

Original article

USING OF DIGITAL APPLICATIONS TO TRANSFORM PROJECT MANAGEMENT PROCESSES AND MANAGE DATA IN THE OIL AND GAS INDUSTRY

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Abstract: The oil and gas sector is going through a digital transformation to maximize profits, deploying technologies such as Industry 4.0, cloud computing, IIoT, and systems integration. This study focuses on the use of digital applications specifically designed to enhance project management processes and data management, with a particular focus on work turnarounds in oil and gas company located in Kazakhstan. These innovative digital applications offer a way to facilitate efficient planning and analysis, adhering to the Minimum Functional Objectives (MFO) culture. That's how they play a pivotal role in optimizing expenditures, preventing mishaps, and improving overall operational efficiency. However, the successful implementation of these applications is often hindered by several challenges, including the lack of appropriate digital platforms, a shortage of personnel trained in digital technology use, and a limited understanding and implementation of the MFO culture. This paper proposes a comprehensive suite of digital applications, encompassing Salesforce, TA Notes, TA Pro, PWC & A, and Mistras. These applications are specifically designed to improve the planning and execution of work, thereby playing a vital role in the digital transformation of project management processes in the oil and gas industry. The paper also underscores the potential of these technologies to revolutionize project management, while also discussing the challenges to their implementation and providing actionable solutions to overcome these hurdles.

Keywords: Cloud-based data digital platforms; Project management; New technologies; Oil and gas enterprises; Personnel safety; Process optimization; Turnarounds.

1. INTRODUCTION

Changes and challenges are constant for oil and gas refineries. Having overcome the hurdles of fuel composition history and low-profit margins that were part of the 1990s, it is a fact that the industry now faces an increasing number of critical challenges at a time of soaring oil prices. Besides two major problems of

ensuring a stable fuel supply and dealing with quite stringent kind of environmental requirements, especially the ones relevant to climate change, there is an urgent need to develop and apply the latest digital technologies to ensure personnel safety and optimize plant costs, ultimately allowing plants to remain viable, profitable and successful in any environment and under any circumstances.

The survival of a species in nature, according to Charles Darwin's research, does not depend on strength or intelligence. Rather, it is the species that can adapt to change that is more likely to survive (Megginson, 1963, p. 4).

Oil and gas refineries can take advantage of these situations by integrating large, efficient gasification units into their plants for low-cost cogeneration of their own electricity and steam, as well as significant supplies of gaseous hydrogen by processing various low-value hydrocarbon streams such as coke, coal, residues, waste, biomass, etc. Finally, CO₂ capture and sequestration potential in the gasification process is very attractive (Hansmann et al., 2022). Refineries have traditionally been skeptical of building on-site power plants because of their limited power needs (usually about 60 MW for a stand-alone refinery) and because of the capital-intensive nature of such projects. The recent trend toward legislation to limit CO₂ emissions, improve energy efficiency, and liberalize the electricity market, combined with the growing need to dispose of refinery waste streams, has caused many businesses to rethink their approaches (Hansmann et al., 2022).

Oil and gas companies are always striving to stay ahead in the game by utilizing digital technology to enhance their business opportunities. With the rapid evolution of digital technology, it has become crucial for all types of businesses to reassess their current practices. This has led to traditional industries undergoing transformation or merging, offline businesses transitioning to online platforms, changes in business models, the emergence of new companies, and even some corporate brands disappearing (Bhansali, 2013, p. 4).

The fourth industrial revolution is the latest digitalization trend (LaValle et al., 2010) that has a significant impact because it refers to a versatile technology that affects various industries, businesses, and even the behavior of consumers (Schwab, 2017). According to Brynjolfsson and McAfee (2017) this allows enterprises to optimize existing business processes, changes the organizational structure of the enterprise (Verhoef et al., 2021), and involves modifying the activities that contribute to creating value for customers throughout the entire industry value chain

(Birkinshaw, 2017, p. 40). Thus, digitalization not only provides efficiency gains but can also lead to changes across the industry and the organization, leading to new business models that redefine and expand existing value-based approaches (Rossi et al., 2020).

Although digitalization offers many opportunities for businesses to create new or modify their current business models (as stated by Jacobides et al., 2018, p. 2255), the downside is that it also presents significant challenges for established companies. Frankly speaking, the constant evolution of digital technologies Thus, digitalization adds a level of complexity and requires greater flexibility in strategic forecasting, planning, and control (Amit & Schoemaker, 1993, p. 35). For existing companies, digitalization often requires balancing the use of existing business relationships with the creation of new business opportunities (Volberda et al., 2021). All innovations of global digitalization, destroy the environmental landscape of enterprises, requiring them to adapt and adjust to the new realities of business in a short period of time (Christensen et al., 2016).

