

MEASUREMENT AND ANALYSIS OF TECHNOLOGICAL CAPABILITIES IN THE DRILLING INDUSTRY USING TECHNOLOGY NEEDS ASSESSMENT MODEL

(CASE STUDY: NATIONAL IRANIAN DRILLING COMPANY)

*** Abdolaziz Saedi Nia¹**

¹ *PhD Student in Business Administration, University of Industries and Mines, Iran, Ahvaz Branch*

**Author for Correspondence*

ABSTRACT

In today's competitive environment, technology-related issues are of great importance for producing high-quality products and providing superior services. Accordingly, the importance of technology management grows increasingly. Technology and its proper management are highly important factors in the success of companies competing at national and international levels. Economic challenges of the present age range from direct threats such as intensifying competition and technological substitution to new opportunities created by the presence of new technologies and the emergence of new markets. The life cycle of technology is so short that some companies will even simply obsolete their products to save their competitive advantage. The speed of changes is increasing. Therefore, the current situation should be evaluated carefully with a look to the future. This paper tried to analyze the level of technological capabilities of Khuzestan NIDC using the Technology Needs Assessment (TNA) Model. This model assesses a firm's capability from 9 different aspects and determines its status and technological gap in each aspect. At the end, recommendations towards reducing this gap are provided.

Keywords: *Technology, Technology capability, Technology assessment, Technology Needs Assessment (TNA) model*

INTRODUCTION

For so many years, technology has been considered as a factor influencing all personal and social affairs. In recent years, this has become an important issue to discuss the future of the nations and humanity. Developing countries tried to gain and improve their used technologies to compensate for the backwardness and a better life; and developed countries did the same for more power in international competition and maintaining their dominance. The first step in the process of technology development is to determine and to have knowledge of the actual power of technology. In order to plan for technology development, it is necessary to know our technological position, according to the current situation. Furthermore, there is a direct relationship between the development of technology and economic, social, political and cultural development of a country so that one can say the technology is a key factor for the creation of wealth, power and knowledge in the countries and is considered as a powerful means of national development. Technology assessment determines our strengths and weaknesses in our considered technology through assessing the level of technological capabilities and provides the basis for decisions regarding technology development capabilities. The results of the technology assessment directly affect our decisions about technology transfer or capability development. With identifying our weaknesses, we can seek to identify how to strengthen these areas using more advanced technologies.

National Iranian Drilling Company (NIDC) is a company active in the field of oil and gas drilling services founded in 1979 as a subsidiary of National Iranian Oil Company. NIDC has a comprehensive and operational system of manpower that is active in the field of exploration, development and drilling oil and gas wells. It owns drilling rigs and various machinery and equipment for drilling services. The company

Research Article

provides services such as technical services of drilling in cementing operations, acidizing, tubing and completion of wells, testing and determining the productivity of the well, air drilling, under balanced drilling and etc. National Iranian Drilling Company provides more than 90 percent of drilling services needed by Iranian oil companies.

Review Of Literature

Technology is a systematic knowledge used in the production of a product or provision of a service in the industry, agriculture or commerce, and installation or maintenance of an industrial plant or equipment, or in the management of an industrial company (WIPO, 2010). Innovation is also the conversion of knowledge and ideas into new or improved products, processes or services to gain a competitive advantage (Microsoft Corporation, 2007). Innovative and technological capabilities in the industry include the technical, managerial and institutional skills which are the result of integrating the knowledge and skills of the firm members over time. Innovation potentials are only one aspect of technological capabilities. Technological capabilities are a procedure by which an organization combines skills, individuals' learning, educational or academic competencies, technologies embodied in the machinery and other objects to be able to act as an organization. This process is accompanied by permanent interaction between members, efficient flow of information, decision-making and synergy (Lall, 2002). In our country, little attention has been paid to the assessment of technological capabilities at the level of firms. In this respect, very little efforts have been made for culture-building. Even if an organization is willing to move in that direction, few references and resources are available to it. Today, to remain competitive, organizations must inevitably turn to the evolution of technology and the creation of advanced technologies. But this question is raised that "What is the best way to help reduce the technology gap in the way of technology acquisition?" (Jafarnejad, 2006) On the other hand, technology capability assessment is a process in which the current level of technological capabilities of the organization is measured to identify the technological strengths and weaknesses of the organization, from one hand, and to compare technological capabilities of the organization both with the competitors and the ideal situation, on the other hand, and to compensate for the unfavorable cases. There are different models to assess the capabilities associated with innovation and technology. These views and models are described in three general categories shown in the following table (Tabatabaeeian, 2005)

