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Applications of information technology (IT) in Iraq's petroleum industry

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ABSTRACT: The crucial role of information technology (IT) in operating and managing industrial systems is widely recognized, and Iraq's IT capabilities hold great promise for its industrial and other economic sectors. The demand for IT services has risen considerably, particularly for oil and gas companies, which face the challenge of boosting capital asset returns while ensuring safety and sustainability. They need to manage rising demands as well as competition for access to oil reserves while driving improved asset reliability, productivity, and performance.
This application show how information technology is used in the petroleum industry. It specifically examines information technology applications in the upstream, midstream, and downstream important segments of the petroleum industry during the drilling process. The increased price volatility's noteworthy effect on the profitability of the energy industry is just one of the current supply chain management challenges. Better supply chain management aids in lowering operational costs, a challenge that many businesses are under demand to address right away. The study's theoretical and practical value is in exposing the characteristics and issues with the infrastructure supporting the Iraqi oil industry and in creating a control algorithm for the evolution of its Regular visual inspections of pipelines, offshore oil rigs, and other infrastructure may be carried out swiftly and safely thanks to technology. Light devices that enable temperature checks using infrared scanning are available in modern applications. Hazards like poisonous substances can be identified by other sensors from a safe distance. Enhancing oil and gas safety with artificial intelligence technologies protects the environment and ensures worker safety

Keywords: Information technology, the refining process, functions, limitations, drilling process

1. INTRODUCTION

1.1 Information Technology

There is no need to introduce Iraq's Information Technology (IT) industry. IT is still expanding at a rapid rate after playing a significant role in Iraq's rise to prominence as a global economic power. The international reputation of Iraq's IT expertise is strong, and it represents a thriving sector within the country's economy. As time progresses, IT services have seen a significant rise in demand, and it is considered a vital source of growth and employment on a global scale, the IT sector has developed. Currently, open-source data on flaring and remote sensing tools are being used to tap a nation's IT potential to develop a greater understanding of air pollution linked to the oil industry. Utilizing Google Earth Engine and machine learning tools to monitor the activities and effects of the oil business. Using publicly downloadable satellite imagery, open-source data, and mapping tools to map possible environmental hotspots. The technical reconstruction of oil refineries to ensure the production of motor fuels in accordance with international standards should be one of the most important areas for development of the production infrastructure in the Iraqi oil industry, according to this study, which was based on the collection and processing of expert survey data. Figure shows the locations of Iraq's major oil refineries. [1].

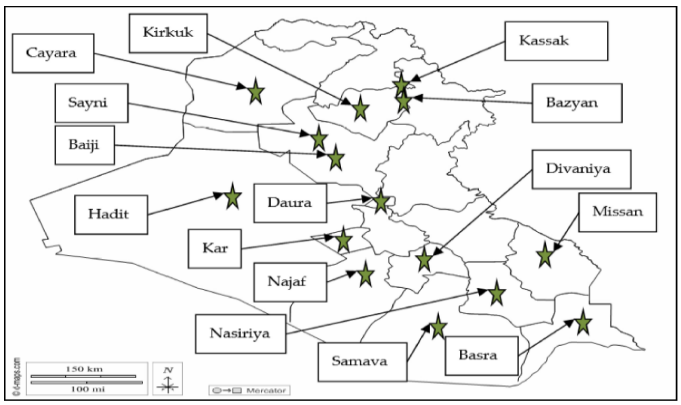

Figure (1): Location of oil well receivers and restructure [1]

With the help of technology, the industry is now able to explore deeper Gulf of Mexico waters and make a ton of new discoveries with very little harm to the environment. Through greater productivity in practically every area, IT has the ability to improve long-term economic prospects.

Shell commissioned the McKinsey research to assess the effectiveness of its efforts to accelerate the adoption of expandable tubular technology.

The analysis discovered that internal investment totaling several tens of millions of dollars had in fact contributed to a more than 50% reduction in time to market.

