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Computational Analogies of Machine Learning concept in the Oil and Gas Industry and its Transformation in the Industry 4.0 Era

JES Journal of Electrical Systems

Abstract: - The fourth Industrial Revolution, commonly known as Industry 4.0 is enabling Oil and Gas industry to transform its business process and operations and adopt digital technologies to drive innovation, enhance production and operate more efficiently. The oil and Gas industry is enhancing Knowledge Management with advancement in digital technologies such as big data analytics, and artificial intelligence to transform vast information gathered historically stored in documents and systems as well as subject matter expert experience into digital knowledge to establish advisory systems to support decisions in the Oil and Gas operations.

In organizations, knowledge has become an important success element and so is the case with the oil and gas industry, which is one of the most important sectors in energy. It must be dealt with and leveraged efficiently and effectively for competing in the world market by the creation of a competitive and sustainable environment in organizations. Oil exploration is a knowledge-intensive process in which effective operations and commercial success may be accomplished by identifying and evaluating possibilities early on and making knowledge-based choices. To be productive and competitive, the oil and gas industry must embrace knowledge management processes, where professionals may play a key role in managing information to easily address issues. However, the capacity to handle knowledge cannot be instilled in a single day; it is a culture that has been created over time via specialists and their expertise. The oil and gas sector has undergone significant changes throughout the years, affecting all of its sections, including exploration, production, and refining, and has got significant implications for marketing plans, production strategies, and R&D strategies. Only efficient knowledge management strategies with the aid of big data can encompass knowledge generation, information exchange, transformation, and dissemination of information in present times. The emergence of Generative Artificial Intelligence Chatbot such as ChatGPT is transforming the way knowledge has been managed traditionally. Applying the right strategies to enhance knowledge management is vital for the Oil industry to extract, develop, maintain, preserve and disseminate knowledge for effective operations.

This paper introduces and discusses the developments in knowledge management, and explores the interrelationship between AI/ML, big data, and knowledge management in the oil and gas industry.

Keywords: Natural Language Process, AI, ChatGPT

1. Introduction

1.1 Background

The primary goals of any Knowledge Management program in any company are to improve the performance of the individuals involved in the organization. It is more than just sharing knowledge; but is indeed a valuable by-product of the business operations, as it explicitly designs and implements tools, mechanisms, methodologies, structures, as well as principles for improving decision making with implicit advancements in identification, capture confirmations, and modification of relevant knowledge for making decisions. Today, we have many tools to help us run a successful business, techniques for handling knowledge, analyzing its flow in an organization, ways of improving the flow, possibilities to capitalize on, and methods for observing.

Today, organizations can get a competitive edge by utilizing many tools, sharp methodologies, and numerous strategies for knowledge management. This advancement strengthens the organization's ability to handle and address real-world business problems. Thus, knowledge management is becoming a solution to business problems with a significant distinction; there is growing acknowledgment of using knowledge management for handling any business issue easily. Aside from that, it aids in developing user-friendly technology for managing information with cooperation and access; yet, Knowledge Management could not be quantified, nor can its influence be gauged.

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1.2 The interrelationship between big data and knowledge management

Organizations have traditionally been cognizant of knowledge management; yet, new difficulties emerge regularly, necessitating new techniques to address these challenges. One fundamental difficulty in businesses is the harnessing of big data and, the most crucial part is the linkage with the organizations' knowledge management competence. The promising future of big data for enterprises in creating essential knowledge and achieving a competitive edge has driven companies to spend heavily in this field. Extensive data analytics aid in analyzing and extracting necessary knowledge from vast amounts of data. This knowledge may then be utilized to improve the performance of various operations inside an organization. Big data also is related to knowledge management competency thanks to its ability for considerable knowledge growth and the ability to address organizational procedures. Organizations have only recently begun to experiment with significant data knowledge generation.

It is seen that knowledge management achieved great attention in the energy sectors, in the oil and gas sectors (Phillips and Vollmer, 2000; Brown et al., 1997; Bargach et al., 2001; Behounek and Martinez, 2002), as they exhibited tremendous impact on the performances (Troxler and Lauche, 2003; Minyard, 2003; Salmador Sánchez and Palacios, 2008; Mesler, 2002). Numerous oil- gas companies, e.g., have encouraged KM measures, including developing knowledge management strategies, instituting these systems, creating knowledge guides and reward packages, describing experiences, cultivating a culture of knowledge sharing, establishing communities of practice (CoPs), trying to measure knowledge management maturity, and so on.

Also, the capabilities for the creation, as well as application of the new knowledge management system, appear to be the source of competitive advantages that are pretty hard to imitate (Spender, 1996; Nonaka, 1991; Crossan and Berdrow, 2003; Zollo and Winter, 2002), and organizational learning seems to be meant for the development of those capabilities. Some academics underlined the significance of information access, exchange, and creation as components of an organization's capacity to learn and innovate (Davenport, 2005; Krogh et al., 2000).

1.3 Impacts of Industry 4.0 on the oil and gas sector

After Industry 1.0 (steam engine era), Industry 2.0 (electrification era), and Industry 3.0(information era), in early 2013, the idea of Industry 4.0 was proposed. The goal of Industry 4.0 is to employ information technologies to foster industrial change in the intelligent era. Industry 4.0 innovations are the outcome of the full integration of informatization and industrialization (Gilchrist, 2016); the industry 4.0 conceptual plan (Hankel and Rexroth, 2015) contains four primary components: smart factory, intelligent logistics, intelligent services, and intelligent production (Kagermann et al., 2013).

