Using SWOT Analysis to Develop a Strategy for the Transfer of Intelligent Oil Fields Technology in Iran

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Abstract
Oil and natural gas are the main industries in the energy market and play a critical role in the global economy. This industry is improved due to technological advancements, and new technologies are applied for better exploitation and increased profitability. When dealing with shared oil reservoirs, the importance of this issue becomes more apparent. This paper describes a SWOT carried out to plan the strategy for the transfer of intelligent oil fields technology in Iran. Several potential solutions may be pursued to enhance the transfer and implementation of intelligent technology in Iranian oil fields. These may involve the establishment of oil field development contracts with neighboring countries to manage shared fields collaboratively, the avoidance of conflicts of interest in equipment supply contracts, the implementation of legal requirements mandating the adoption of intelligent field technology by oil companies, the provision of investment incentives, and the hiring of information technology and network specialists. By implementing these measures, it is anticipated that the overall efficiency and effectiveness of oil field operations in Iran will be significantly improved.

Keywords: Oil industry; strategy; technology transfer; intelligent oil field; SWOT

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Introduction

This study aims to develop an ideal strategy for the transfer of intelligent oil fields technology in Iran, taking into account the most suitable technology transfer techniques for the oil sector and using the SWOT analysis.

The cost of employing intelligent well technology is a crucial factor. Consequently, it is essential to exploit the advantages of this technology with its applications in various instances and processes (Ranjith et al., 2017; Temizel, Canbaz, Alsaheib, & Monfared, 2020). In a study (Mass, 2016) the NPV of the ideal well with intelligent completion found to be 40% greater than the NPV of the optimal well with traditional completion.

The oil sector is seeing a new wave of digital fields and a rising consensus towards intelligent operations and predictive maintenance (Temer & Pehl, 2017). Organizational structure influences the capacity to comprehend the benefits of integrated operations and digitalized assessments (Devold, Graven, & Halvorsrød, 2017). Through improved asset monitoring and maintenance forecasts, operators can boost productivity and cut operating costs (Wanasinghe et al., 2020). The workforce's structure, culture, and skills also need to change simultaneously. One of the obstacles to this is the underestimation or disregard of the need to modify work processes, including the operation model (Choubey & Karmakar, 2021; Ershaghi, Paul, Hauser, Crompton, & Sankur, 2016). Massive data sets, powerful analytics, and complex systems that govern everything from reservoirs to surface equipment have altered oilfield operations.

The adoption of intelligent well technology increases output (Spitz, 2019). Three criteria determine the value of oil reservoir intelligent technology: the decrease in water production; an economical oil production rate; and time-saving equipment (Oladepo, Ako, Orodu, Adeleke, & Fadairo, 2019). Intelligent well technology permits the regulation of well flow to minimize water output and expenses (Lizcano, de Sousa Ferreira, & Moreno, 2020; Pinto, Herrera, & Angarita, 2018).

An intelligent well without an effective reservoir management plan does not always result in positive outcomes. Improving the efficiency of the reservoir beyond individual well efficiencies necessitates seeing the broad picture at the field level. It is insufficient to get reservoir-level details in isolation from the field-level context (Cao, Zhang, & Johansen, 2019). The non-productive time (NPT) is another significant obstacle for oil and gas firms (Mabkhot, Al-Ahmari, Salah, & Alkhalefah, 2018; Temer & Pehl, 2017). Identifying the causes of NPT and its negative effect on operations reveals chances for ongoing development (Wanasinghe et al., 2020). The predominance of subsurface tool failure demonstrates the need for a more comprehensive maintenance approach. There are still obstacles to overcome, which include attitude, data quality, and Industrial Internet of Things (IIOT) device security risks (Temer & Pehl, 2017).

Intelligent fields enable team members and their coworkers to coordinate actions in real-time. According to (Al-Kadem, Gomaa, Al Yateem, & Al Maghlouth, 2022), remote control reduces the number of times equipment must be transported to continue an activity. It reduces the requirement for human interaction and reduces the cost of logistics categorization.

Strategic planning is identifying, articulating, communicating, and controlling strategy execution. When examining the impact of strategic decisions on organizational performance, it is crucial to pay close attention to the features of strategic planning (Arend, Zhao, Song, & Im, 2017; Zaim, Muhammed, & Tarim, 2019). Strategic priorities are typically developed as strategic processes rather than discrete decision-making activities (George, Walker, & Monster, 2019; Wolf & Floyd, 2013). Strategic management assesses and executes effective decisions to assist project teams in attaining long-term goals (Ganguly, Talukdar, & Chatterjee, 2019). The environment can influence strategic decision-making. Multiple external and internal elements affect the achievement of any organization or undertaking.