Introduction Of The Model Used In This Study

Technology Needs Assessment (TNA) model was used to assess the firms' technological capabilities. According to this model, the firm's capabilities are measured by a questionnaire based on 9 aspects. Classification of technological capabilities aspects in this model is as follows: Aspect of awareness: the company's ability and awareness to recognize the need to improve the technology. Aspect of search: the company's ability to identify technological opportunities and threats. Aspect of institutionalization of competence orientation: the company's ability to institutionalize the competence orientation (differentiation between competitors) Aspect of technology strategy: the company's ability to develop an appropriate strategy to support the business. Aspect of assessment and selection of technology: the company's ability to assess and select a suitable technological solution. Aspect of technology acquisition: the company's ability to gain and use a technology. Aspect of application and absorption of technology: the company's ability to implement and use the technology effectively. Aspect of learning: the company's ability to learn from previous experiences to improve the technology and new products. Aspect of enjoying the external links: the company's ability to communicate with the supply network and enjoy the external links (universities, research centers, foundations, consultancy, research, etc.)

Research Objectives and Questions

This paper aims to analyze the level of Technological Capabilities of NIDC and determine the technological gap at each level.

Research Article

- a- The main research questions are: 1) At what level are the company's technological capabilities?
 2) According to the levels of technological capabilities, which category Khuzestan NIDC falls into?
 3) What is the size of technological gap in each of the 9 aspects and what solutions are recommended to eliminate the gap?

Table1: Classification Of Technological Capability Assessment Models

Models for determining the technology gap	Models for assessing the causes of technological gap	Models for providing a mechanism to compensate for the technological gap
Atlantic technology model Porter's model Panda and Ramanathen model Floyd model Technology needs management model Technology content assessment model Technology status assessment model Economic value added model	Ford model Lindsay model Atlantic technology model Floyd model Technology needs management model, model of technological capability levels	Ford model Lindsay model Fall model, Garcia – Arrola model, Lane model Technology needs assessment model, science and Technology management Information system model technology needs management model

b) Secondary research questions are:

1. Does the company know the need for technology improvement?
2. Does the company have the ability to find relationships between the external opportunities and threats, and the company's products and services?
3. Does the company see certain aspects in itself to get distinguished from its competitors?
4. Can the company develop a strategy to support the business and profitability?
5. Is the company capable of assessing some technologies in its relevant industry, and of choosing one of them?
6. Is the company able to acquire certain technology?
7. Is the company capable of implementing and using the technology appropriately?
8. Does the company use previous experience in manufacturing new products?
9. Does the company cooperate with universities, research institutes and consultants?

METHODOLOGY

This study is applied in terms of the purpose; and is survey in terms of the method used Technology Needs Assessment (TNA) model was used to obtain data.

STATISTICAL POPULATION

The statistical population of this research is consisted of middle and senior managers and experts of National Iranian Drilling Company (NIDC) with BA and MA degrees and work experience of more than 5 years. However, due to limited number of experts , the complete enumeration method was used and then experts were weighted Table 2.

Table2: Descriptive Parameters Of Respondents

Row	Educational level	number	Average work experience
1	MA Degree	16	8
2	BA Degree	20	10

Research Article

METHOD OF DATA ANALYSIS

Two methods were used to analyze the research data:

a) The Method Of Statistical Analysis

In this method, data is collected and summarized using statistical indicators. In other words, for descriptive analysis, the collected data are first summarized through developing a frequency distribution table and then displayed on the graph. Finally, they are summarized using other statistical indicators.

b) Analysis Method Based On Expert Judgment

The use of experts’ judgment for data analysis is one of the most important decisions making methods in that research that the use of their results is very important; and a possible error or high percentage of error in other methods of analysis in these studies may reduce the validity of the results. This method was used in this study to analyze data and research questions.