The oil and gas sector has shown technological constraints. According to McKinsey, the oil and gas sector is the only one that has dropped productivity over the last 100 years when matched to other asset-intensive sectors (Handscomb et al., 2016). In this context, intense pressure has compelled several oil and gas corporations to increase their quest for efficiency, lowering costs, boosting output, and maximizing profits. Along with the rapid growth of Industry 4.0, many technologies like cloud computing, IoT, and big data are progressively being implemented in the sector, and old industrial output technologies will adapt and be replaced. As a result, for muscular development, the oil and gas sector must rely on Industry 4.0. Each generation in the advancement of oil and gas technology will see earth-shattering changes and technological breakthroughs (Yang et al., 2016); petroleum & energy technologies have begun a transformation in the early twenty-first century, and the following decade would become the golden age of technological evolution. The fundamental purpose of "Oil and Gas 4.0" is to leverage modern digital technology to increase industrial value. However, most organizations' digitization processes are slow. As per statistics, one-third of the oil/gas companies say they are "modern" or "explorative" in digitalization. Usually, the oil and gas sector should be at the forefront of new technology, but the fact is that only some regions or groups of the oil and gas sector can adopt new technologies. The oil and gas business has used various techniques in recent years, including robots and satellites. Nevertheless, all these technologies are asset-level, so there is no transdisciplinary linkage.

2. Methodology

2.1 Systematic Literature Review

Searches were conducted in IEEE Xplore, SpringerLink, Science Direct, ACM library, Jstor, Ijtef, and Google Scholar to identify papers about knowledge management in the oil and gas industry. The PRISMA guidelines were used to conduct the aforementioned systematic review (figure 1). The Scopus and Web of Science databases have been utilized; however, due to the continuously evolving nature of the discipline, numerous academic sources were adopted (including Ph.D. dissertations). Additional highlighted material was chosen from the extracted literature's identified articles. The study's supplemental material was culled from numerous search engines, including Science and Technology of Advanced Materials, Science Direct, the Directory of Open Access Journals, and PLOS ONE. This approach also recognized abstracts from several scientific events of the Knowledge management world summit and bibliographies of numerous publications.

The papers evaluated for participation in our research should meet specific requirements, including the required scientific discipline(s), publication time, and languages. The types of research considered appropriate were comprehensive review articles on knowledge management in the oil and gas business and its transformations in the digital era. This was accomplished by investigating the many scopes of those sectors—the period span in which the literature review was viewed as one of the report's characteristics. The publishing year was set between 2017 and 2022 to deal with one of the most recent statistics. However, earlier research is also included due to the searches for literature reviews in previously studied studies. The period between 2017–2022-time period was concentrated and an in-depth investigation of various online databases (Google Scholar, Scopus, Web of Science), was conducted to sort out the most recent articles that occurred during this period. This can be attributed to the fact that the knowledge management system's transformation has reached a certain maturity level during this time, allowing for a complete study.

2.2 Study Inclusion Criteria

The papers that analyzed knowledge management in the oil and gas sector and those that showed its impacts on the industry's progress were highlighted. Also, specific emphasis was given to those studies that linked big data to knowledge management capability for valuable knowledge generation and the ability to improve organizational processes. The transformations in knowledge management with the advent of technological progress because of digital advancement were examined, and the significant challenges and opportunities of the oil and gas sector in this context were discussed. Every decade in the growth of the world's oil and gas technologies will see earth-shattering changes, and there will be some seismic shifts. In the early twentieth century, oil and gas technologies began to evolve. It is assumed that the following decade will be the technological golden era of the oil and gas industry.

Data Extraction and Management The search results were filtered by employing a reference management software tool, and the articles were classified based on the title and abstract. Reviewers independently examined the relevant effects in their entirety, and all selected, duplicated, and rejected publications were assessed using a PRISMA flow chart (Figure 1).

The initial stage in the elimination process was to search using the Google Scholar search engine, which listed 16,000 studies. Around 150 items were retrieved using brackets from around the search word ‘knowledge management on reducing the time frame to 2017–2022.

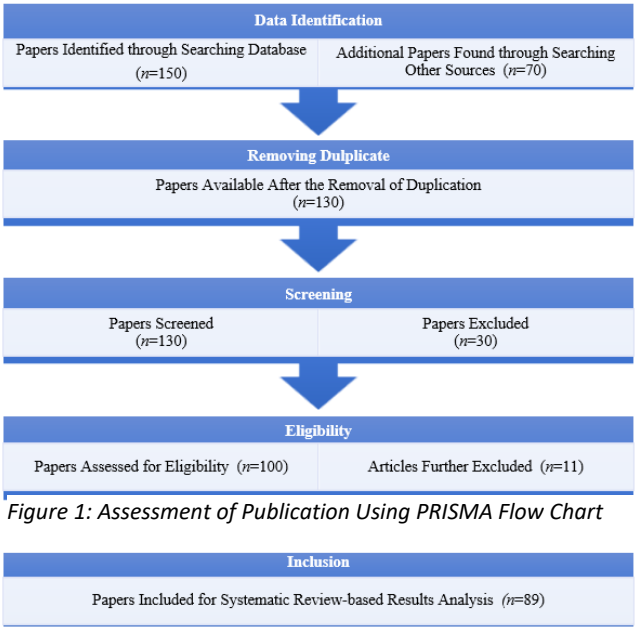

Figure 1: Assessment of Publication Using PRISMA Flow Chart

Additional material was included in the list of the extracted literature as a result of a study of the reference lists. During the screening process, 70 duplicates were discovered. Following the exclusion of this research, 100 full-text studies were evaluated for eligibility. Following the full-text review, 11 papers were removed for various reasons, resulting in a final selection of 89 system dynamics research. Each of the remaining 89 research was analyzed, the relevant data for this study was acquired and collated, and the necessary information was retrieved.

2.4 Included Studies

Most of the studies highlighted knowledge management and the massive potential of big data for organizations to create valuable knowledge and gain a competitive advantage. Industry 4.0 aims to use information technology to promote industrial change, and the impact of these technological advancements in the energy sector is included. Some organizations and experts think that "Oil and Gas 4.0" will radically disrupt the oil and gas industry's status quo, bringing tremendous benefits because it will expedite the oil and gas industry's digitalization. The studies that highlight these aspects are included in the analysis because they will help determine the transformational challenges and opportunities of knowledge management in the modern digital revolution in every field.