2. RESEARCH METHODOLOGY

It is important to mention here that methodology employed in this study comes with a hybrid approach, integrating both desk research and multiple case studies for an overall exploration of the topic. The desk research constitutes a comprehensive examination of existing scholarly literature and industry reports, particularly focusing on the implementation of digital technologies in project management within the oil and gas industry. On the other hand, the case studies concentrated on a selection of prominent oil and gas enterprise in Kazakhstan, known for their innovative adoption of digital tools. The data for these case studies was gathered through a series of interviews with key personnel involved in the project management operations of these companies. Moreover, an exhaustive review of project documentation was undertaken to provide a more detailed context and a clearer picture of the processes involved. Moreover, data analysis was performed using thematic analysis, a method involving the identification, examination, and reporting of patterns or 'themes' within the

data. The key objective of this analysis was to uncover insights into the influence of digital applications on project management processes, particularly in the context of work turnarounds.

It should be noted that different methods were used to test the recommended digital applications and to obtain evidence confirming the working hypotheses during research. For example, preliminary studies on testing of the Mistras application used in the desk study demonstrated its value and usefulness by creating a mobile cloud platform that allows inspection, and storage of historical data and provides real-time information. In addition, this method allows not only to keep the study data but also to update the site inspection results and continuously monitor these processes.

The digital Salesforce web platform application has been tested as one of the powerful tools for planning and managing projects in various fields, including science and research. This platform allowed grouping, filtering, and optimization of workloads, and significantly organized and managed the research projects. The MFC thinking method was enabled to be used during the research parameters evaluation.

This platform as well as TA Notes and TA Pro have been demonstrated in an empirical study, where measurements and observations yielded effective results on crew changes and periodically timed and updated schedules at work sites.

The TA Notes application actively used the measurement method to share information among the researchers, which facilitated communication and improved work coordination.

Thus, it can be noted that in order to justify the proposed solutions, the authors have conducted theoretical, empirical and desk research. Digital technologies proposed for project and data management in the process of various works have been researched and studied by many scientists, and this article was an attempt to summarize and describe the impact and their validation with reference to the object of research. The hypothetico-deductive methods

in the research methodology made sure that all of these applications prove to be effective.

On the basis of the conducted desk and empirical research, the argumentation was built methodologically with the results of their effective application. In order to achieve the research goal, the authors attempted to use the most effective tools and methods to determine the multidimensional description of applications with the expected results. The research effectiveness main criteria were the observation and measurement, description and generalization, and satisfaction of the researchers with the use of these applications.

It should be noted that during obtaining the data, the researchers' team has been identified and selected to use these applications, and the other project team will use traditional research methods as a control group. This approach methodology covers collecting data on selected indicators from both groups and conducting a reflective analysis to compare the effectiveness of using apps and traditional research methods. Based on the results of the study, a decision was made whether to continue using apps in the research or to return to traditional methods. Interpretation of the results will allow in the medium term to confirm the results obtained and decide on further actions depending on their significance and compliance with the established research objectives. Overall, these applications can help improve the project management process, increase the efficiency of the project team, and provide a more accurate and reliable analysis of project performance. In addition, all of these applications can be used to analyze and optimize project performance. For example, by analyzing the obtained data, the project bottleneck can be identified to be improved.

Thus, the research methodology includes the following steps to get the most out of these applications:

- Evaluate current project management processes and problems, that is, prior to using these applications analyze the current processes and identify problems that need to be solved. This will help determine which applications can be most useful in solving specific problems;

- Defining specific goals, that is, what specific goals need to be achieved with these applications, such as enhancing coordination between team members, optimizing the planning processes, or improving workplace safety;
- Selecting the most appropriate applications, i.e., based on the analysis of the current processes and objectives to be met, select the most appropriate applications to solve the problem;
- Customization of the applications used, i.e., once the appropriate applications have been selected, they need to be configured for the specific needs of the project, and the processes associated with their use need to be adjusted;
- Training the project team, i.e. to use the applications effectively, it is required to train team members on how to use them and how they can help solve specific problems;
- Constantly analyze processes, that is,

to get the most out of these applications, it is required to constantly analyze processes and deliverables to identify weak points and determine ways to improve them.

In general, optimizing these applications involves analyzing the project's specific needs, selecting the most appropriate applications, customizing them for specific project needs, training team members, and continually analyzing processes and results.