Summary Of Research Results

After filling out the questionnaire by managers and experts, their scores were compared with each other and the total score was compared with Table 4. Finally, the results of this study and comparison of the company’s technological capabilities were presented. However, for greater precision, the sum of scores was multiplied by 5.

a) Summary Of The Results Of The Research Sub-questions

Results of the 9- aspect indicators in answering the research sub-questions have been presented in Figures 2 to 10. (The scores of indicators are between 0 and 20).

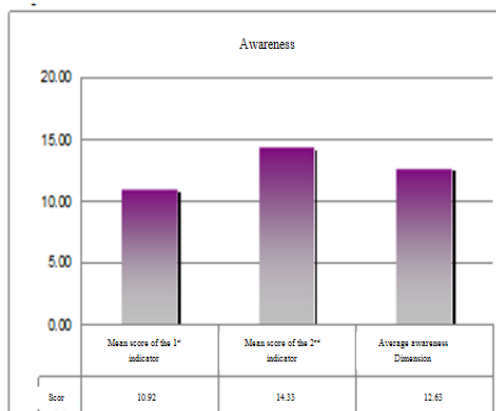


Figure2:Results Of The Awareness Aspect Indicators

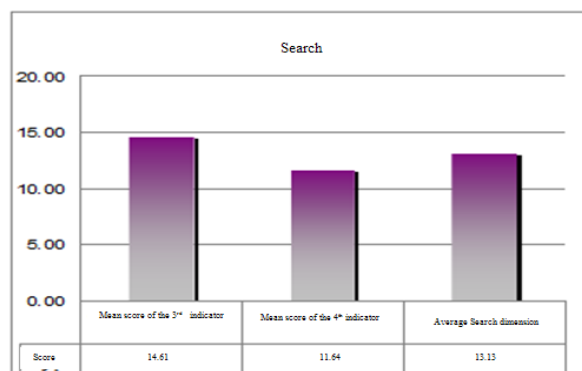


Figure3:Results Of The Search Aspect Indicators

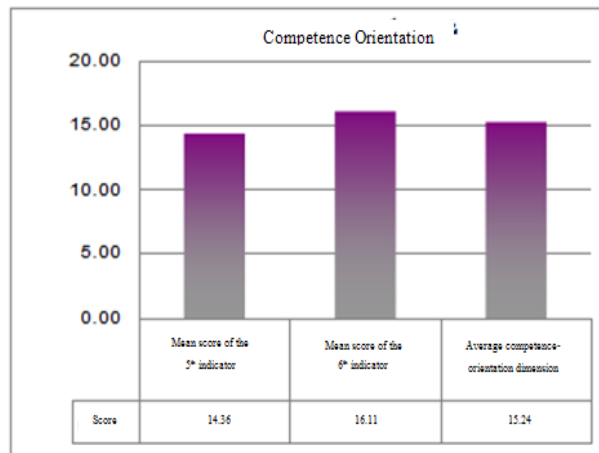


Figure4: Results Of The Competence Orientation Aspect Indicators

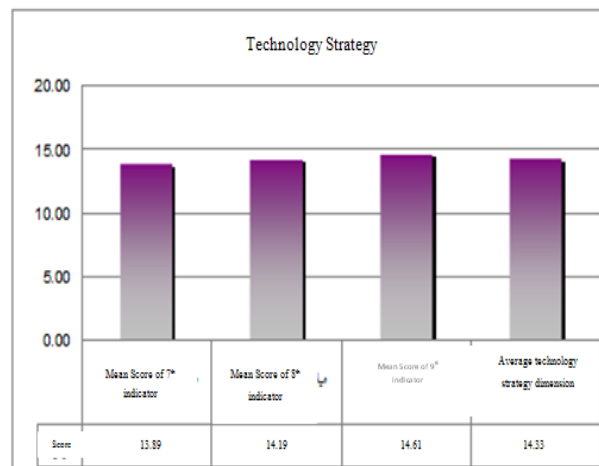


Figure5: Results Of The Technology Strategy Aspect Indicators

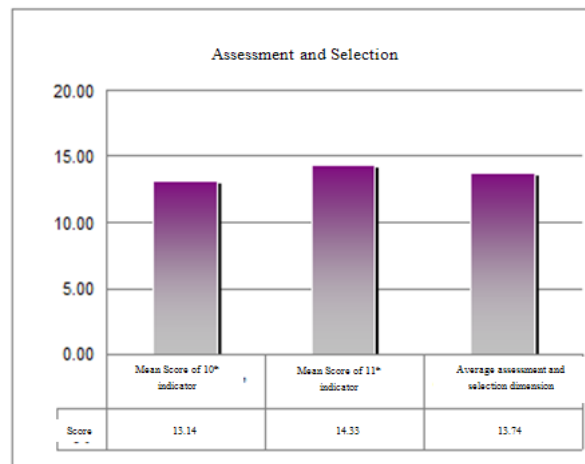


Figure 6: Results Of The Assessment And Selection Aspect Indicators

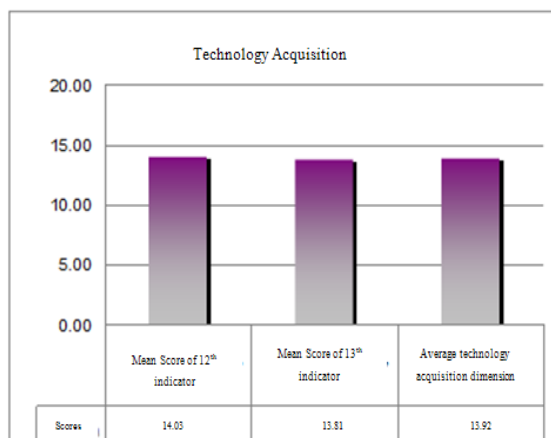


Figure 7: Results Of The Technology Acquisition Aspect Indicators

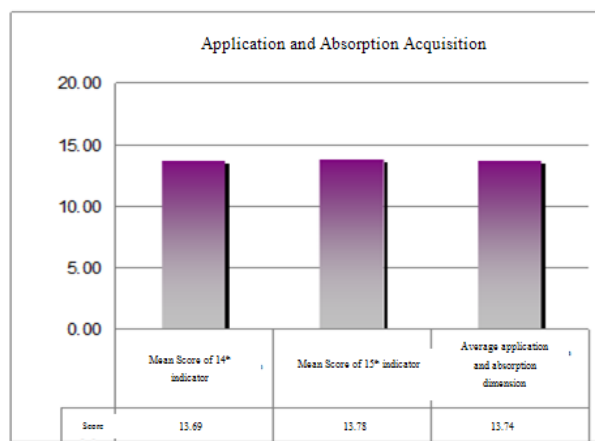


Figure 8: Results Of The Application And Absorption Aspect Indicators

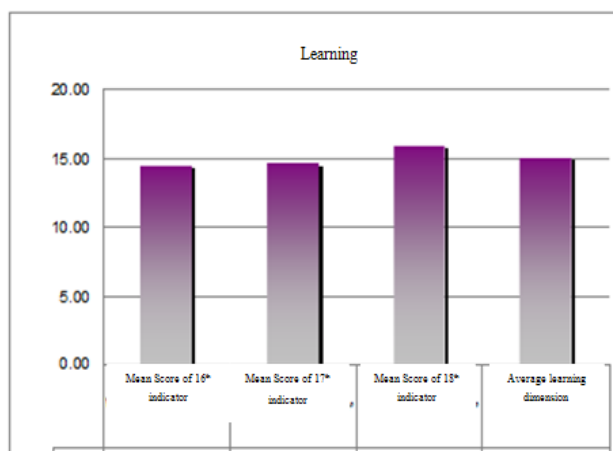


Figure 9: Results Of The Learning Aspect Indicators

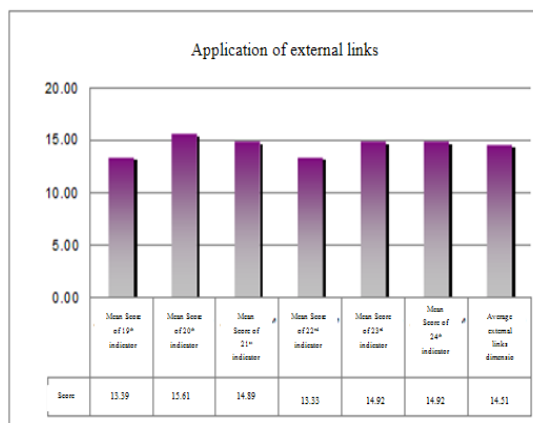


Figure10: Results Of The Application Of External Links Indicators