3. Knowledge Management Literature review

3.1 Tacit and Explicit Knowledge

There are various methods to classify the knowledge that a company can handle. The study on knowledge management (Kogut and Zander 1992; Nonaka 1994; Grant 1996) defines different categories of expertise on their transferability. A significant distinction is between tacit as well as explicit knowledge. Tacit knowledge is the reservoir of skills and knowledge inside an organization—primarily within the employees' minds. It cannot be easily defined or identified yet may be critical to its proper operation.

Explicit knowledge is the information that is more visible and may be found in instructions, paperwork, files, and other easily accessible sources. According to Nonaka (1994), while explicit knowledge is generally simpler to access and convey (mainly through information systems), maintaining both kinds of knowledge is critical to fulfilling knowledge management goals. To succeed, organizations must get the tacit knowledge present in their employees' different experiences, which is most typically accomplished via richer types of knowledge transmission such as contact between individuals and groups.

The majority of the knowledge managed by businesses consists of both tacit and explicit knowledge. Best practices transfer, for example, is one of the most critical places of KM among oil and gas firms. Best practices are typically identified through explicit performance statistics, but their evaluation and transfer necessitate significant levels of tacit knowledge at both the organizational and individual levels. Associated with this, there is an important concept called knowledge management champions. Knowledge management champions emerge organically and play a significant role in keeping the momentum of knowledge sharing going when such programs are established. Organizations will benefit more from developing such people and encouraging them to take on more important responsibilities. A qualified Knowledge Champion recognizes when and where to take the lead and when to yield authority.

3.2 Knowledge Management and Business Intelligence

Although most tacit knowledge exists in specialists' minds, the major concept of knowledge management would be to transfer it from tacit to explicit(Côrte-Real, Neto, and Neves, 2012), Leveraging this information necessitates the use of various techniques that would allow other consumers to profit from it. According to al. AlSuwaidan, L. and Zemirli, N., 2015, knowledge management is vital in organizational learning, competing contexts, and corporate globalization. The bulk of company decision-makers bases their decisions upon the information they possess. As a result, technology is critical to their judgments. Business intelligence is a notion that has arisen to help with general decision-making (Ferreira, Pedrosa, and Bernardino, 2017). The business intelligence evolution from data to knowledge and information has had an impact on decision-making (Gadu and El-Khameesy, 2014). Bernardino examined a variety of methodologies, technology, and applications to demonstrate the importance of knowledge management within business intelligence. Weidong, Weihui, and Kunlong, 2010 created integrated knowledge management as well as a business intelligence approach. They said

that while business intelligence tools focus on the data layer, decision-making is only dependent on data analysis reports, but knowledge management focuses on acquiring and sharing expertise irrespective of operating facts.

3.3 AI Data mining and knowledge management

Intelligent techniques rely on the experience and knowledge of human analysts to solve issues, and therefore, they imitate their thinking and behavior in a given problem area. Typically, a systems analyst offers "rules of thumb" for evaluating problems, either directly with the assistance of skilled system engineers or implicitly by deriving the rules from pertinent sets of data. Intelligent systems may be used to produce, transmit, and disseminate corporate knowledge. KM is indeed an organizational technique that advocates a comprehensive approach to recognizing, managing and sharing the organization's intellectual assets as well as its workers' unarticulated knowledge and experience.

Knowledge bases may be used in all three stages of the knowledge life - cycle: knowledge generation, transfer of knowledge, and knowledge usage. A vast quantity of high-quality information on issues from certain areas of human endeavor is acceptably incorporated into each intelligent system. As intelligent systems, an expert system may then use embedded information to effectively solve issues in its area of expertise in a way that would be regarded as clever whether the same issues were solved by a human.

In Knowledge Management research, advances in information systems (IT are frequently seen as accelerators for organizational transformation projects (Tsui, 2005). Deep learning discoveries have significantly increased algorithms' ability to replicate human capacities like "seeing" (image identification), "listening" (voice recognition and natural language processing), along with "deciding" (analytical processing). Such AI technologies are rapidly making their way into business applications when paired with a huge amount of data and improved computer capacity (Kaplan & Haenlein, 2019; Canhoto & Clear, 2020).

In knowledge management, deep learning AI has got the potential for knowledge production because of its predictive capacity in circumstances such as estimating sales possibilities (Eitle and Buxmann, 2019). This aspect is defined by Agrawal et al. (2017) as "the capacity to use the knowledge you already know and produce the information you did not originally have." Deep learning Artificial intelligence can identify patterns in heretofore unrecognized datasets as a consequence of its ability to "derive its own rules" based on comparable patterns in data.

Recent improvements in natural language processing or machine learning for database search operations have enabled required information to be extracted from the textual information, like the one found in well as well as reservoir records. The most difficult obstacle in applying these approaches to unstructured information in the petroleum industry appears to be a lack of availability of labeled training data that may assist AI models to grasp sector-specific jargon and phrases. Other data difficulties in the oil and gas industry include accessibility, privacy, laws and conformity, and patent protection, along with various digital obstacles. Large oil and gas organizations may need to consider how data is gathered at their many facilities throughout the world, what rules may affect data access from a specific physical place, and also what digital firewalls may limit access to data

3.4 Knowledge Management approaches in the oil and gas sector

Organizations perform with the assistance of systems rather than machines; in organizational success, the machinery model depicts multiple inputs for specific processes into outputs, which may or may not be correct or effective in comprehending the complexities of the tasks. Externally and internally, organizations share knowledge with their personnel. When it comes to conveying such essential knowledge and information, there are specific problems. Technology can assist in generating data, news, and knowledge on the individuals engaged and the situation at hand. Still, it cannot trigger knowledge sharing without the concern and interest of those concerned. To make such knowledge sharing easier in an organization, it must focus on information guidelines, human resource policies, departmental cooperation, group dynamics, organizational incentive systems, and other relevant activities depending on the nature of the training involved. Also, external pressure, varying consumer expectations, regulating authority expectations, social support systems, individuals involved, and other associated dynamics are considered. As a result, Knowledge Management may be used to create a customer-centered strategy that can be considered a complicated system. Thus, Knowledge Management may be looked at as a framework or

a plan that will allow them to establish a set of practices to gather knowledge, which would help them to enhance current and future consequences. When it comes to managing information and technological culture, there are three primary resources to consider: people, process culture, and technology. These three reserves can enable organizations to use and share information quickly and effectively for the advancement of the organization. The oil and gas sector will be no exception.

