models help make business operations more efficient and help companies promote their products more effectively. AI-related technologies, in combination with cognitive computing, natural language processing, machine learning, and deep learning, comprise a new digital era for customer interaction. Brand experience, online and offline, is enhanced through various devices and touchpoints with consumers. Hyperpersonalization finalizes the customer and response model, transforming them into real-time, on-the-spot, and just-in-time strategies. Providing consumers with the goods they want in the right space, time, and form for them, using AI has become remarkably efficient. In retail, AI/ML maintenance is widely leveraged for marketing, demand management, customer retention, personalization, and merchandising. Product development is an area where the retail AI system could be better implemented.

Equation 3 : Personalized Experience Optimization

Tailoring offers and experiences to individual customer preferences.

Utility Function for Personalization:

Uij = αRelevanceij + βPersonal Preference ij

Where:

- **U_{ij}** = Utility score of offer j for customer i
- ***α*** and β = Weights for relevance and personal preference
- Relevance ij = Relevance score of offer j for customer i
- Personal Preference ij = Personal preference score for offer j for customer i

5.1. Data Collection and Analysis

The best, and by now in fact the only reliable data for customer behavior models is derived from historic and new interactions between customers and the retailer. In many cases, such data can be purchased through loyalty programs, whether or not the retailer offers the program. Both demographic and transactional data are crucial, and while demographics can be compiled from customers' addresses, the most valuable data comes from purchase histories, but also with a precise purchase location and times. New incentives can help gather the necessary data. We receive the

transactional level data of customers who opt into this service. Moreover, through such partnerships, with both ethical and financial trades, retailers can help stimulate the local economy and, at the same time, better contextualize their employees to engage their local customers.

Similarly valuable are international anonymized transactional data, which we are currently pursuing. Regardless of whether data is directly collected or purchased, similar ethical questions and fiduciary responsibilities to customers are replicated when using these types of third-party data assets. Data of this type is first-party since it is directly taken from the business or the organization. It is also useful for training machine learning models. Since data can be queried at will, most companies are familiar with these types of data.

5.2. Predictive Analytics and Personalization

Personalizing the user experience is an oft-stated necessity for customer retention. Data is the modern gold. The more retail companies know about their customers, the more they can predict their next actions. Ninety percent of the data has been collected in the previous two years, and its volume is rapidly increasing. Each person uses a device that collects and transfers phone numbers, email addresses, and physical addresses. Thanks to GPS sessions, the information on the site can also be described. Enterprise solutions allow companies to pay you with promotions based on your location and movements across the shops. This valuable data contributes to learning what can be relevant to your customers and pushes the limits of personalization. It does so in two ways: predictive analysis and profiling. The challenges are to work for privacy and personalization at the same time and to respect the requirements of the GDPR.

Predictive analysis refers to the use of data to obtain predictions about the client's future behavior. The principle of efficiency is simple: the more data available allows the learning algorithm to improve its forecast. The algorithm's power increases by doing this. Hence the term "big data." Thanks to a presence in the market, some retail stores can collect data on the online and in-store shopping habits of several million customers. The data is classified, stored, and phased out over time in secure environments. This virtually unlimited flow of customer details allows progressive retail chains to develop anticipatory models tailored to their customers. They use developments in the field of artificial intelligence and diverse learning systems combined with programming interfaces that connect the models to different applications. They comprise postal mail bids that appeal to customers physically, online actions on smartphones, and devices close to consumers. Customer opinions are integrated into voice services. For personalized recommendations and notifications, interesting models are developed.

6. Conclusion

The innovative use of big data-driven cloud-based AI/ML models in retail can provide insights to encourage customer retention and confidence in the Internet of Things. The use of technological solutions can lead to more competitive customer offers and greater customer responsiveness and agility. They enable continuous holistic assessment of the potential implication of business decisions as well as the ability to understand differences in presented offers, which may increase the perceived discrimination capabilities by the end customer. As such, the use of AI/ML models may increase customer engagement with the retailer which is more associated with positive customer experience and may contribute to the increase in sales and enable an increased understanding and lifecycle management of the customer by the retailer continuously versus more traditional approaches.

Of course, not all businesses in a competitive retail environment have the time and money to invest in R&D and innovation platforms to solve these problems. Many of these areas should be solved in a collaborative environment, attracting multiple businesses or business experts, government, and of course, universities. As recent data environments evolve with combined platforms, big data solutions that may require extensive data engineering may be placed on shared platforms to enhance data engineering and bring AI/ML directly to the data. Governments can incentivize shared models and data to evolve and maintain national and international success through tested incentive schemes, while universities can contribute through existing AI/ML knowledge and the formation of extended research partnerships between universities and companies.

6.1. Future Trends

The 21st-century growth in online retail and the resultant powerful Internet giants are built on a foundation of monitoring and data collection, with a heavy reliance on AI and ML models to deliver intelligent personalization to their users. Much of the real work done by the models and the personalization is hidden, including recommendation engines for products or content, deep learning to identify unique styles from vast product inventories, image recognition systems, etc. However, much of this investment comes with a potential for further development and scrutiny, and so it is likely that both AI/ML-driven models in retail and the models themselves will come under pressure in several areas including a) the attainment of full personalization; b) the efficacy and impact of AI/ML models; c) the control of AI/ML biases; and d) ethical impacts. In addition, a new trend of real-time 'etail' is likely to put further pressure on traditional retail.

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