Although there have been recent geopolitical challenges, oil production in Kazakhstan has seen a positive growth trend in 2021, with a total of 85.9 million tons produced (23% of which was consumed domestically), while gas production amounted to 54.2 billion cubic meters. Over the past 30 years, Kazakhstan has increased oil production 3.5 times, and in 2021 its rank was 13th by production, in the world (2% of global production) (Fig.1).



Figure 1: Oil and condensate production dynamics, million tons

Karachaganak Petroleum Operating B.V, North Caspian Operating Company B.V. (NCOC), and (KPO) Tengizchevroil LLP (TCO), are the most significant development and production projects in Kazakhstan. TCO produces about 600,000 barrels of oil per day, which is 40 percent of the country's total production, and plans to reach production of 1,000,000 barrels per day in the next couple of years upon completion of an expansion project at the Tengiz field. The benefits of implementing digital tools and technologies to support successful turnaround activities at refineries in Kazakhstan should be noted. During the turnaround, production stops so equipment can be inspected and repaired. The turnaround also includes measures to upgrade

or improve equipment. These activities take years of planning and preparation. Technology helps us prepare more effectively for major turnarounds (Jusan Analytics, 2022).

One such digital implementation is the Salesforce platform. Salesforce provides a unified records platform. The ability to access data in one place has proven to be very convenient and useful, and the reporting features make it easier to allocate responsibilities and make decisions. Preparation and planning of large mega turnarounds begin in advance with a phase-by-phase approach, the start date and duration of each phase being determined by the complexity and project large scale. There is an

approach with 7 phases of preparation and planning demonstrated in the Figure 2.

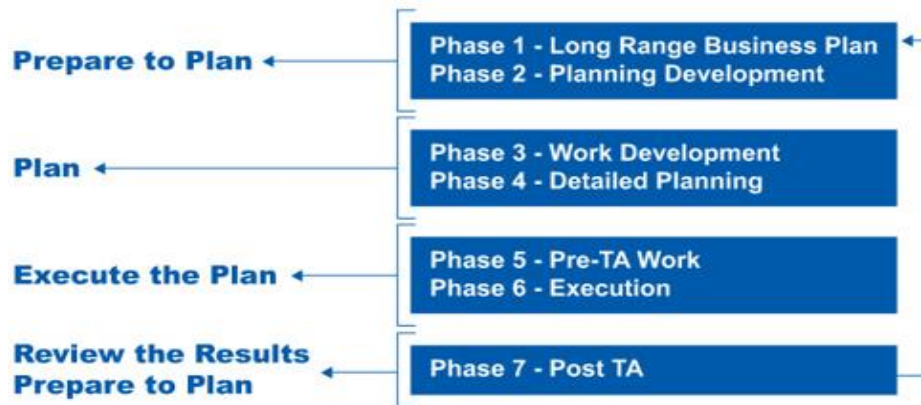


Figure 2: Seven phases of planning and preparation

A critical aspect is a timely communication to stakeholders in submitting the scope of work to the Salesforce platform at the start of Phase 2 (development and planning) 18 months prior to the start of work on the site. The platform digitally enables tasks in all 7 phases and expands intelligence capabilities. A cloud-based application that provides a one-stop solution for turnaround planning, performance tracking, and knowledge sharing across the enterprise.

Efficiency factors:

- Eliminates manual data entry and updates;
- Creates a single pattern of correct information;
- Improves consistency between departments;
- Increases visibility of turnaround work list, cost status, and planning;

- Increases management and staff engagement.

Key platform features:

- Strategic objectives from phases one through seven are built into the digital workflow;
- Work list, planning tasks, studies, cost estimates, and SME evaluations are all stored in one common system;
- There are a number of features that allow to capture of lessons learned, risk logs, and action items and link them to specific projects for further detail and analysis;
- The reporting and dashboard functions provide any team member with easy access to information on the status of project readiness (Fig. 3);
- Web app is available on mobile devices.



Figure 3: Salesforce app dashboard

One of the key features of the platform is a built-in prioritization tool based on integrity and reliability factors (RIPT). RIPT is a prioritization tool used to aggregate large amounts of inputs and help identify the most needed work and also offers a recommended sequence of execution to decision-makers. It

must be borne in mind that the quality of the information provided will depend on the quality of the data entered. Given the data entered, the RIPT uses a number of criteria to assign jobs to priority levels A, B, C, and D while assigning a serial score.