The upstream oil and gas sectors rely on the strength of their natural resources, infrastructure, processing facilities and technology, human resources, and the most essential energy product market demands. If one of the components changes, it has an impact on the industry's management, planning, as well as production. To be a profitable enterprise, it is critical to use the best resources and fill the remaining gaps with the finest practical approaches.

In the current global context, organizations need a knowledge management framework as a crucial strategy to handle a competitive environment and increase their competence to face the problems in their business, regardless of the organization's size. As a result, information and knowledge management has emerged as the most critical strategic strategy for the oil and gas sector. Knowledge of such executives in key positions in the industry who are expected to retire in the following years, if not utilized appropriately, might lead to loss of knowledge or create a significant gap in knowledge in the company, particularly in the oil and gas sector. And knowledge management could provide a solution to this cognitive loss via two different modes of failure: staff retirement as well as mobility of employees. Firms in the oil and gas sector were early adopters of knowledge management and paved the path for Knowledge Management adoption.

3.5 The significant challenges and opportunities of knowledge management in oil and gas companies

There seem to be significant problems in providing an appropriate approach to acquiring one of the most valuable information pools and expertise in oil explorations, particularly in knowledge-intensive disciplines including geology, geophysics, and drilling. Other issues include improving performance in expensive and risky offshore infrastructure projects. Creating user-populated Knowledge Bases to protect the base of an oil company by lowering capital and operational expenses, increasing efficiency and uptime, and hence enhancing market positioning for competition in the world market has become a significant problem in the oil and gas sector. Organizations must adapt and follow the latest cultures to manage human resources, and this is a massive challenge for organizations.

As a result, organizations in operations face numerous concerns and obstacles in handling the necessary information to function and execute their business operations. Enterprises should also estimate the value of their knowledge resources, of the people involved, and try and find a way to explore opportunities to use their relevant data for maximizing the organizational returns by adaptation of knowledge management in the organizations. Another difficulty is that their clientele ought to have more excellent knowledge and make better decisions. The primary concern in the oil and gas sector is recognizing and forming responders capable of resolving the bulk of its problems in the field of safety and associated research & innovation. The organization should better understand precisely what sort of threat is still out there. It will also set the tone for long-term natural capital assessments and any sampling prerequisites that may have to be conducted as the critical impact of the knowledge management system. As a result, oil firms began to focus on knowledge management actively.

User-populated Knowledge management systems are also proven to be helpful. Organizations in the oil and gas sector have developed a portal approach. They employ this portal system as a workspace for participant teams and conversations and documentation for learning communities. It is expanding rapidly to become the sole solution for materials of reference. So far, the most significant benefit of knowledge management to oil companies has been the "protection of the bases,". Knowledge gets recorded and disseminated on subjects such as improving the success rate of locating oil fields, minimizing maintenance downtime within oil refineries, and speeding up the construction of petrol stations. However, when oil becomes scarce and attention shifts to renewables, the major oil companies will need to focus their Knowledge Management on generating new information, innovations, and rapid skills acquisition.

3.6 Implementation of a knowledge management strategy in the oil and gas sector

In the oil and gas sector, as per the analysis of researchers and industry experts, there should be the proper and sudden implementation of knowledge management irrespective of the size of the organization. It has become an essential part of any organization and those firms without proper knowledge of management strategies are considered poorly. As a result, these organizations have shown lots of concern and interest in implementing knowledge management in their enterprise and have actively started establishing portals.

Organizations should be committed to using what they've learned to drive development and performance throughout their organizations. Instead of attempting to develop anything, they should prioritize the acquisition of expertise from outside their business. Each day a better concept not implemented is a missed opportunity. The organizations should cultivate a culture of sharing more and sharing more quickly as they are responsible for successful Knowledge Management deployment. Every organization that uses Knowledge Management as a critical strategy must apply knowledge more efficiently than its competitors. Knowledge management is the foundation for success in a new company while adapting personnel to a rapidly changing working environment. It may be applied to the Energy industry to make a significant contribution. Knowledge Management is used to project output in those elements to manage any number of projects. Organizations should give leaders opportunities to share their expertise at their level and generate new ones. Organizations must attain a professional standard in acquiring knowledge, consolidating and retaining it, and afterward making what's been learned available to all involved in operations to become skilled decision-makers as quickly as feasible.

After several years of expertise, knowledge management might not have been a novel notion. However, using an available Knowledge Management system could be a cost-effective way to address new or relevant operational challenges in the oil and gas sector, such as retaining practical knowledge throughout a time frame of workforce aging and improving efficiency via the community of practice. Furthermore, many businesses are fine-tuning the best practices transition process through content management solutions and communities to reduce downtime at field sites around the world.

In the oil and gas sector, those sections that have achieved success by employing knowledge and management principles could take benefit of an infrastructure that is perfectly established and more knowledgeable workforces with a knowledge management team for addressing potential challenges, such as globalization issues, acquisitions, reduction of downtime, content, and organizing people. By perceiving the problem as an opportunity rather than inadequacy, establishments in the Energy industry, notably the Oil and Gas sector, can attain exemplary performances in knowledge sharing and can integrate with the changes happening worldwide.