A comprehensive assessment of an organization or region can be conducted through a SWOT analysis. This evaluation method considers the entity's strengths, weaknesses, opportunities, and threats while also considering its historical performance, present state, and future potential. Such an analysis can provide valuable insights for decision-making and strategic planning purposes (Pickton & Wright, 1998; Vlados, 2019). Using SWOT analysis, an study (Xingang, Jiaoli, & Bei, 2013) determined the status of shale gas in China. A study (Azubuike, Songi, Irowarisima, & Chinda, 2018) evaluated the legal difficulties and key policies for Algerian shale gas expansion. Another study (Hajizadeh, 2019) investigated the potential application of machine learning in the oil and gas business. The results showed that the industry needs to focus on tactics and make data collection teams that can move quickly.

2 Methodology

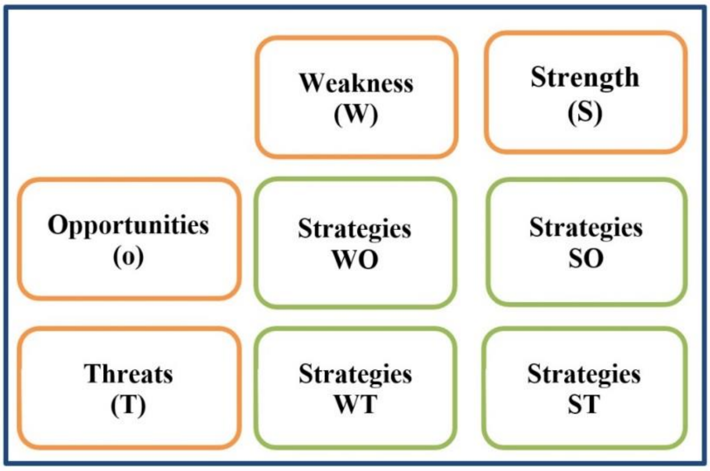
The information gathered in the preceding steps, such as surveys, interviews, and economic calculations, is used to make a strategy with the SWOT approach. Thus, based on the findings of surveys, discussions, and financial analyses, strengths, weaknesses, opportunities, and threats are recognized and expressed, and relevant research methods are proposed.

Using the SWOT analysis approach, this research identified the stakeholder engagement strategies for the organization to increase the current strengths and opportunities and decrease and remove the existing threats and weaknesses by designing relevant strategies. The following procedures were carried out to construct the matrix of threats, opportunities, weaknesses, and strengths to develop the strategy for deploying intelligent oil fields in Iran:

1. Making a list of significant prospects in the external environment
2. Compilation of a list of the external environment's significant risks
3. Creating an Inventory of Internal Assets
4. Compiling a list of internal defects
5. Comparing internal and external strengths and opportunities and recording the group's findings
6. Comparing internal deficiencies to external opportunities and documenting the results within the WO strategy group
7. Comparing and documenting internal and external strengths and weaknesses within the ST strategies group
8. Comparing internal vulnerabilities to external threats and recording the findings within the WT strategy group

The required information for constructing the SWOT matrix is acquired through the responses to surveys and interviews. Following the above mentioned processes, the suitable solutions for modernizing Iran's oil fields are articulated. Figure 1 illustrates an example of a SWOT matrix.

Figure 1: Sample SWOT matrix



3 Results and Discussions

Using the SWOT analysis to develop a plan to transfer intelligent oil field technologies Using surveys, interviews, and economic calculations, the SWOT approach was used to create a plan. It is done to identify the organization's strengths, weaknesses, threats, and opportunities so that relevant data strategies may be developed. Therefore, based on these statistics, the followings are the strengths, weaknesses, opportunities, and threats:

3.1 Strengths

The findings of a recent survey indicate that there is potential for implementing intelligent technology in Iran's oil fields. Interviews with industry experts reveal that many of the oil fields in Iran are relatively young and underdeveloped. By conducting thorough research on these fields, it may be possible to develop intelligent solutions that could help to improve their performance. One promising avenue for exploration is the creation of automated safety valves for wells, which was suggested during one of the interviews. A summary of the strengths identified during the survey can be found in Table 1.