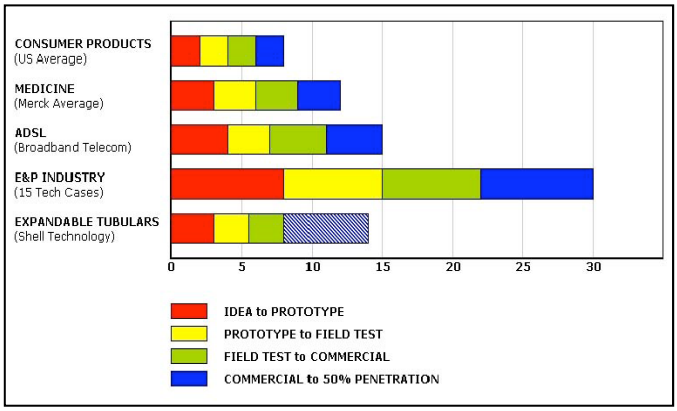

Figure (2): Years to market for various sectors [2]

When requested to enumerate the primary five external factors that are influencing their businesses presently, technological advancement received the highest responses see Figure (3). Although 61 percent of people now believe that technology advancements are a significant external factor, technological breakthroughs have mostly been used in four the environment, enhanced recovery & output, production cycle time, and cost-efficiency in the extraction of oil and gas chain [2].

Field	Asian NOCs (in consortium with other non-Asian companies)	Country
Rumaila (N&S)	CNPC and others	China
Zubair	Kogas and others	Korea
Maysan Group	CNOOC, TPAO	China, Turkey
Majnoon	Petronas and others	Malaysia
Halfaya	CNPC, Petronas, and others	China, Malaysia
Gharaf	Petronas, JAPEX	Malaysia, Japan
Badra	Kogas, Petronas, TPAO and others	Korea, Malaysia, Turkey
Block 8	Pak Petroleum	Pakistan
Block 9	Kuwait Energy, TPAO and others	Kuwait, Turkey
Block 10	JAPEX and others	Japan

Figure (3): Asian NOSc [2]

1.2 Petroleum Sector in Iraq

Iraq is regarded as having the second-largest known oil reserves in the world, behind the Kingdom of Saudi Arabia, with an estimated 115 billion barrels of proven oil reserves. As many areas of the Western Sahara lack accurate petro-geological maps and are anticipated to contain significant amounts of oil, some believe that Iraq's reserves will surpass those of the other Gulf nations once study and exploration are completed in these areas. Initial projections point to the potential of 100 billion additional barrels. It is believed that Iraq has 110 trillion cubic feet of natural gas reserves. And according to economists, Iraq's oil fields rank first in the world for having low production costs due to the existence of crude. If we consider that the number of producing wells in Iraq ranges between 1,500 and 1,700 wells, while it is anticipated that the wells will eventually reach at least 100,000 wells upon completion of the research, it is possible to visualize the small size of Iraqi oil production in comparison to stock. Despite these impressive oil production capacities, Iraq's oil energy appears to be suspended and restricted to two major fields. The first is the southern Rumaila field, which has 663 productive wells. The Kirkuk field, which is the second major field and has about 337 wells, suffers from the issue of being depleted due to focus Al j e for extended periods of time (discovered in 1927), particularly during the siege. There is a need for more current research and funding in this area.

Table (1) As shown in the table below, most of Iraq's oil reserves are located in the giant and very giant fields. These 15 fields account for about 40% of the country's total proven reserves. [4]

Total	500 less than	500-1,000	1,000-5,000	5,000 More From	Million barrels
Developed fields					
15th	3	4	5	3	Number of fields
100	1.2	6.7	23.4	68.7	% Of its relative importance from the developed reserve
Undeveloped fields					
58	39	7	8	4	Number of fields
100	6.7	6.9	26	60.4	% Of its relative importance from the undeveloped reserve

1.3 The main issues facing the oil industry

The oil and gas exploration and production sector, arguably, requires the widest range of human, political, mechanical, and technological skills in the modern economy. Nowadays, because of the competition for natural resources, businesses explore and produce in hostile, far-off, and occasionally dangerous environments where even the most straightforward logistical operations can be difficult and expensive. Additionally, [4] professional human resources are getting older and becoming more in short supply as the environment becomes more diverse and harsh and the issues get more complicated. The key to developing the sector is intelligent monitoring, deploying downhole sensors to keep an eye on wells. The implementation of new procedures and oversight for centrally monitored wells may be challenging.