3.7 Value creation from big data

Big data has enormous potential for generating value from massive volumes of unstructured and structured material. More giant corporations and developed economies already are making strides in this area (Kwon et al., 2015). Earlier ample data research has proven its significance in a variety of industries. Davenport (2014) discovered that, compared to similar datasets, big data aims to improve organizational efficiency and performance both externally and internally. Big data can provide additional advantages for organizations if it is integrated into their primary management and operational processes (Bordeleau et al., 2018b)

Big data plays an essential role in the new model, process, service innovation, and greater competitiveness (Corte-Real et al., 2019). It aids decision-making through the use of machine learning algorithms. For example, Chen et al. (2017) investigated massive data generated by mobile apps. Using a multi-method approach, they used mobile app usage to identify high-value clients and their preferences. If correlated with big data, value creation could be linked to the design and use of knowledge. The original DIKW (data, information, knowledge, and wisdom) framework (Ackoff, 1989) proposed that data transforms into information, which then transforms into knowledge. Data is made up of basic figures and facts. They acquire information whenever they are placed in perspective and given significance. Finally, knowledge is formed whenever this information is digested and why and how data could be shared. Knowledge is made up of actionable insights derived from data, and all these actionable insights could be used to make wise decisions (Abbasi et al., 2016). When we look at extensive data, we see that it is both unstructured and structured. When information is processed utilizing analytics in a particular context, it creates

usable knowledge in terms of actionable insights, which can subsequently be used to improve organizational performance (Shams et al.,2019; Carayannis et al., 2018). Traditionally knowledge management is built on three pillars: people, processes, and technology (Davenport et al., 1998; Pee and Kankanhalli, 2009). Similarly, creating and applying knowledge using big data is highly reliant on these three aspects. In terms of personnel, data analysts and researchers are responsible for running optimization algorithms and analyses on data to identify patterns, which are then critically analyzed to yield actionable insights because of the technologies that allow massive amounts of unstructured and structured data to be analyzed and updated in real-time while communicating the findings to all actors participating in the program (Rialti et al., 2018).

Finally, knowledge generation is carried out by combining data from researchers and technology. That knowledge then is saved and shared to be applicable in appropriate circumstances. As Sumbal et al. (2017) pointed out, big data is an unexplored source of vital predictive information that can be integrated with individuals' tacit and explicit knowledge to improve organizational performance. This approach is founded on the firm's knowledge-based paradigm, in which big data is viewed as a resource for generating practical knowledge. Because the core of data is its applicability to fast-changing and dynamic situations, dynamic capability theory is applicable here (Rialti et al., 2019). Organizations should not only leverage and repurpose expertise from the present ample data resources for bettering performance, but they must also gather and analyze fresh information to deal with any real-time issues and challenges. Theoretically, the link between obtaining knowledge via big data and implementing it is compelling. However, it is a significant issue for enterprises (Rialti et al., 2018). For this reason, organizations must establish adequate big data analytics platforms, although there has been limited success in this area.

3.8 The role of knowledge graphs and knowledge models

The need for intelligent data recovery services has shifted from basic data collecting and acquisitions to automatic knowledge applications, from data collection to information acquisition and management of knowledge, and eventually to the transition process of application domains in the area of big data. Knowledge graphs are a type of optimized and efficient knowledge management that employs nodes to indicate items or ideas and relationships. The knowledge graph connects diverse things and concepts to generate a set of connections that enables users to search for information accurately in. a timely manner (Sundheim, 1996,). Researchers can use knowledge graphs to assess and explore situations from a "connection" viewpoint. The evolution of search queries is accelerated by the knowledge graph. Users could more precisely access knowledge using knowledge graphs (Agichtein and Gravano,2000). Knowledge graphing technology has three steps in terms of practical application: knowledge graph building, knowledge system administration, and knowledge graph applications (Figure 2). It is important to characterize all types of exploration and production knowledge into computational structures, assemble this knowledge sensibly, and build a manufacturing knowledge

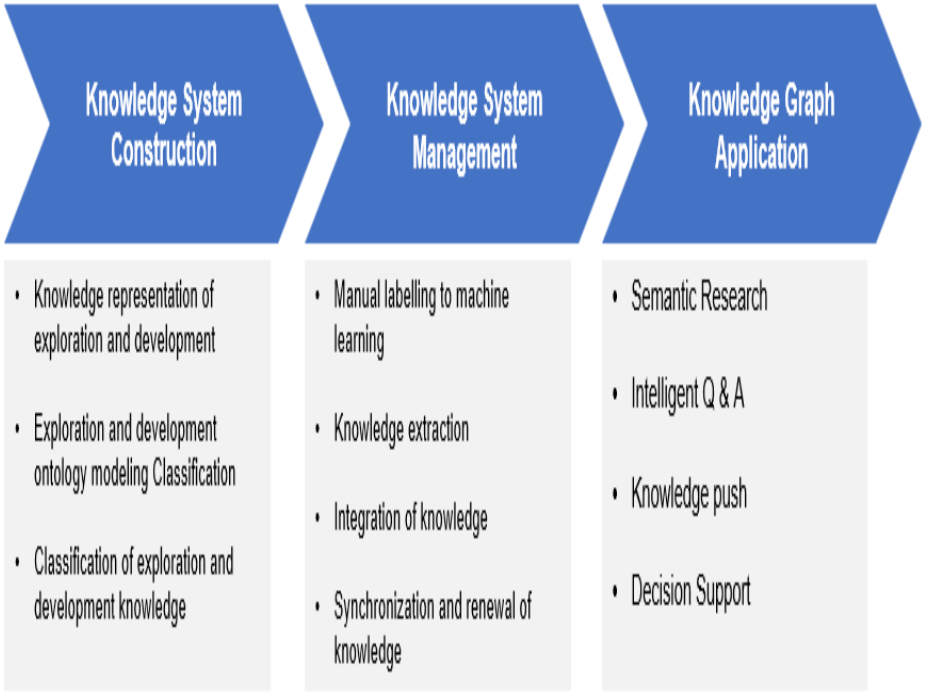

Figure 2: Knowledge graph technology in the oil and gas industry (Guan et.al., 2019)

system in the knowledge graph construction phase. Natural language processing with deep learning techniques is used to extract knowledge from organized, semi-structured, as well as unstructured texts, as well as from heterogeneous datasets via physical linkages and eliminations.