Table 1: Criteria for assigning jobs to priority levels A, B, C, and D

RIPT Threshold		
A	Compliance	External obligations with a specific due date that is rigid or already agreed upon with external parties
B	Strategic	Critical few projects, typically approved by business unit leadership. When possible, these projects should be prioritized by other criteria (compliance, risk reduction, economics).
C	HES Risk Efficiency	Efficiency ≥ 15 Risk Units/USD
D	All	If A, B, or C criteria is not met

RIPT key factors - risk, strategy, and compliance drivers (RSC). RSC Drivers capture what is known about the project:

- Risk Man Score - Tool assigns letter designation per the RIPT Thresholds. Other criteria in the tool can only enhance scores, and never decrease.
- Risk Man Category - Weighting is given (Public H&S, Workforce H&S) to enhance the Risk Man score).
- PSRR (Process Safety Risk

Reduction) - Weighting is given, if the PSRR score exists, to enhance the Risk Man score.

- Compliance - If yes, the tool assigns an “A” designation. Other criteria in the tool can only enhance scores, and never decrease. If no, other criteria will determine the score.
- Strategy - If yes, the tool assigns a “B” designation. Other criteria in the tool can only enhance scores, and never

decrease. If no, other criteria will determine the score.

Based on the inputs to the tool and the analysis performed in each section on the previous slides, RIPT produces an overall letter designation and a Seriatim score. The RIPT simply attempts to highlight the right work for execution, using set criteria. Decisions to fund or not fund will be made by Business Unit Management.

It should be noted that more than 1,670 work requests were received by conducting a study on turnaround preparation and planning in the past eight months. Following a phase-by-phase preparation strategy, RIPT sessions were carried out for all provided scope of work. As a result, the team was able to reduce the time for validation and freeze the scope of work by 2 months earlier according to previous practices, thereby freeing up more time for detailed work planning. During these sessions, the team could screen more than 318 work requests (Fig. 3), these requests did not meet the basic criteria of safe plant operation, and implementation was not cost-effective for the company.

Thus, by using a Salesforce digital platform and Minimum Functional Objective thinking, the economic benefit of these activities was - \$ 16 million (Figure 3), more than a thousand saved man-hours and personnel safety by assigning manpower only to really significant work. I would like to give an example from 2005 when a 3 bedroom, 2 bath house with 2 car garage was built in Tyler, Texas, and all of this work was done in 3 hours. The conclusion of this event is not to build a house in the shortest period, but to create a new mindset of building (Brynjolfsson & McAfee, 2017).

TA Pro app allows tracking and updating work progress in real-time. Gives planning engineers more time to perform progress assessments and

provide guidance on the strategic areas. There is no need to print a large volume of schedules, and it saves time on updating information from the work site to the office before entering it into the program and allows management to analyze the progress of priority work, to make strategic decisions based on quality information from the work site. During the execution of Phase 5 (execution phase), the work is carried out 24/7 day and night shift, a shift of 12 hours for the main staff and a 13-hour shift for responsible persons, which goes against the labor laws of Kazakhstan and requires a special memorandum and the consent of employees. 1.5 hours before the shift change between the day and night shift and the start of the meeting with the main decision makers for the next shifts, there was an update on work progress completed on the schedule for shift passed with a queue of representatives from several business partners who came with piles of papers to update the schedule. This interval can be called a “race against time” as during this rush hour, the work progress of dozens of columns, separators, heat exchangers, many work packages, and hundreds of valves needs to be updated incredibly quickly (Su et al., 2023).

Ensuring accurate work percentages data entry is a very important factor in making strategic decisions to prioritize work and allocate human resources and equipment. Each work shift spent more than 1 hour updating the schedule and critically little time to be left to analyze the critical path and provide effective recommendations and suggestions to management to optimize the work. The situation changed dramatically for the better when mobile devices with the installed application have been implemented. Business partner representatives up to a certain hour of each shift, the best practice is to make updates up to 4 hours of each shift to the work schedule with mobile tablets. Entering the percentage of work completion is shown in Figure 4.

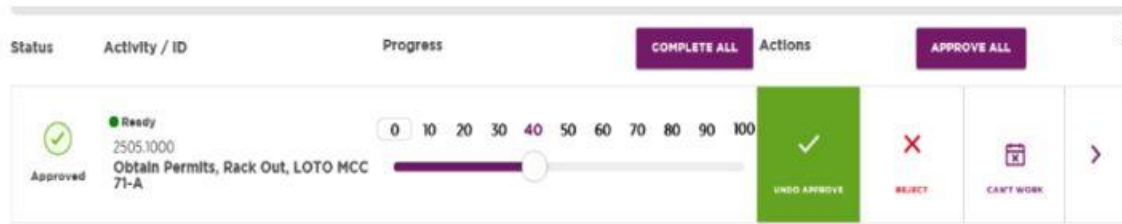


Figure 4: Illustration of entering a percentage of the work performed in TA Pro app.