Table 1: Summery of strengths factors

Agent type	Excerpts from the description
Strengths	• Opportunities to use intelligent technology • Conduct extensive research on intelligence • Existence of young and less developed fields suitable for implementing intelligent systems • Production of automatic well safety valve in Iran

3.2 Weakness

The initial survey results indicate that Iran's intelligent oil fields face a significant challenge in convincing managers to adopt intelligent technology. Furthermore, subsequent surveys have revealed that the low Technology Readiness Level (TRL) and inadequate integration of advanced technological solutions in the exploration and production of oil reserves represent additional obstacles. Semi-structured interviews conducted to obtain further insight have indicated that Iran's oil reservoirs are encountering several challenges, including limited refinery capacity, aging oil reservoirs, constraints in reservoir selection due to internal consumption, and water, sand, and pressure drop production. The interviews have also unveiled that the primary obstacles to the intelligence of oil fields technology intelligence of oil fields include managers' resistance to change, reluctance to take risks in utilizing new equipment, insufficient focus on offshore fields and optimization, inadequate oil and gas reservoir recovery, reduced production in certain wells, and skepticism regarding the long-term advantages of intelligence.

Based on the feedback received during the interviews, it has become evident that using intelligent equipment in the oil industry poses several challenges. The malfunctioning of outdated equipment, the incompatibility of specific equipment with the installation site, and the decision-making process of top management through correspondence are among the challenges faced. To address these challenges, the interviewees have recommended considering the lack of foresight during drilling, handling, and planning, considering the current workforce's situation, and prioritizing long-term return on investment.

During our research and data gathering, we conducted two structured interviews in the final stage. The first interview was focused on assessing the operational integrity of an Oil and Gas Company, which revealed the need to implement a management information system at the well level. Additionally, we identified issues related to the field and decision-making by top management and communication. The second interview addressed the business intelligence and competitive advantage of the company, which led to the identification of several weaknesses. These included the absence of a workforce warning system in the wells, reliance on daily monitoring to identify problems, production delays when issues arise, prolonged analysis time for well problems, and the need for predictive solutions to anticipate issues before they occur. For a brief and concise summary of these weaknesses, please refer to Table 2.

Table 2: Summery of weakness factors

Agent type	Excerpts from the description
weakness	• It is not currently utilizing intelligent technology due to its low TRL level of intelligence. • It can be challenging to persuade managers to adopt intelligent technology, as they may resist change, need more faith in the long-term advantages of such technology, and may be hesitant to take risks associated with investing in new equipment for a long-term return on investment. • Aging of some Iranian oil reservoirs as a result of the production of water, sand, and pressure drop in the reservoirs • Limitations in the choice of the reservoir due to internal consumption and the limit of the capacity of refineries • Lack of attention to optimization and lack of adequate oil and gas reservoir recovery • Considering the decrease in production in some wells, not paying attention to offshore fields • The non-compliance of some equipment installed in the past with the management of the place of installation and use of the equipment, and on the other hand, the failure of this old intelligent equipment • Adopting intelligent systems in drilling without having an intelligent vision • The status of current working personnel when adopting intelligent systems • The management information system is not being used at the well and field level because of the manual development and exploitation system. It is due to decisions made by top management and communication issues. • Lack of workforce warning system in the wells • They notice the problem in the well only by monitoring it every day, and on the other hand, the long time to analyze the situation of the well causes a delay in production when the problem occurs, which is due to the lack of predicting the solution before the problem occurs.

3.3 Opportunities

The initial survey results suggest that joint cooperation and reverse engineering methods facilitates the transfer intelligent technology in Iran's oil fields. Based on the semi-structured interviews conducted, it is recommended to employ horizontal drilling and multi-branch wells for optimal exploitation of Iran's oil reservoirs. The interviewees' experiences indicate that building a well-embedded pump in Iran is feasible.

Using intelligent technology in oil fields offers numerous benefits, including extracting from multiple layers of a reservoir through intelligent equipment, preventing unwanted water and gas from entering the well column, and increasing well productivity by 1 to 3 percent. Intelligent equipment also enables well integration, facilitates real-time decision-making, and has been validated by the parliament's energy committee. The profitability of intelligent technology at the field scale has been confirmed, and it reduces the number of required wells.