Human resource management, organizational developments, information technologies, reputation and brand management, and performance assessment are all fields that have collided to form KM (Bukowitz and Williams 1999). Knowledge management models have reused formats that combine information and data for the aim of maintaining, enhancing, sharing, gathering, and analyzing knowledge to stimulate understanding. They are used by businesses to gather, store, and analyze data to gain a competitive edge. These concepts are critical components of enterprises that want to use KM technologies.

Along the knowledge management lifecycle, the Integrated Knowledge Management Framework presented by (reference) consists of KM components that gather, cleanse, store, organize, extract, and communicate data, information, and knowledge intelligently. Data mining, Realtime collaboration, knowledge management workflows, automation, intelligent agents, semantic searches, and communication tools are some of the technical components that make the framework smart. The platform provides real-time transmission of knowledge to proactively monitor, analyze, optimize operations, and make choices by integrating historical and real-time data and related knowledge. This platform enables employees to proactively monitor, analyze, optimize operations, and make knowledge-driven choices by intelligently capturing, managing, preserving, and delivering knowledge in real-time into E&P processes and operations. Having clear data governance, data quality management, information, and record management practice shall enable effectiveness.

The Integrated Knowledge Management Framework as well as its components are depicted in Figure 3 below

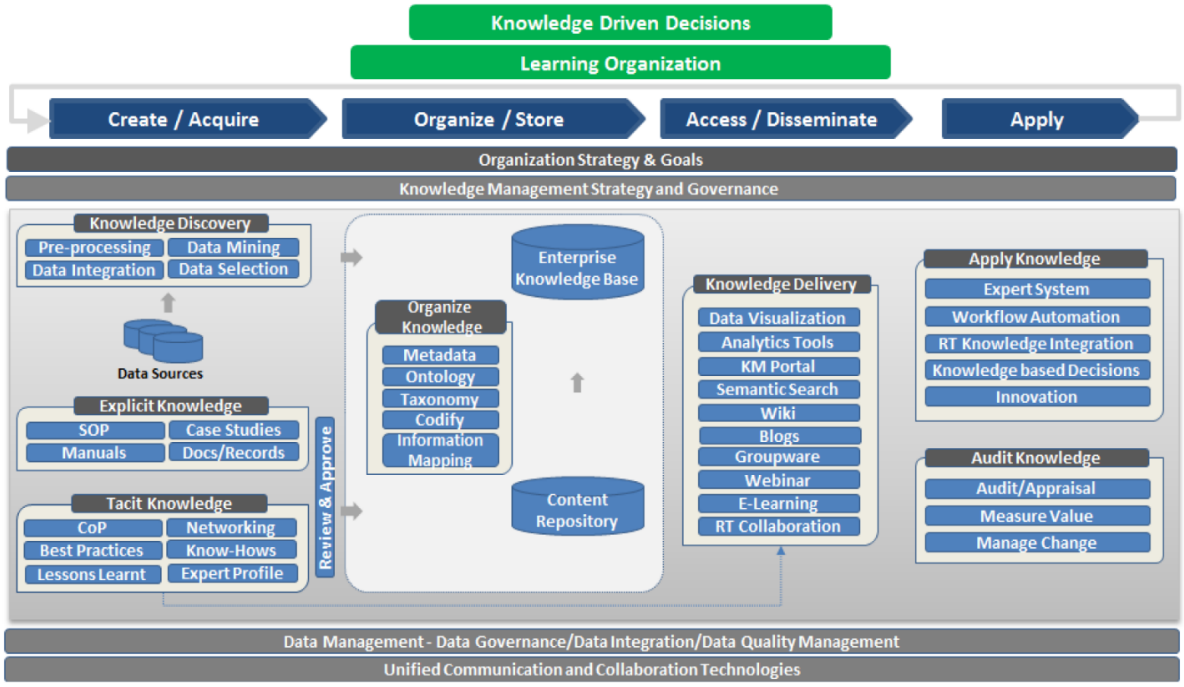

Figure 3: Knowledge management framework (David, 2016).

3.9 Knowledge Management in Digital Oil Fields

The petroleum industry's need to learn more about sub-surface and surface activities has prompted it to collect larger amounts of data of diverse sorts at a higher frequency. Nonetheless, finding important data from such data is difficult and time-consuming, thus decision-making gets difficult. Business operations are increasing as a result of evolving technology, and industry specialists can build more sophisticated, advanced, and automatic workflows. These sophisticated workflows are necessary to eliminate time lag and close the gap across various interlinking procedures. As a consequence, the time spent making decisions is reduced, and the quality of the

decisions is improved. Similarly, with the advancement of technology, data management has evolved significantly. To handle large volumes of data and to take swift decisions for improved business advantages, knowledge management is necessary, which comprises data collection from diverse sources, cleansing, authenticating, and evaluation. The oil and gas industry's desire for data integration and enhanced business processes has led to various Digital Oil Field installations during the last decade.

In a constant cycle of analysis, improvement, and comprehensive reservoir management, the contemporary digital oilfield leverages real-time operational field data. Permanent subsurface instrumentation, flowline network sensors, surface facilities, along with managed field actuator equipment like control valves, are all sources of operational data. This functionality allows for real-time operation control and optimization. Instrumentations, automation systems, and collaboration developments are accelerating large datasets for oil and gas companies. According to analysts, these quantities are increasing every year. Data of various forms, as well as data from many sources, must be integrated in such a way that users may access several disciplines at the same time. Data must first be rectified and certified to eliminate discrepancies and mistakes before being analyzed. Lack of availability of data and measurement uncertainties limit real-time production optimization. When collecting data from field sensors, for example, tolerance, accuracy, drift, standardization, location, sample rate, and temperatures are all crucial. Any of the variables might cause inaccurate sensor data. Data validation is critical in this situation. Uncertainties and modeling are integrated to reduce a global absolute error in which fresh sensor data is calculated using robust statistics. As a result, good data management techniques are an important part of the DOF (Saputelli et al., 2013).