B) Summary of the results of the main questions of research

The first main question of research: At what level are the company's technological capabilities?

The level of technological capabilities of Khuzestan NIDC and the mean score obtained in each of 9 aspects are given in Table 3.

The second main question of research:

According to the levels of technological capabilities, which category Khuzestan NIDC falls into?

The mean score of 24 questions is 339.56 which according to the table 4 of the firms classification, Khuzestan National Drilling Company is categorized in the category of C. C-type companies (strategic) have a true understanding how to improve their company's technological capabilities. They also have great ability in executing their projects and a strategic look to the capability-building.

The third main question of research: What is the size of technological gap in each of the 9 aspects and what solutions are recommended to eliminate the gap?

The distance between the existing technological gap and the ideal status (number 100) is shown in Table 5 and Figure 11 (radar chart).

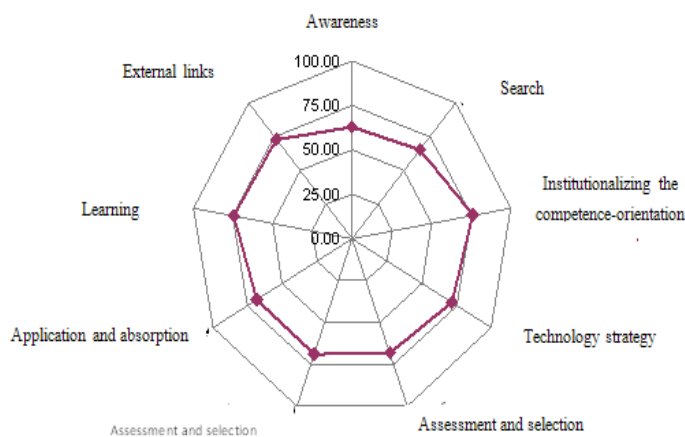


Figure 11: Diagram Of Technological Capabilities In Various Aspects

Research Article

Table 3: The Company’s Capability In Each Of Indicators And 9 Technological Aspects

Aspects	Number	Indicator	Score	Mean
Awareness	1	Awareness of commerce technology	54.58	63.13
	2	The role of technology in business strategy	71.67	
Search	3	Assessment of the technological opportunities	73.06	65.63