Of course, the progress of critical work must be monitored very closely and only up-to-date information must be entered independently if there is field experience, or specialists must be involved. As a result, when approaching the peak hour, it was possible to only click on the data synchronization button and the program gave the user a recalculated graph with updated data for all equipment units.

After some time, it became apparent that this digital initiative does have a positive effect. Conducting a survey with business partners who used the application, we were able to get feedback, which mainly included a request to show full information about the work, i.e., representatives of business partners wanted to see information about the progress of the project, with a delay or ahead of schedule one or another business partner.

One high-performance digital product is TA Notes, an application to report shift change that allows for improving communication and changeover processes, therefore improving overall efficiency. The app is mobile and can be used by all project participants. The convenience lies in the fact that the management can get the necessary information on any piece of equipment at any time by going to the application and selecting the equipment of interest.

In 2022, there were 3 fatalities by TCO contractors and subcontractors at the Tengiz field. Such incidents are tragic and unacceptable, and the oil and gas industry should learn a lesson from this incident to further improve safety systems. The reliability, Maintenance, and Turnaround product line department is launching a new Pneumatic Work Capture and Assessment (PWC) tool, a platform based on "PowerApps" designed to

increase the overall safety of work performed with pneumatic equipment on Base Operation Projects and Future Growth Projects. As the owner of this product, in the shortest time possible, together with the IT team and under the guidance of a safe production operation program within a unified company, the PWC&A tool was released to provide visibility of work performed with pneumatic equipment, collecting information to improve the applicable review, approval and verification activities.

Activities are not limited to pneumatic strength tests and some additional examples include operational hydraulic tests, leak tests, air purges, and steam purges. The purpose of implementing this tool: the company values safety. In retaliation to recent incidents, the company's unified program on safe operation will work across all facilities and every site to follow safety procedures. The goal of every employee is to foster a culture of safety and ensure that there are never more fatalities in day-to-day operations. During work analysis, it was determined that significant enhancements could be made to improve the visibility of pneumatic equipment work being performed at Tengiz field and readiness to safely perform this work. The goal is to use a digital tool to make this activity visible and ensure that permits and assurances are in place before work begins.

Expected Benefits:

- The system is easy to use to understand the pneumatic work scope.
- Ability to generate reports in Power BI - Clarity of requirements to obtain approvals.
- Checking safety precautions before work starts.