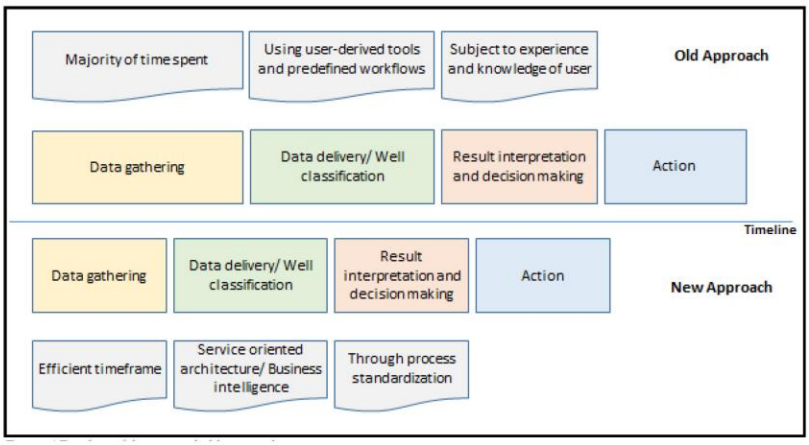

Figure 4: Timeline of the new and old approaches for process implementation with respect to time (Chanana, Soni, and Bhakne, 2016)

In Figure 4, a time comparison is established between both the new and old techniques to process implementation. Processes such as data collection and validation require less time inside the new method than in the previous technique, allowing actions to be performed sooner. As technology advances, many such sophisticated happenings will be present in the oil and gas companies, but without proper management and coordination of knowledge, these advancements will not be fruitful.

Oil and gas companies have increased in size and geographical spread, which makes it extremely difficult to obtain knowledge fast or even know whether expertise is present inside the company. Due to the constant turnover of staff, it is necessary to provide the clients with trust that the company is capable in certain areas of work. To make knowledge sharing easier in an organization, it must pay attention to human resource policies, communication policies, team dynamics, administrative collaboration, organizational incentive systems, and any other related activities that are important to the process. In the petroleum sector, knowledge management (KM) may be conceived of as a framework or a strategy that allows for the creation of a set of processes for collecting and sharing information. There are three main resources in balancing an organization's culture: people, technology, and process culture which can facilitate an organization to efficiently and effectively use and exchange intelligence for the benefit of the organization, and the oil and gas sector is no exception. The oil and gas upstream sectors rely on the quality of their resources, infrastructure, processing technologies, and expertise. If one of these variables changes, it has an impact on the company's management, planning, and output. Everything isn't perfect by nature; there seem to be weaknesses and strengths, such as resource base without investment, knowledge with no management, people with skills without organization, readiness to do but inadequate infrastructure, execution power but no quality, success without sustainable practices, perception with no decision-making, and so forth. It is critical to take advantage of the greatest resources available to be successful. Everyone

can be an expert in their area, but to be a maestro of everything in a given capital endeavor, teams and organizations must analyze and share experience, know-how, and expertise to gain a comprehensive understanding of all accessible facts. Only then, the digital advancements can be best leveraged in any industry.

4. Analysis and Discussions

The findings show that the oil and gas industry has been starting to work with data since its inception; nevertheless, the phrase "big data" has become more extensively used because of technological advancements, as fields are outfitted with a far significantly more significant number of sensors and tools that consistently generate high amounts of information (Feblowitz, 2013). The problem for oil and gas corporations now is to use this information efficiently to extract knowledge and value development. Overall, there is a widespread agreement on the link between big data as well as knowledge management; nevertheless, this link is uncertain for the market in the Middle East, mainly since these companies still are having difficulties with knowledge management (Haamann and Basten, 2018, Geisler and Wickramasinghe, 2015). For them, big data is a rung on the ladder. The findings also show that the mega-companies engaged in the study fully grasp the relationship between big data and knowledge management. However, most of the initiatives are in the experimental phase, with only a few in the development process. Based on the feedback, the relationship between big data and knowledge management can be divided into the following distinct yet connected components.

According to Fahey and Prusak (1998), knowledge is neither data nor information, and it should not be viewed as stock but as a flow embedded in many day-to-day organizational processes, as Nonaka and Takeuchi (1995) and Wiig (1995) have emphasized. Furthermore, knowledge is a reasoned opinion that enables an entity to behave maturely (Nonaka and Takeuchi, 1995). The distinction between knowledge and information has been much discussed in the literature (Davenport and Prusak, 1998; Alavi and Leidner, 2001). Knowledge is seen at the top level as obtained from knowledge and data being extracted from data. Let's analyze this on the premise of knowledge management principles. We can see that this link is supported by the literature, which shows that knowledge exists in diverse forms throughout businesses (Ball, 2011). Big data is one method for analyzing enormous amounts of data from various sources to produce expected knowledge (Bose, 2009). The first step in big data analytics is to use "machine learning" systems to determine hidden, non-obvious patterns of knowledge in the data which have the potential to create knowledge; the second step is testing and corroborating these relationships, which involves "human learning" as well as human insights for understanding, revise, and verify or repudiate such relationships (Hair Jr, 2007). Thus, unlike the traditional view of knowledge being generated and held by people (Grant,1996), knowledge is formed from diverse and copious data utilizing analytics in the first stage.

Big data is generally recognized and encouraged in the oil and gas industry. It is primarily the ability to harness data from diverse systems and analyze it to improve organizational performance by leveraging advanced digital technologies. Organizations, particularly supermajors, are in an experimental stage and have had some achievements, but overall, little effort has been made into big data. More committed attempts are required to reach excellent productivity from extensive data, which will undoubtedly take time.

