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Analyzing the Technological Capability of National Iranian South Oil Company and Determining the Existing Technological Gap to Offer Improvement Solutions (Case Study: Oil and Gas Projects)

By

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Abstract

Today, technology plays a major role in the competitiveness of enterprises. Employing modern and advanced technologies allows enterprises to offer better products and services with lower prices and better features (in terms of quality, flexibility, reliability, and so forth). In addition, technology may lead to creating and distributing new products and services into the current market or new markets. Therefore, technology can improve the competitive advantage of an enterprise, and the lack of attention to it can lead to the loss of market share. On the other hand, due to the increased rate of technological developments and introduction of new technologies, reduced lifespan of technologies, and that they are becoming more complex and costly, the need for technology management is inevitable. This paper seeks to use Panda and Ramanathen's assessment model to analyze technology needs and the capabilities level of the existing technologies in oil and gas projects. In this model, the capability levels of enterprise are assessed from 3 primary and 9 secondary dimensions. In addition, the enterprise status at each dimension is determined and a number of recommendations are given to narrow the existing gap.

Keywords: *Technology, technological capability, technology assessment, technology need assessment model*

1. Introduction

For years, technology has been regarded as a factor with influence on social and personal life. In recent years, it has turned into the fundamental discussion about nations and human future. Developing countries have sought to improve technologies to compensate for the backwardness, lead a better life, seize more power in international competitions, and maintain their dominance. The first stage in technology development is determination and awareness of technology potentiality. In order to plan for technology development, it is essential to know our current technological status. On the other hand, there is a direct relationship between technology development with economic, social, political, and cultural development in every country. In that, one can say technology is the major factor in creating wealth, and obtaining capability and knowledge, and also a powerful tool for national development. Technology assessment exposes our technological weaknesses and strengths by inspecting technology capabilities. It also lays the ground for making decisions about the development of technology capabilities. The results from technology assessment directly affect our decision-making process, regarding the transfer of technology and the development of capabilities. By identifying our weaknesses, it is possible to find out how to address them, using more advanced technologies.

National Iranian south Oil Company (NISOC), headquartered in Ahwaz, is a subsidiary of National Iranian Oil Company, as the largest oil producer in Iran. Now, this company produces over 80% of oil and 16% of gas in Iran, in that 3 million barrels of crude oil, 800 million cubic feet of natural gas, and 150 thousand barrels of gas condensates are extracted per day. This company has two main branches managerial and staff sectors, including: production management, technical affairs management, engineering and construction management; Its affiliated companies include Karon, Maroon, Aghajari, Gachsaran, and Masjid Soleiman Oil and Gas Exploitation companies, Iranian Drilling Company, South Engineering Services and Turbine Industrial Equipment, and Oil General Welfare Services Company. Engineering and construction management accounts for 85% of the budget of NISOC for funding oil and

gas projects, construction projects, and other major projects, annually. The oil and gas projects have the main responsibility for the advancement of the projects, from approval and issuing of the description of needs by the technical/operational committee to final operationalization and delivery of the projects to the applicant. Meanwhile, all required activities and operations such as preliminary and detailed studies, supply of goods, coordinating tendering formalities and selecting contractor/consultant, executive operation, testing and launching, and other staff and ancillary works, required for performing fundamentally and optimally, in accordance with standards, as well as for maintaining performance/technical capabilities and power, are upon this unit. Regarding this, oil and gas projects are responsible for 135 projects and 444 sub-projects, on average, with an approved budget of 35000 billion Rials.