	4	Assessment of the technological weaknesses	58.19	
Institutionalizing the competence-orientation	5	Having specific technological capabilities	71.81	76.18
	6	Awareness of External and internal technology resources	80.56	
Technology strategy	7	Company management skills in technology strategy development	69.44	71.16
	8	Identification of priorities of technological basis of the company	70.97	
	9	Having a proper vision for technology development	73.06	
Assessment and selection	10	Having the choice of technology	65.69	68.68
	11	Awareness of the best sources of technology	71.67	
Technology Acquisition	12	Effective acquisition of technology from foreign sources	70.14	69.58
	13	Communication with external suppliers of technology	69.03	
Application and capturing the technology	14	Proper organization of technological activities of firms	68.47	68.68
	15	Transparent process of technological projects	68.89	
Learning	16	Appropriate systems for technology assessment	72.50	75.09
	17	Paying attention to future technology projects	73.47	
	18	Ability to learn from one technology to another technology	79.31	
Applying external links	19	The use of government’s incentive policies	66.94	72.55
	20	The use of Consultants for Assessment of Technology	78.06	
	21	The use of people outside the companies for technological development	74.44	
	22	The use of other companies' technology in the implementation of the technology strategy	66.67	
	23	The use of cooperative research centers and universities	74.58	
	24	The use of cooperative state research centers	74.58	