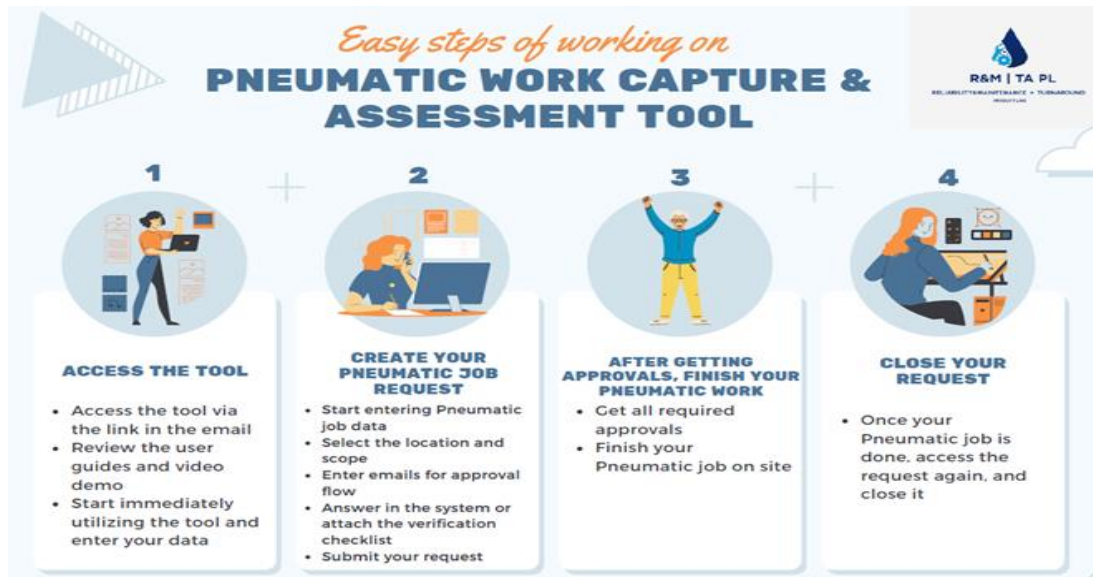


Figure 5: Main navigation actions in PWC&A

At the moment, the tool is not used due to the lack of additional resources to maintain the tool. Digital tools such as Salesforce, PWC & A, TA Pro, and TA Notes, promote safe turnaround on schedule and budget and potentially standardize plant operations processes to help the company win under any difficult circumstances. A significant amount of time was spent on the inspection of the work site based on the practice of past years. It took time to do all sorts of inspections, get the paperwork to the office, uploads it to the database, and wait for the results. MISTRAS Digital® has developed fieldwork software and tools that can be integrated with inspection database management systems (IDMS) and commercial maintenance management systems (CMMS). This integration creates a fully connected centralized database that eliminates the need for manual entry of inspection data. With this system, businesses can receive immediate notifications and real-time access to all completed actions, allowing them to identify bottlenecks and reduce delays in the verification process. Additionally, the system's cloud-based storage allows for easy access to large amounts of data from any mobile device, at any time and from anywhere. Data analytics are needed to monitor equipment performance before unforeseen catastrophic failures occur. The combination of the above technologies gives a company the following advantages:

- Rather than relying on manual checks, assets and processes can be monitored in real-time.

- This allows authorized parties to access organized, secure, and up-to-date data for reporting and informed decision-making.
- Additionally, stakeholders can use this system for instant communication to report any maintenance or equipment verification issues.

Using manual, paper-based verification processes can often lead to errors and inaccuracies in reports. With MISTRAS Digital, the goal is to optimize refinery operations which will result in more transparent work processes, improved quality and safety, and maximum compliance. Specifically, the platform offers the following benefits. One can plan and schedule inspections based on a set schedule, and all data can be sent electronically to be tracked in the database. This includes information on the status of the data, such as whether it's verified, approved, or still in progress. Additionally, any physical documents, such as photos, drawings, permits, and occupational safety/workplace hazard analyses, can be easily accessed through a readily available electronic record. Mobile devices can also be used to quickly photograph equipment and upload the images to a centralized platform. All reports, quality reviews, IDMS data, project tracking, and key performance indicators can be entered electronically and are immediately accessible to staff on any device. You can easily access this information through the client application

or over the internet via cellular or Wi-Fi, even when offline, for greater flexibility in all work environments.

The innovative platform is designed to provide personnel with real-time information about all assets, ensuring safe and efficient refinery operations at peak performance. This application takes advantage of cloud computing, energy analytics, and Internet of Things sensors to modernize the inspection process from planning to sign-off. With MISTRAS Digital, control, maintenance, and reliability groups are integrated into one centralized platform for real-time information exchange. Data is automatically pulled from IDMS and used to track the conditions and status of pre-inspection work, which allows for effective planning and scheduling. The system also allows for third-party contractors to be scheduled to carry out necessary work.

MISTRAS Digital offers a cloud-based reporting platform that employees can access anytime, anywhere through their mobile devices, and get the following benefits from the platform:

- The software generates KPIs for business unit leaders to make informed decisions for improvements (Mittal et al., 2017).
- Inspection personnel can submit reports directly to IDMS, eliminating redundant data entry, with any delays or anomalies notified to stakeholders.

The deep integration of industrial technology and information technology introduces innovations in the organization of production and work methods, causing industrial solutions and traditional industrial modernization with the emergence of new industries, new formats, and new models. To achieve industrial transformation and growth, it is essential to effectively implement digital technologies like IoT, cloud computing, 5G, big data, artificial intelligence, and blockchain. These technologies can aid in business model restructuring, management model reform, and innovation of core competencies. By utilizing these tools, businesses can upgrade their value growth and stay competitive in the market. It's important to recognize the potential of these technologies and leverage them to achieve

success in the modern digital landscape (Tarasov, 2018, p. 64).

As the speed of information spread, intelligence increase, big data, as well as cash flow has become the lifeblood of enterprises. Each piece of data is like a neuron in the enterprise's brain, recording various resources and activities. Data has no doubt become one of the significant strategic resources for businesses as well as society, responsible for production, operations, and management activities. Without efficient data transfer and usage, digital transformation cannot occur, and other operations will suffer. The oil and gas industry can benefit significantly from data sharing, including internal enterprise planning, purchasing, production, sales, and refers to various types of data, including financial data, as well as data related to the value chain. This value chain data encompasses production, refining, transportation, sales, storage, and marketing. External market supply and demand, price adjustments, and political environment changes are also essential data points. With vast potential and value, data sharing is crucial for the oil and gas industry to achieve digital transformation and stay competitive in the market (Mittal et al., 2017).