2. Literature Review

Technology is known as a systematic knowledge in: manufacturing a product or providing industrial, agricultural, or business services; installing, launching, and maintaining an industrial plant and/or equipment; and managing an industrial company (WIPPO, 2010). In addition, innovation is considered as the conversion of knowledge and ideas into new products. It is also regarded as a tool for improving findings, processes, and services, or for gaining competitive advantage (Microsoft Corporation, 2007).
Innovative and technological capabilities in industry include technical, managerial, and institutional skills, obtained via integrating knowledge and skills of enterprise's members over time. The innovative capabilities are only one aspect of technological capabilities. Technological capabilities are a technique, by which an organization integrates skills, individuals' learning, educational competencies, technologies embedded in machinery, and so forth to perform like an organization. This process is accompanied by a permanent interaction between the members, effective flow of information, decision-makings, and synergy (Lall, 2002). On the other hand, technological capability assessment is a process where the current level of technological capabilities of an organization is measured, not only to determine its technological weaknesses and strengths, but also to compare the organization's technological capabilities with those of its rivals and ideal level, and so to compensate for shortages. There are different models for assessing innovative and technological capabilities, where theses perspectives and models are grouped in three general categories as follows (Tabatabaian, 2005):

A) Gap determination models, including:
- Technology atlas model
- Porter's model
- Panda and Ramanthen's model
- Floyd's model
- Technology needs management model
- Technology content assessment model
- Technology status assessment model
- Economic value-added model

B) Models to assess the causes of the gap, including:
- Ford's model
- Lindsay's model
- Technology atlas model
- Floyd's model
- Technology needs management model
- Technology capabilities levels model

C) Models to provide solutions to compensate for the gaps, including:
- Ford's model

- Lindsay's model
- Fall's model
- Garcia-Arreola's model
- Lin's model
- Technology needs assessment model
- Science and technology management information systems model
- Technology needs management model

Introducing the Model Used in the Study

Panda and Ramanathen's technology levels assessment model is a tool for detecting and determining the capabilities required for implementing technology priorities in enterprises. It addresses technological capability levels from 3 primary and 9 secondary dimensions with 36 indexes. Figure 1 shows the categorization of technological capability dimensions based on Panda and Ramanathen's model.

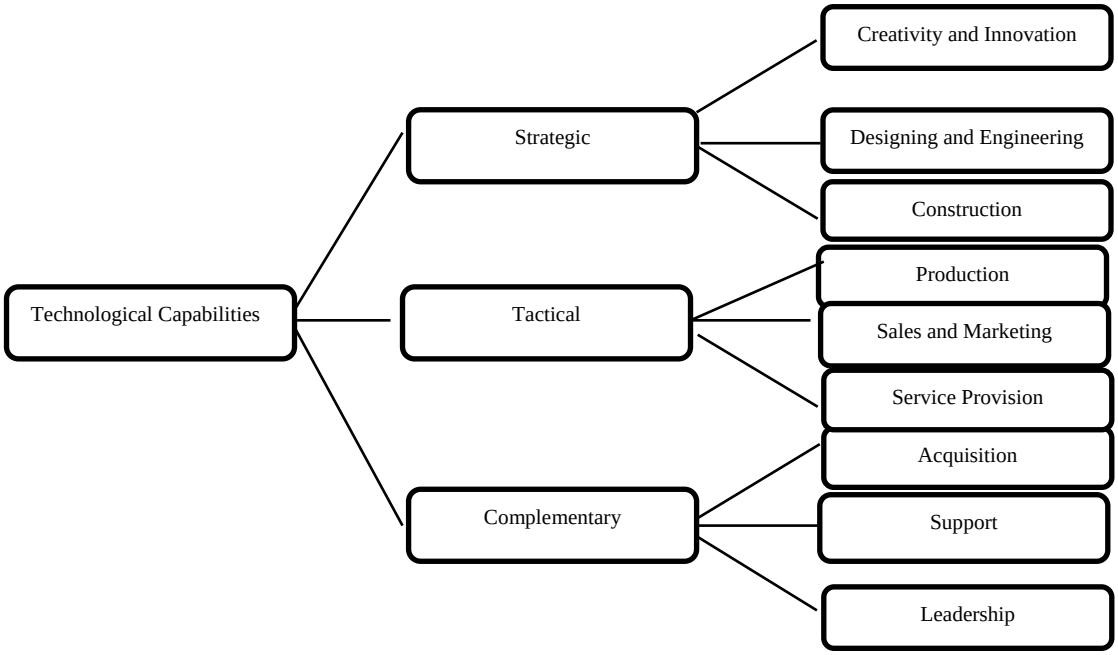

Figure 1: Categorizing innovative and technological capabilities (Radfar et al., 2011).