In a controlled laboratory setting, it can be challenging to swiftly and accurately collect data; in a setting like the North Sea or Sub-Saharan Africa, it can be an overwhelming undertaking. A global network of different business partners might be challenging to integrate with modern technology, even while it has the potential to lead to great things in the future. Most of the potentially helpful data that is currently being collected is neither routinely preserved nor made available to those who can benefit from it the most. An awareness of the difficulties, as well as the skills to critically examine data and discern past trends, are necessary to address complex production challenges like sanding, where particles, particularly sand, infiltrate and clog wells and negatively affect production.

1.4 Turning data into intelligence

Modern monitoring systems have the ability to generate over one terabyte of data in a day from just one field. Due to the complexity and variety of data, which includes pump performance, fluid composition, temperature, and pressure changes, an on-demand method of accessing and analysing the data is required. Interdepartmental communication can be slowed down by moving the data across disconnected.

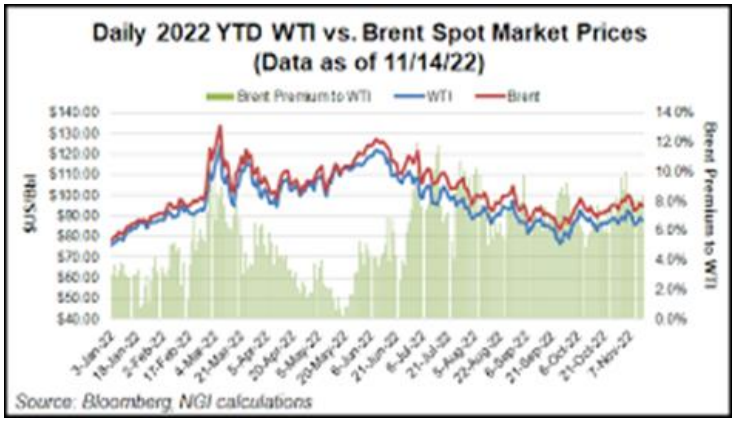

Figure (4): Daily 2022 YTD WTT vs. Brent spot market prices [3]

A strategy based on-demand access to data can provide commercial value by Processing raw data into meaningful knowledge that can be delivered remotely, in the correct format, and at the appropriate time to the intended recipient. The intelligent, on-demand oil field does not simply collect and store data. Figure (5) shows data how it effects about prices of oil when collected amount of data for oil and gas operations and projects, there is a significant need for sophisticated specialist software from the upstream, middle, and downstream sectors. [3]

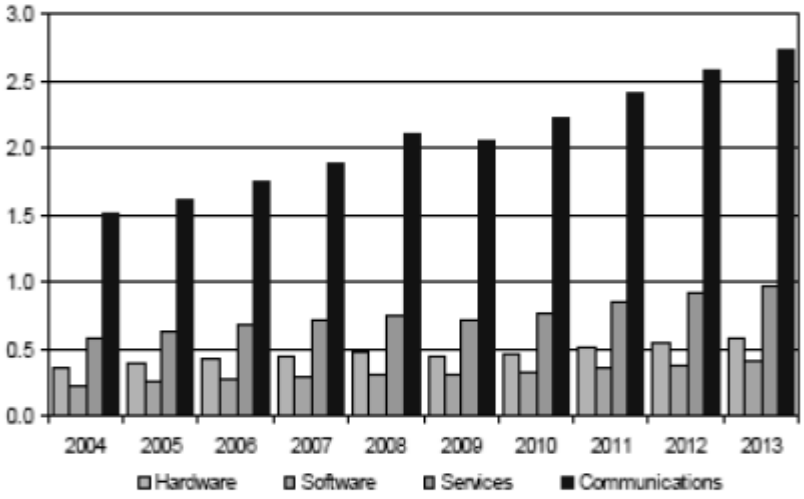

Figure (5): Major Segments' Global ICT Spending [3]

2. The use of information technology in the production and exploration of the petroleum industry.

You can use IT together and arrange data obtained through exploration. A SOA/PPDM infrastructure enables a wide range of applications. Utilize data hub and integration technology to link and integrate data, Manage the workforce's understanding of upstream operations using 3D geospatial visualization tools, by employing petroleum production accounting, you can monitor and distribute the expenses of oilfield operations, while utilizing 3D geospatial visualization tools to examine, depict, and comprehend exploration data [4].