Implementing intelligent technology has a significant positive impact on production, income, and profit. It presents a promising opportunity to establish an appropriate strategy for managerial accountability. Table 3 provides a summary of the potential opportunities.

Table 3: Summery of opportunities factors

Agent type	Excerpts from the description
Opportunities	• Transfer of technology to through joint cooperation • Technology transfer through reverse engineering given the local expertise in building interior well pumps in Iran • Horizontal drilling and multi-branch wells • The possibility of production from multiple layers of reservoirs using intelligent equipment prevents unwanted water and gas from entering the well column and, as a result, increases the wells' productivity by 1 to 3 percent. • Integration of wells using intelligent equipment that makes real-time and accurate decisions. • There has been confirmation of the benefits of adopting intelligent systems in the parliament's energy committee. It can result in managers being held accountable by their superiors for delays in implementing new technology. • The profitability of adopting intelligent systems in oil fields reduces the number of wells and increases the production time, which leads to a significant increase in production and subsequent increase in income and profits.

3.4 Threats

Following an initial survey and a series of semi-structured interviews, it was determined that the primary obstacles to implementing intelligent oil field technology in Iran are the current suppliers and inadequate equipment. The financial burden of completing wells and the prevailing economic challenges were also identified as significant hindrances. Of particular concern are foreign contractors' specific oil field development projects, which have yet to be realized. A summary of the identified threats is provided in Table 4.

Table 4: Summary of threats factors

Agent type	Excerpts from the description
Threats	• Current suppliers and lack of the equipment • More expensive intelligent completion of wells and economic problems • There were instances where foreign contractors left specific oil field development projects incomplete.

In the following, nine strategies are defined and presented as suitable strategies by the researcher, shown in Figure 2.

Figure 2: SWOT matrix

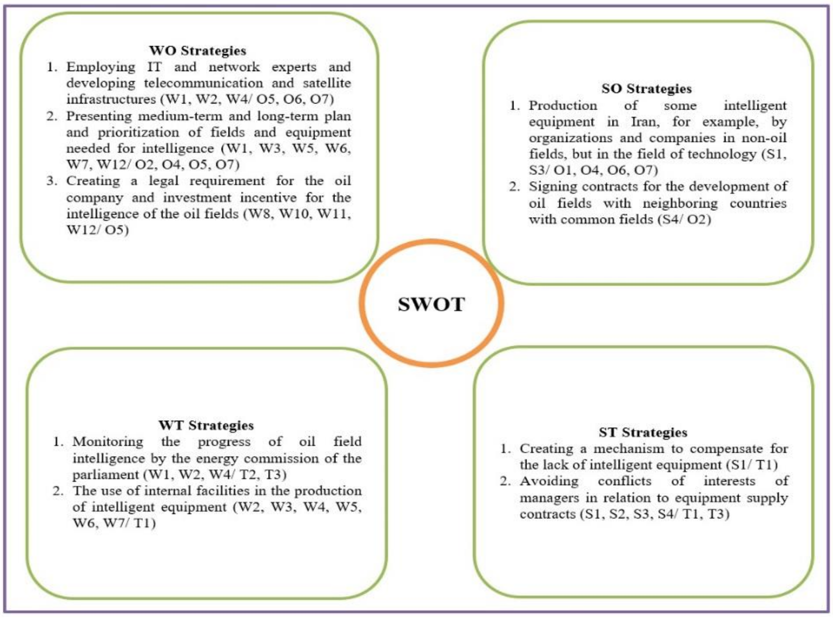


Table 5 outlines a range of techniques and associated inquiries that support the development of oil fields through contract negotiations with neighboring countries that share these resources. Another strategy involves the creation of intelligence equipment specific to Iran, which technology-focused organizations and businesses outside the oil industry can facilitate. Additional efforts include devising methods to circumvent sanctions, as well as departing self-interest managers from equipment supply contracts. Moreover, a legal mandate for oil companies and incentives for investment in oil field intelligence will be established, along with the presentation of medium- and long-term strategies. To optimize productivity, fields, and equipment will be ranked, and the expertise of IT and network professionals will be sought to advance telecommunication and satellite infrastructures. Lastly, the Energy Commission of Parliament will monitor progress, and domestic energy sources will be utilized to produce intelligent equipment.