Research Objectives and Questions

The goal of this research is to assess the levels of technological capabilities of oil and gas projects, and to determine the technological gap existing at each level.

The main research questions are:

1. What is the level of technological capabilities?
2. What is the extent of technology gap at the three primary dimensions?

The secondary research questions are:

1. What is the level of the organization's technological capabilities?
2. What is the level of the organization's tactical technological capabilities of the organization?
3. What is the level of the organization's complementary technological capabilities of the organization?

3. Research Method:

In this applied-survey study, Panda and Ramanathen's model based questionnaire was used to obtain the required data.

Research Population

The statistical population includes senior and middle managers, as well as oil and gas projects executives and experts with BA and MA degrees, with over five years of work experience. Due to the limited number of experts, head counting sampling method has been used and weights have been applied to the experts (Table 1).

Table 1: Descriptive parameters of the respondents

Row	Educational level	Number	Average work experience
1	BA	24	18
2	MA	13	15

4. Summarizing Research Findings

A) Summarizing the findings from the secondary research questions

A1) What is the level of technological capabilities?

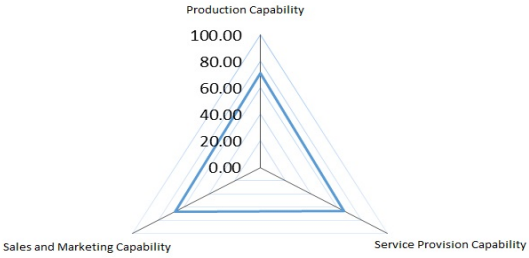

Diagram 1: Strategic technological capabilities

Table 2: Strategic technological capabilities

Components	Success rate (in percent) of each secondary
Innovation	59.93
Engineering and designing capabilities	74.97
Construction	71.66
Overall mean	68.85

A2) What is the level of tactical capabilities?

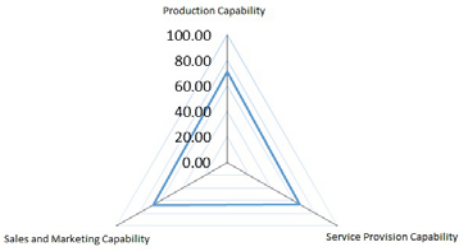

Diagram 2: Tactical technological capabilities

Table 3: Tactical technological capabilities

Components	Success rate (in percent) of each secondary dimension
Production capabilities	71.08
Sales and marketing capabilities	66.71
Service provision capabilities	65.74
Overall mean	67.84

A3) What is the level of complementary capabilities?

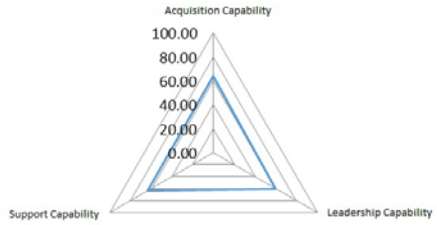

Diagram 3: Complementary technological capabilities

Table 4: Complementary technological capabilities

Components	Success rate (in percent) of each secondary dimension
Acquisition capability	64.12
Support capability	63.73
leadership capability	60.14
Overall mean	62.66