A. Horizontal drilling

Another example of time-to-market is horizontal drilling. With more contact with a reservoir's productive layer thanks to the use of horizontal wells, production is increased while drilling and finishing costs are reduced. Typically, the cost of a horizontal well is 25 to 300 percent higher than that of a vertical well, a horizontal well has the potential for considerably higher production [4].

The use of horizontal wells is an instance where a new technology has become more prevalent as costs have decreased, technological advancements have occurred, and potential hazards have become better understood and managed, over the course of several decades.
A newly developed HDD planning program called HDD Directional Drilling Software combines charting and Tool Face Calculations. The software creates all the charting for azimuth, tangents, turns and bends, and dog legs with just a few inputs. It also covers river crossing, hydropower water courses, tunneling, mining, and civil engineering. Requires Windows 7, Windows 8, or Windows 10 and Microsoft Office 2010 or later.

B. Improve oilfield operations

The use of Information Technology (IT) allows for the tracking and allocation of production costs related to oilfield operations by utilizing petroleum production accounting. Additionally, it enables the integration of data on production with information on operations and finances through a specialized enterprise bus designed for the petroleum industry, as well as custom workflows. Applying business intelligence techniques tailored to the oil and gas industry, it is possible to maximize oilfield ROI by managing resource allocation, maintenance spending, and margin analysis [5]. Sib has the ability to impact the production of chemicals and petroleum products through a distinctive blend of technology solutions and business-oriented expertise.

C. Application of machine learning in oil well reservoir

Research on machine learning (ML) is acknowledged as a useful instrument for examining reservoir simulations in oil wells, offering a fresh perspective on comprehending and forecasting intricate reservoir operations. Machine learning (ML) techniques are perfect when several parameters, including fluid saturation, temperature, pressure, porosity, permeability, etc., need to be considered simultaneously during reservoir simulations. Its capacity to manage multivariate and high-dimensional data is the reason for this. The multidimensional study's capabilities greatly improve reservoir simulation and prediction accuracy. [6].

D. Speed up the expansion of revenue generated from downstream operations

By utilizing IT, you can take advantage of valuable customer relationships, expedite retail expansion by boosting revenue from non-fuel sources, predict and regulate demand through Oracle's advanced predictive demand planning solutions, and manage contracts effectively using specialized pricing and contract management tools tailored for the industry.

E. Increase Customer Management Efficiency

Through the use of IT, it is possible to enhance targeted account sales, acquire and keep track of opportunity and tender details, capture and manage contact information, and gain a comprehensive global view of the customer measurement through the drilling process, or MWD, is a technique used these days to identify the stages of directional wells using high-quality sensors. Standard drilling may be done while surveying, which gives these equipment an advantage over the others. One must stop drilling while the gyro or single- or multi-shot tools are run in the hole and retrieved before the survey can be obtained using information technology and software [7].

F. Enterprise solution

The current challenges involve integrating, updating, and ensuring that data is "live" in order to enhance decision-making across all levels of the company. Taking into account best practices and international standards, a comprehensive view of processes and procedures, having "One Single Solution" that covers all regions, areas of business, and frequently several industrial sectors IT has extensive experience with deployment, rollout, upgrades, and application support for the Microsoft product family as well as SAP, Oracle, Oracle PeopleSoft, and Oracle CRM ERP solutions.

G. The supply chain of the Oil and Gas industry

Although there are many small oilfield operators and service providers, a sizable portion of the market is controlled by multinational service providers that offer packaged goods and services to their clients. These large utilities have little incentive to innovate or introduce new technologies that could replace existing, profitable product lines, and with the general caution of operators, this presents a significant challenge to the introduction of

innovative technologies. The main focus is on cost reduction and increased production efficiency, with little differentiation from competitors [8].

Providing skilled workers with instant access to measurements via networked and instrumented equipment can boost productivity. Establishing a connection between offshore and onshore support centres that facilitates global, real-time collaboration can further accelerate decision-making and increase output. Business intelligence and performance management software, as well as analytics-based solutions designed specifically for the industry, can be used to gain insights and optimize the supply chain and inventory, ultimately leading to better decision-making.