Complete data sharing can significantly improve asset value while transforming decision-making methods and business operations from traditional as well as manual type of statistical calculations and then having empirical analysis to get an accurate analysis based on models, data, and systems. This efficient analysis supports optimal resource allocation, forecasts for efficient market performance, and production, processing, transportation, sales, storage, and trading relationships to maximize overall company benefits. By utilizing complete data sharing, businesses can enhance their operations and decision-making processes, leading to improved efficiency and profitability (Su et al., 2023).

As technology continues to advance and integrate into our daily lives, various applications are becoming more prevalent. For businesses, it is crucial to maintain data authenticity, privilege, validity, and compliance with business requirements when analyzing data. Implementing data

management with uniform criteria and quality will offer an institutional guarantee for application exchange between different enterprises. In their book, author Bhansali highlights the importance of data governance, explaining that it can help organizations in so many ways, like helping them to manage their data more efficiently, reduce information usage costs, improve compliance and control, and create high-quality data. By adhering to data governance norms, businesses can ensure that their data is properly managed, leading to improved compliance, cost savings, and high-quality data (Bhansali, 2013, p. 8).

3. HIGH QUALITY DATA CAN BE IMPROVED ONLY THROUGH DATA MANAGEMENT

It is essential for businesses to integrate data management with various business units, not just the IT department. Oil and gas companies' current business information systems suffer from multiple data collection, inconsistent data standards, repetitive data entry, as well as poor data quality, that is known to severely limit the level of data exchange and impede the company's digitalization. Additionally, technology platforms have inconsistent specifications, lack adaptability, and are challenging to integrate and share. Data is scattered, making it difficult to search with incompatible standards, repeating records, and inconsistent data (Evans, 2022).

Data Governance advocates for standard, quality, secure, and collaborative data management guided by co-creation, sharing, and collaborative data management. It ensures the organization, system, and process operation. It is also critical to organize relevant parties to jointly perform data management activities and encourage them to establish a company data management system, improving data management capabilities. Data management activities should be divided into advanced information systems and data storage, built into the entire system lifecycle. By implementing data governance norms, businesses can streamline their data management processes, leading to improved collaboration, data quality, and organizational efficiency (Evans, 2022).

To promote high-quality advances in data management, all parties involved must work together to create a new corporate data management model based on “co-creation, co-management, and co-sharing”. Currently, the oil and gas industry faces several challenges in the process of forming, processing, and applying data for various reasons. To overcome these challenges, there is a need to accelerate the construction of a data management system that includes a centralized data management department, standardized data management, metadata and master data, and regular assessments of data management capabilities. Additionally, it is essential to strengthen the collection of dynamic data throughout the industry chain and create a comprehensive system of data collection, transfer, and aggregation that covers the entire business chain. To achieve this, systematic thinking and systematic solutions must be applied, and policies must be implemented concerning concept, organization, management, and technology to comprehensively improve data management capabilities. By taking a collaborative approach and implementing sound policies and practices, the oil and gas industry can overcome its data management challenges and achieve greater efficiency and success (Weber, 2007).

A data management system has been proposed by many foreign scientists during their research. For instance, Wende's framework model identifies various areas of decision-making and their corresponding roles (JSC NC, 2021). This model's most significant contribution is creating accountability for data quality within organizations. While the decision-making domains and roles proposed by Wende are useful for structural configuration of data management, there is no evidence of its effectiveness in various organizational scenarios. The most powerful decision-making data management model is the one proposed by Khatri and Brown. Their structure outlines five decision areas: data criteria, quality, metadata, access, and lifecycle, and defines the type and scope of decision areas. This model proposes different levels of decision-making authority, such as centralized, decentralized, and shared, within the same organizational decision-making area.

Additionally, it provides a common language of standard terms, making it widely applicable in subsequent studies (Hansmann et al., 2022).

A data management system focuses on data standards, quality, security, and sharing and ensures organizations, institutions' operations, and processes according to recommendations for collaborative data creation, sharing, and joint data management. This system, supported by a data management platform, is an innovative mechanism for analyzing and sharing data integration. Thus, Blockchain technology can help create data management systems and management capabilities in the oil and gas industry (Bouncken & Barwinski, 2020, p. 100).