Table 5: Degree of capabilities and technological gap in each index

Components	Index	Average index (percent)	Gap rate (percent)
Creativity capability	Improvement of the current products and processes	67.70	32.30
	Invention of new products and processes	57.30	42.70
	Creation of new organizational structures	57.84	42.16
	Planning, monitoring, and controlling R&D projects	56.89	43.11
Engineering and designing capabilities	Projects assessment based on the technical, economic, financial, environmental, and social consequences criteria	74.86	25.16
	Minor conventional and engineering designs in the processes and the products	78.24	21.76
	Reconstruction or redevelopment of the purchased technologies	70.27	29.73
	Adaptability to the purchased or developed technology	72.03	27.97
	Planning, monitoring, and controlling the design and engineering activities of the contracts	79.46	20.54
Construction capability	Supporting feasibility studies and ability to perform value engineering	70.41	29.59
	Performing activities related to the building of structures	68.24	31.76
	Carrying out the contract works	72.16	27.84
	Planning, monitoring and controlling the construction and launching	75.81	24.19
Production capabilities	Effective use and control of technology in the core and support processes	64.32	35.68
	Quality assurance, inspection, and inventory control	68.92	31.08
	Troubleshooting, repairing, preventive maintenance, and repairing damages	72.97	27.03
	production planning, maintenance scheduling, and equipment maintenance	78.11	21.89
Sales and marketing capabilities	Customers identification, auction bidding price deceleration, negotiation about the terms of sale	70.68	29.32
	Supplying products or services to the customers	71.22	28.78
	Planning, monitoring, and coordinating marketing and sales activities	58.24	41.76

Contd…..

Service provision capabilities	Diagnosis of the problems, performing corrective measures, retiring the product	55.27	44.73
	Providing technical recommendations to customers	69.32	30.68
	Researching into identification of customers' needs and their satisfaction level	66.76	33.24
	Planning, monitoring, and coordinating service provision, and scheduling equipments and service staff	71.62	28.38
Acquisition capability	Identification, assessment, negotiation, and finalization of acquisition conditions of technology and support facilities	66.62	33.38
	Identification, assessment, negotiation, and finalization of funding conditions	62.97	37.03
	Identification, assessment, negotiation, and finalization of labour supply conditions	64.19	35.81
	Planning, monitoring, and coordinating resource supply processes	62.70	37.30
Support capability	Provision of training programs	72.84	27.16
	Strategic planning	57.43	42.57
	networking and information support	69.37	30.27
	Maintaining high level of security and safety	61.76	38.24
	Technology sales	56.89	43.11
leadership capability	Technology routing	61.76	38.24
	Decision-making and implementation	60.54	39.46
	Integration of the organizational activities	58.11	41.89

B) Summarizing the findings from the main research questions

The first main question: What is the level of technological capability of the oil and gas projects?
In view of the study results, the mean scores and the dimensions of technological capability percentage (Table 6), Diagram 4 is drawn.

Table 6: Technological capability mean of the oil and gas projects

Primary dimensions	Secondary dimensions	Percentage of the secondary dimensions of capability	Percentage of the primary dimensions of capability
Strategic technology capabilities	Innovation capabilities	59.93	69.32
	Engineering and designing capabilities	74.97	
	Construction capability	71.66	
Tactical technological capabilities	Production capabilities	71.8	67.95
	Sales and marketing capabilities	66.71	
	Service provision capabilities	65.74	
Complementary technology capabilities	Acquisition capability	64.12	62.96
	Support capability	63.73	
	leadership capability	60.14	
Average percentage of technological capabilities			66.78

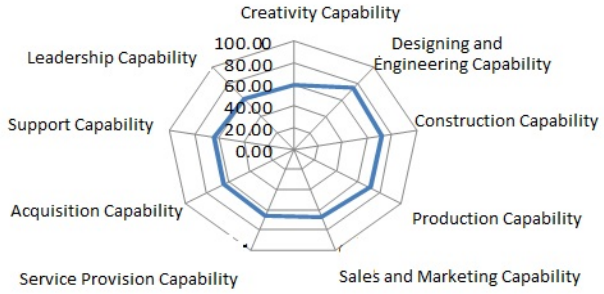

Diagram 4: Diagram of technology capabilities from the various aspects

Companies can be grouped into four categories (Table 8).