IT plays a good role to enhanced well performance that can be achieved through intelligent reservoir management, which involves installing sensors in pumps, pipes, and throughout the entire field to create data that can be matched with historical tendencies and applied to improve the well's performance [8].

H. The management of information that is integrated

Chemical and petroleum companies must operate in environments that are geographically scattered and segmented, from offshore platforms to land-based headquarters, which demands real-time coordination and communication across segments. [9]. The combined information solutions offered by SLB can provide the chemical and petroleum sectors with the visibility, automation, and control necessary to capture, integrate, and manage data at the source, assisting operations and choices across the entire company.

I. Managing security in the oil industry

As a crucial component of G4S Risk Management, G4S Secure Solutions Iraq (SSI) offers secure support services, ordnance management, risk consultation, specialized training, and integrated solutions in various challenging, hostile, or distant business situations. With our clients, we establish long-term strategic collaborations and adjust our solutions to fit their evolving needs as situations change over time. We are nimble, flexible, and strong [10].

J. Cloud Computing

Oil and gas firms, which operate in a highly data-intensive industry, can benefit from cloud computing as it provides a highly automated and flexible alternative for the procurement and provision of IT services. With cloud computing, scalability can be achieved on a large scale, and it can facilitate collaboration both within companies and across partner ecosystems, as well as the quick and low-investment deployment of new services. Oil and gas firms can visualize manufacturing intelligence capabilities and oilfield information thanks to IBM cloud service delivery and management solutions. By utilizing sophisticated measurement and predictive analysis techniques, decision-making is also improved. Increased automation and integration optimization results in improved enterprise connectivity with ERP and other systems [11].

K. Environment and Health Safety

Businesses now place a greater emphasis on being environmentally, health, and safety conscious. It has been concluded that the digitalization and combination of safety protocols and work management activities need an integrated ERP system. IT is skilled at creating and modifying Safe Work Permit Systems to meet the specific client-site/infrastructure needs. Additionally, IT provides consulting, transformation, and support services for SAP's EHS and Metric Stream's GRC Solutions. Knowing where your personnel are being crucial for safety. In hazardous working environments, locating people and valuable resources during evacuations can be challenging. SLB's awareness of location and safety options are reliable option for the chemicals and petroleum industry to safeguard workers and tangible assets from potential risks.

Management is only one aspect of intelligence. In addition, about foreseeing issues before they arise and, in some situations, automatically making adjustments to avert them. The objective is to lower risk and cost complexity and maintain compliance with onerous local requirements. Complexity cannot be avoided; your response to it is where you have a choice. For chemical and petroleum upstream companies: offers information on exploration and production in a format that is simple to understand. Excellent practices for geoscientists are established. Better methods for managing the life cycle of plants are provided for downstream chemical and petroleum firms. Builds a framework for dealing with regulatory compliance. Captures knowledge from the workforce and applies best practices.

L. Analytics for Business and Performance Management

One of the main challenges faced by companies is consolidating data from multiple systems into a single, reliable source. TCS offers Combined planning instruments, easy-to-use dashboards, and CPM scorecards to address this issue. They help set up appropriate KPIs for evaluating business performance and creating reliable balanced scorecard applications. TCS also offers KPIs for balanced scorecard applications that can measure and display KPIs in near-real time with a visually appealing interface [10]. Additionally, TCS delivers business intelligence and performance management services that give insights for improved decision-making, using analytics-based solutions that rely on sector-specific blueprints and dashboards, to enhance supply chain and inventory. They can assist in deploying and supporting these solutions with a well-defined BI strategy.

The number of patent applications that are submitted annually is another indicator of technological advancement. The four biggest oil and gas firms' patent activity is displayed in Figure (6). The main service companies' patent activity is displayed in Figure (6). The ratio of service business patent applications to oil and gas super majors is eight to one for the most recent year. This demonstrates that the primary source of technology for the oilfield is a utility company.