It is highly advisable to adopt a multifaceted approach to oil field development,which entails collaborating with neighboring countries that share similar fields, assigning efficient managers overseeing equipment supply contracts, adhering to legal mandates governing oil companies, providing investment incentives for oil field development, recruiting seasoned IT and network specialists, and bolstering telecommunication and satellite infrastructure. Additionally, it is recommended to leverage internal resources to produce sophisticated intelligence equipment.

Table 5: Strategic issues and proposed strategies

trategy numbe r	egion	The question	The strategy
	O	How to take advantage of opportunities 1, 4, 6, and 7?	igning an oil field development agreement with neighboring countries with common fields
	O	How can you benefit from the experience of making some equipment in different industries?	Production of some intelligent equipment in Iran, for example, by non-oil organizations and companies familiar with the technology
3	ST	How can the technological needs of the oil industry be solved?	Creating a mechanism to avoid sanctions
4	ST	How to obtain intelligent technology supply contracts using threats 1 and 3?	Preventing conflicts of interests of managers in relation to equipment supply contracts
5	WO	How can the challenge of not using intelligent technology be solved by using opportunities 5?	Creating a legal requirement for the oil company and investment incentive for adopting intelligent systems in oil fields
6	WO	How can the oil fields be made intelligent in the current situation?	Presenting medium-term and long-term plan and prioritizing fields and equipment needed for adopting intelligent systems
7	WO	How can accidents and delays in production be prevented by using opportunities 5, 6, and 7?	Employing IT and network specialists and developing telecommunication and satellite infrastructures
8	WT	How to prevent the negative impact of stakeholders and disruption in intelligent systems projects?	Pursuing the progress of intelligent systems projects by the energy committee of the parliament
9	WT	How to acquire intelligence technology in the conditions of embargo?	The use of local capabilities for production of intelligent systems equipment

When presenting different strategies, it is essential to acknowledge that an alternative plan may be necessary if one approach is not feasible. Based on the findings of the SWOT matrix, we recommend nine initiatives for the transfer of intelligent technology in Iran's oil fields. These strategies include signing contracts with neighboring countries to develop oil fields that are shared, producing intelligent equipment in Iran through non-oil technology-related organizations and companies, creating a mechanism to bypass sanctions, eliminating managers with vested interests in equipment supply contracts, introducing legal requirements and investment incentives for oil businesses, and prioritizing intelligent-required fields and equipment. In addition, we suggest utilizing IT and network specialists, developing telecommunication and satellite infrastructures, monitoring intelligent progress through the Parliament Energy Commission, and using domestic capabilities for producing intelligent systems equipment.

These initiatives will help increase efficiency, productivity, and profitability in the oil sector in Iran.

It is essential to establish a comprehensive plan to create a thorough and effective strategy. It is imperative to consider numerous approaches to achieve desired outcomes. There is a range of potential avenues for consideration, including exploring collaborative opportunities with neighboring countries for development contracts and pursuing investment options. However, it is essential to note that such alternatives may conflict with the current approach of prioritizing domestic equipment and power sources. Careful consideration and analysis of all options are necessary to determine the most effective path forward. It is recommended to propose a range of strategies that can be tailored to specific situations to avoid repeating past mistakes and experiencing further project failures. By implementing intelligent strategy, organizations can elevate technological advancement, operational efficiency, business acumen, and competitive edge.

5 Conclusion and Policy Implications

The SWOT analysis results have yielded nine recommended options for transferring intelligent technology in Iranian oil fields. These strategies include negotiating contracts with neighboring nations to develop shared fields, manufacturing intelligence equipment domestically, and implementing a mechanism to evade sanctions. It is imperative to avoid conflicts of interest in equipment supply contracts, establish legal requirements for oil companies, encourage investment in intelligent oil fields, present medium- and long-term plans, and prioritize the fields and equipment needed for intelligence. The addition of IT and network specialists and the construction of satellite infrastructure are essential steps in intelligence development. The Parliamentary Energy Commission oversees this development, and domestic resources are used to build intelligent equipment.

When formulating strategies for field development, it is critical to consider a range of factors, including negotiating contracts with neighboring countries, attracting investments, and avoiding sanctions. However, specific strategies may conflict with others, such as promoting domestic equipment production and utilizing local capabilities.it is essential to have a comprehensive suite of strategies that can be adapted based on specific circumstances to prevent the repetition of previous errors that have resulted in project cancellations or delays.

Implementing intelligent technology transfer strategies can significantly enhance technological maturity, operational integration, commercial intelligence, and competitive advantage.

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