Large corporations and organizations' competitiveness is strongly reliant on how they keep and retrieve their information. Most of the content in current electronic media is text-based, audio-based, or video-based and thus it is not systematically organized. Finding and retaining information is difficult in this currently poorly structured medium. Furthermore, corporative information and expertise should be blended with the employer's personal experiences and knowledge. Large amounts of raw data cannot overcome these challenges, create value, or give a competitive edge unless managed well. Also, as the amount of information available is continually rising, conversion of information into valuable knowledge has emerged as a significant issue.

The rapid and enthusiastic adoption of KM tools by the oil and gas industry during the ten years around 1995-to 2004 demonstrates the significant potential for knowledge management to improve efficiency, enable learning, strengthen organizational abilities, and foster innovation in international, technologically intensive firms facing continuously shifting operations and business prerequisites. There seems to be little doubt that knowledge management has contributed significantly to businesses' success in trying to deal with the tremendous difficulties of the last couple of decades and along with the technical challenges of frontier investigations and achievement,

the organizational challenges of enormous business size, the challenges of environmental protection, as well as the competitive challenges of restricted access to several of the world's most alluring hydrocarbon resources matters.

It is expected that knowledge management would eventually grow as the oil and gas industry gets matured. The Oil and gas production will continue for many years and the rest of the oil and gas would be increasingly difficult to get this would create great potential for cost-effective technological advancements. The futuristic knowledge management approach would be based on the integration of most modern digital technologies with knowledge management principles. Human management and integration of data would be more transparent and accountable. The future of knowledge management would be solely based on artificial intelligence and the integration of big data into operations and the organizations who are willing to adopt it will leverage a lot in the present situation. Organizations have to be predictable, and the future of explorative industries depends just on the deployment and selection of suitable methods to cope with upheaval and uncertainty. As a result, the capacity, flexibility, and fast adaptability as well as skill development to fulfill the demands of the environment appear to be extremely important. The most significant consequences of the future research process on knowledge management in the oil and industry are also making predictions, making attractive futuristic changes, and understanding the causes of change, so the implementation of prospective knowledge management improves organizational effectiveness.

Future hybrid system development should include multiple disciplinary reservoir geoscience knowledge and increase the quantity of critical data extracted between data kinds so that credible extrapolation from wellbores may be obtained. The probabilistic reasoning sequence for "Perception-Based Information Processing" provides a new route in AI that may improve AI's capacity to deal handle real-world issues when decision-relevant data is a combination of measurement and perceptions. What is less well known is that many significant AI challenges fall into this group.

The systematic literature review conducted in this study revealed the influence of knowledge management practices in the Oil and Gas sector. The real transformation leveraging the benefits of digital technologies is in the early stage, and in the future times, a full-scale market disruption would be witnessed. Accurate intelligent knowledge management and visual analysis aid in a better understanding of regional evolution, migration of hydrocarbons, and accumulating mechanisms in the oil and gas industry for making potential explorations in a better manner ((Guan, Zhang, and Zhang, 2019). Given the breadth and complexity of the topic, the thesis opens many future research possibilities. The rapidly changing environment as well as technological advancements have a lot of influence in this sector and conducting follow-up research in the knowledge management sector at various stages of digital transformation will help in analyzing the outcomes of past predictions as well as future expectations. So future research in knowledge management should focus on empirical investigations and research on how digital advancements at each stage affects the knowledge management practices in the oil and gas industry. This data should be analyzed in various geographical locations and such an analysis will help in gaining an understanding of the barriers to knowledge management practices in the oil and gas sector. Better knowledge about the emerging skill sets and competencies helps in the formulation of a new organizational structure and reinvigorates the stakeholder relationship.

5. Conclusion

According to the analysis of various literature related to knowledge management in the oil and gas industry, it was revealed that advancements in big data help in the more efficient management of knowledge in an organization. Leveraging AI and ML for effective use for knowledge management purposes transforms organizational efficiency and competitiveness. Uncovering knowledge through reasoning is an exciting component for increased corporate performance. Furthermore, when making decisions based on big data, the tacit knowledge from experienced staff is critical. Actionable knowledge is created by combining relevant staff's tacit understanding with explicit knowledge gathered from big data. However, there is indeed a possibility that big data will reduce the need for tacit knowledge in the future as algorithms get more sophisticated. This conflict between these two realms — in other words, tacit knowledge replacement using predictive knowledge via big data, is worth exploring because results do not provide much concrete proof. So this has to be examined more as firms grow

more mature in their use of big data. Integration is the primary barrier to big data. It necessitates a significant amount of effort regarding the usage of tools and the methods of integrating data from diverse clusters.

For even more than decades, the oil and gas sector has benefited from Knowledge Management advancements. Knowledge Management approaches to support executing business process have made production more effective and is thriving during the rapid advancement of technology, an expansion of offshore drilling, multiple acquisitions, rising dependence on foreign oil suppliers, and an awareness of environmental issues. When oil and gas firms engage in developing new technologies, acquiring new assets, developing new fields, developing partnerships, and government regulation, their Knowledge Management groups may help by supporting those engagements by delivering knowledge for effective execution When it comes to strategy implementation, cost reduction, and environmental challenges in oil and gas business, the transformational changes in knowledge management indeed acts one of the important pillars to overcome the challenges of the oil and gas sector. In recent decades, there has been a great emphasis placed on sustainable development, particularly in the oil and gas industry. Companies all over the world are broadening their techniques to keep up with the current trend, and technological advancements in the knowledge management sector are viewed as critical factors to achieving long-term development. This, together with the oil and gas industry's ongoing technological progress, has compelled the sector to adopt next-generation digital solutions to deliver knowledge seamlessly to the digital business process driven by users and artificial intelligence to effectively operate the Oil and Gas business across its value chain and accelerate the learning curve of Oil and Gas workforce.

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