Transformation places significant emphasis on developing digital and project skills, as well as motivating employees. For example, in the Lean 6 Sigma (LSS) program implementation project, employees of mining enterprises of the KMG group are trained with further certification. A total of 13 LSS projects have been implemented in oil production in 2021, which brought benefits amounting to 72 million tenges. Previously, the LSS project was successfully implemented at the refinery. Since 2016, 156 projects have been implemented at refineries with a total direct

economic effect of 1.2 billion tenge due to reduced consumption of reagents and steam, reduced electricity consumption, and reduced equipment repair costs. 89 employees have been trained and certified. "Qazaqstan Project Management Awards" National Competition recognized the project "Implementation of Lean 6 Sigma in Oil Refining and Petrochemicals Business Area" as the best project of 2021 in Kazakhstan (Teece, 2010, p. 172).

Technical readiness of enterprises in Kazakhstan for transition to digital technology is largely determined by the basic level of production automation and, in particular, the availability of PCS (process control system), PDM and ERP (enterprise resource management system), ECMAS (Electricity Commercial Metering Automated System), MES (production management system), MRO (maintenance and repair), electronic document control, where there is a difference between industries (Table. 2). The enterprises digitalization level remains low: only 20 enterprises showed above average (19% of surveyed enterprises, the leading one - mining and metallurgical complex), 24 enterprises - average (22%), 63 enterprises - low (59%) (Usmanov, 2022).

Table 2: Information systems implemented in Oil and Gas enterprises in the Republic of Kazakhstan

Item	Industry/number of enterprises surveyed	
	Oil and Gas Industry	Power Industry
Number of business processes automated	23	8
Number of enterprises with automation service department	7	2
Number of systems/software implemented	17	6
Number of enterprises allocated expenses for digitalization training of employees	5	0

Digital transformation barriers in enterprises are caused by:

- Limited cybersecurity, unauthorized access, data leakage; difficulties in complying with digital standards, and regulations;
- Limited availability of new technology solution providers;
- Low competence of employees in the IT sphere;
- Problems with the financial resources to invest in digitalization, sufficient infrastructure for digitalization, a clear vision of the benefits of its development.

An enterprise needs a specialist-analyst, who knows how production works, what the problems are, and how to properly form the task for IT colleagues. The speed of digitalization is influenced by the scale and specificity of production, industry, the work of individual organizational units, and the coherence of their interaction. Therefore, data management activities must be carried out with all relevant parties. Data management actions should relate to advanced information systems and data storage and be built into the entire system lifecycle to jointly address unresolved data issues to make possible improvements in the quality of data resources from the given source. As a result, all parties involved can share high-quality data and create a new “co-create, co-manage and co-share” data management model for the company (Dikhanbayeva et al., 2021).

To facilitate the oil and gas industry, with its process of digital transformation, it is crucial to actively support several initiatives such as encouraging research and development related to the blockchain technology. Ongoing iterative construction, and updates must be carried out to make sure that the efficiency and quality of data management is intact. Additionally, a commitment to the concept and culture of co-creation, sharing, and collaborative data management is necessary. The industry’s digital transformation can be achieved through three aspects: development of standards, application of scenarios, and technology development. This will promote the widespread and standardized use of blockchain technology keeping the oil and gas industry in the context, leading to the implementation of all elements relevant to the data management system. By embracing blockchain technology and adopting a collaborative approach to data management, the oil and gas industry can realize the benefits that can be obtained through the adoption of digital transformation and achieve greater success (Evans, 2022).

4. CONTRIBUTION AND FUTURE RESEARCH DIRECTION

This study significantly contributes to the existing literature by illuminating the tangible impact of digital applications on project

management practices and data handling within the oil and gas sector. With the help of empirical evidence, it underscores the transformative potential of digital technologies within this context, suggesting a variety of applications that can streamline project management processes, thereby increasing efficiency and effectiveness. Moreover, the study also brings to light the challenges that organizations encounter while leveraging these novel technologies. It presents these hurdles not as deterrents but as opportunities for improvement, thereby offering invaluable insights for industry practitioners and policymakers alike, with the ultimate goal of catalyzing successful digital transformation in project management within the oil and gas sector. As we look towards the future, several promising research directions emerge. First, there is a need to investigate the impact of growing technologies such as artificial intelligence, machine learning, and blockchain on project management within the oil and gas industry.

These technologies, with their expansive potential, could further optimize project management processes and data handling, transforming the way the industry operates. Secondly, a more extensive and diverse set of case studies can be conducted to understand the applicability and effectiveness of digital applications in various contexts within the industry. The research can provide a more nuanced understanding of how digital transformation by examining a wider range of scenarios and situations that manifests in different environments. In the end, future research could also focus on formulating strategies to overcome the identified challenges in adopting digital applications for project management in the oil and gas industry. It can provide actionable guidance for industry practitioners, enabling them to navigate the complexities of digital transformation and harness the full potential of digital applications in project management.

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