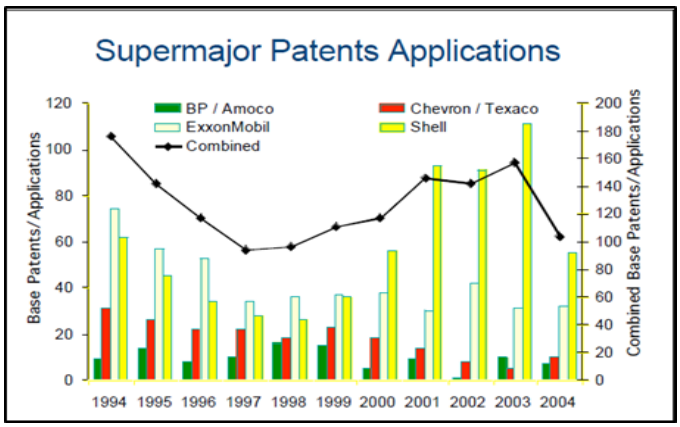

Figure (6): Supermajor patent applications by year [10]

M. Managing risks and trading energy

The petroleum industry is dealing with new challenges and cost increases while trying to manage risks to maintain profitability. Oracle's Enterprise Project and Portfolio Management (EPPM) solutions, specifically designed for pipeline projects, provide executives and project leaders with the necessary tools to control costs and reduce risks in this unpredictable environment [10]. Using EPPM solutions, pipeline companies can determine the most efficient ways to create and execute projects from start to finish, minimizing costs and risks. In addition, API-based Risk-Based Inspection software can help chemical and refining plants identify the most critical equipment to focus on, as a significant portion of their overall most of the risk is focused on a small segment of their equipment.

N. Supply Chain Management

The present difficulties in supply chain management include the notable impact of rising price volatility on the profitability of energy companies. Better supply chain management helps reduce operational expenses, which is a challenge that many firms are under pressure to tackle immediately [12]. The integration of planning and optimization tools with ERP systems, cost optimization, and service level improvement are some of the other significant obstacles that must be overcome. Additionally, during the early stages of a new product or service's deployment, service businesses frequently buy startup firms. Numerous advancements in the sector come from such start-up businesses. Figure (6) depicts a history of Schlumberger acquisitions as an illustration, demonstrating a sharp increase in acquisition frequency over the previous 15 years. 11 It is known that acquisition action at other significant service providers, like Halliburton and Baker Hughes, followed a similar pattern [12].

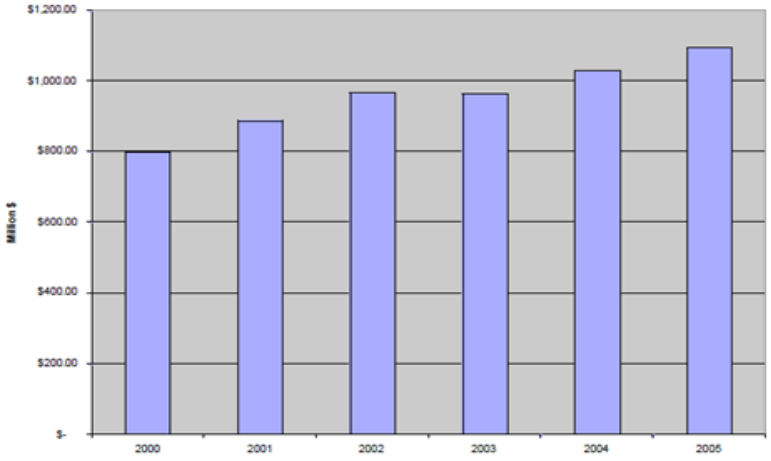

Figure (6): Major service company R&D spending [2]

O. Cost-effective Production and Asset Management

Having access to product knowledge is essential when making important decisions in the workplace. To improve operating reliability, reduce costs, and increase maintenance effectiveness, 3D representations of assets can be utilized. This will result in better asset availability, adaptability, and reliability, allowing for a stronger response to market changes. SLB's Asset Life-Cycle Management solution can assist in cost savings by supplying consolidated information and performance evaluations across various assets within the organization, whether it be a plant or an offshore drilling operation. It can also enhance production through rapid and consistent analysis of operational and equipment data to identify issues related to reliability and safety.