Table 7: Categorization of the companies with respect to the technological and innovation capability levels (Khamseh, 2012).

Overall audit results	Total scores	Enterprises categorization
Your company is weak and inefficient in all important areas of acquisition, exploitation, and development of technology strategy, and so is in need of a comprehensive and immediate improvement program.	0-25	Passive (A)
Your company is weak and inefficient in all important areas of strategy, research, acquisition, and capacity building with respect to technology and innovation, and so is in need of several capabilities to reconstruct these areas.	26-50	Reactive (B)
Your company's internal capabilities are relatively strong with a strategic orientation towards technology and innovation, but they are behind the national technology level in most areas.	51-75	Strategic (C)
Your company has a collection of fully developed technological capabilities and can identify the national technology border. It also has an innovative and pioneering approach in a number of areas, and employs technology and innovation to obtain competitive advantages.	75-100	Creative and Innovative (D)

With respect to the results from the technological capability level assessment and that the total capability level of oil and gas projects is 66.78%, the company has been placed in the strategic enterprises group or group C, based on the categorization of the above table.

Second main question: What is the extent of technology gap at the three primary dimensions?

With respect to the current level and the desired level (100%), it can be said that these two levels are different in three technological capabilities, namely oil and gas projects, engineering management, and construction management, the values of which at each primary dimension are presented in Table 8 and Diagram 5.

Table 8: The qualitative degree of gap between the current and the ideal levels

Technological capabilities	The current level	The gap between the ideal and current levels
Strategic capabilities	68.85	31.15
Tactical capabilities	68.84	31.16
Complementary capabilities	62.66	37.34
The whole technological capabilities	66.78	33.22

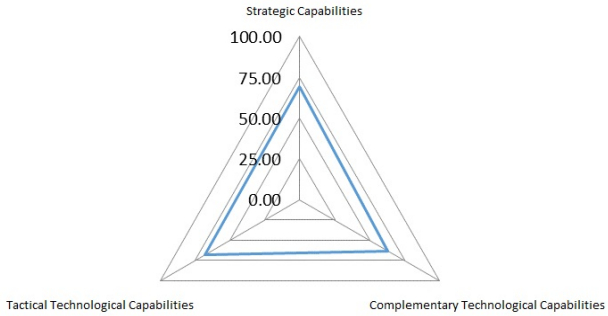

Diagram 5 Technology and innovation capabilities levels from the various dimensions

5. Analysis and Conclusion

- In the primary dimension of strategic capabilities, the secondary dimension of creativity and innovation with 59.93% and the secondary dimension of designing and engineering capabilities with 74.97% have the lowest and the highest scores, respectively. The secondary dimension of construction capabilities with 71.66% is placed between them.
- In the primary dimension of tactical capabilities, the secondary dimension of production capability with 71.08% and the secondary dimension of service provision with 65.74% have the highest and the lowest scores, respectively.
- In the primary dimension of complementary capabilities, the secondary dimension of acquisition capability with 64.71% and the secondary dimension of leadership capability with 60.14% have the highest and the lowest scores, respectively.
- The obtained results indicate that the complementary technological capability dimension with 62.96% and the strategic capability dimension with 69.32% have the lowest and the highest scores, respectively. The tactical technological capability with 67.95% is in the middle.
- In conclusion, the strategic technological capability with the score of 69.32% is the most capable dimension, and the complementary technological capability with 62.96% has the lowest score.
- With respect to the results in Table 8, the strategic capabilities with 31.15% and the complementary capabilities with 37.34% have the smallest and the largest degrees of gap.
- The results from Table 5 indicate that the degree of technological gap is larger in leadership and creativity capabilities than others.

According to the results from the study, these gaps exist at all levels, and thus, to achieve the desired status and eliminate the existing technological gap, senior managers have to employ proper planning and

define improvement projects. In addition, establishing technology management unit in NISOC can be helpful in identifying and determining the weaknesses and strengths from different dimensions, and hence, in decreasing the existing technological gap.

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