P. Solutions for assets that perform at a high level

Increasing asset utilization, enhancing asset visibility, boosting productivity, and improving customer satisfaction are some of the current challenges in asset management. IT solutions, such as "High Performing Assets," can address these challenges by integrating the upper management levels with the operational levels, improving asset visibility, and enabling better monitoring and utilization of assets to achieve core business objectives.

Q. The management of energy trading and associated risks

The current challenges include the demand for fully integrated management software for all front, middle, and back-office operations. When there are changes in commodities traded, asset usage, location, business strategies, and processes, the software requirements also change. Additionally, new laws like the Sarbanes-Oxley Act can impact software specifications [13]. To address these challenges, TCS offers advisory services to choose the best energy trading product, third-party product implementation, and custom application creation in energy trading. TCS also provides services for application implementation, roll-out, upgrade, and support, leveraging their experience in offering solutions for commodity trading in the financial services sector.

R. Pipeline Management, Integrated

Currently, there are issues with SCADA (Security Control and Data Acquisition), CPM (Computerized Pipeline Management System), and GMS (General Management System) connectivity.). Reports from different systems are manually compiled and sought out separately to generate financial documents such as invoices and debit and credit notes as well as for decision-making and integrated reporting. [14].

S. Data Mining Services & Solutions

Data mining is a computational method for extracting crucial facts that can be put to use from sizable datasets [15]. The oil and gas business generates a vast amount of data, which presents upstream companies with a golden opportunity to profit from data mining. Data mining technologies have several commercial advantages, such as

improving decision-making quality and timeliness, identifying prospects with the greatest potential, uncovering previously untapped business opportunities, and enhancing a company's competitive advantage and profitability [16].

3. Future Technology Financing

One way to lessen the dependence of the replenishment of the Iraqi state budget on the prices of the international oil and gas markets is to develop the oil refining sector, which currently receives 20% of hydrocarbons after production, including for the purpose of exporting its products later. In addition to increasing the value of exports, oil refining aids in supplying the domestic market with petroleum products, raises national income due to the expansion of the petrochemical and oil and gas processing industries, and creates new jobs and increases wages for Iraqis [17]. The price increase over time is depicted by new technology in figure (7).

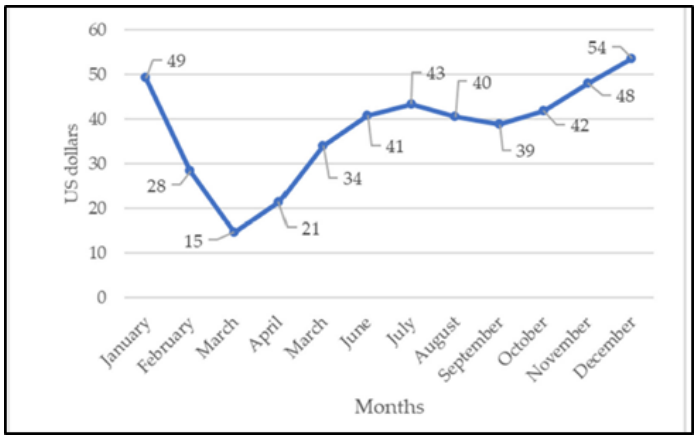

Figure (7): changes in the US dollar value of the average price of a barrel of crude that Iraq exports in 2020.[16]

4. Conclusion

The global IT market offers various technologies and solutions for the petroleum industry. These solutions address every stage, from the very beginning to the very end, of the petroleum industry's business value chain. Investments in IT should be backed by a well-thought-out, comprehensive IT strategy that is in line with business goals. It is important that the integration and interfaces between various software programs be well established. Investments in IT should continually be evaluated for success.

Technology will have the biggest impact on increasing the supply of more difficult-to-find oil and gas and minimizing the harmful environmental effects of energy production and consumption. Businesses must develop, deploy, and integrate these technologies by 2030 in order to enable critical success factors like performance management, enterprise risk management, and strategic production and information technology integration. The drilling and production processes are made easier and more cost-effectively through the use of these applications, which lower the cost of using cloud computing to store data and restore it when necessary.

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CONFLICT OF INTEREST

None

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