Research Article

Table 4: Classification Of Companies According To Innovation And Technological Capability Levels (Khamse, 2012)

The overall assessment results	The sum of scores	Classification of firms
Your company is weak and inefficient in all major areas of acquisition, exploitation and strategy development; and needs a major and immediate improvement program	0-25	Passive (A)
Your company is weakly developed in all areas of strategy, research, technology capacity-building and innovation; and needs a lot of capabilities to rebuild these areas	26-50	Reactive (B)
Your company's is relatively capable in internal capabilities and has a strategic approach to technology and innovation, but it lagged behind the national technology in most areas.	51-57	Strategic (C)
Your company has a complete set of developed technological capabilities and can recognize national boundaries of technology. It has also creative and pioneering approach in a number of areas and benefits from technology and innovation to gain competitive advantage.	76-100	Creative and Innovative (D)

Table 5: Gaps Existing In Different Aspects Of Technological Capabilities With The Desired Level

Aspects	Number of indicators	Mean score of Capabilities	Existing gap
Awareness	2	63.13	36.87
Search	2	65.63	34.37
Institutionalizing the competence-orientation	2	76.18	23.82
Technology strategy	3	71.16	28.84
Assessment and selection	2	68.68	31.32
Technology Acquisition	2	69.58	30.52
Application and capturing the technology	2	68.68	31.32
Learning	3	75.09	24.91
Applying external links	6	72.55	27.45
Mean total score	24	70.07	29.93

CONCLUSION

According to experts and managers, technology plays a main role in the drilling industry. According to the results, aspect of awareness has a score less than other aspects and it requires the company to have a greater awareness about the most important technologies of this industry. Accordingly, it is proposed to strengthen this aspect with the formation of R & D team and [attending] in internal and international seminars.

According to the summary of the results of the search aspect, NIDC has more trouble in the field of technology assessment than other indicators. Accordingly, it is proposed that the company continuously observes the technological changes on a short-term scale and finally on a long-term scale in order to take necessary measures to overcome technological shortcomings by the formation of a team to search the technologies.

Research Article

Results from the indicators of the aspect of institutionalizing the competence orientation suggest a relatively favorable condition. It is recommended that while enhancing this aspect, necessary efforts should be made to maintain the current status and to enhance its competitive advantage, especially in neighboring countries and ultimately at the international level through taking necessary measures to develop the knowledge and to complete the necessary skills.

According to the results from the technology strategy parameters and also, according to experts and managers, National Iranian Drilling Company has relative weaknesses in having technological perspective. Accordingly, it is proposed that given the existing policies, the company's vision is drawn by the senior management and the viewpoints of experts and strategists are used in order to achieve the long-term goals.

Summary of the results of the assessment and selection aspect in both indicators shows that this aspect suffers from technological weaknesses. It is proposed to take necessary measures to remove weakness of technology sources through utilizing experts in the field of technology management.

According to the results of the aspect of technology acquisition, NIDC has less relationship with foreign suppliers of technology, than other indicators. However, increase of score of this indicator depends on the government policy and it is not simply possible.

The aspect of adoption and absorption of technology is directly related to the acquisition of technology. After acquiring the technology, the company takes measures to implement it. According to experts and managers, acquisition and application of technology depends on government's policies and international relations of the government.

According to the results of learning aspect, the company has a good ability to learn new technology. Thus, it is suggested that NIDC takes measure to assess it in appropriate time intervals or after implementation of each technologic project.

According to the results from the aspect of enjoying or application of external links, NIDC did not take enough advantage of government's incentive policies. In addition, it has acted poorly in using other companies in the field of strategic implementation of technology. Accordingly, it is proposed to pave the way and take necessary measures by increasing communication and holding expert meetings in order to utilize the experience and knowledge of other companies in technological fields. As far as NIDC has relatively benefited from the cooperative consultants, research centers and universities in order to do technology assessments; therefore, it is proposed the scope of cooperation and communication with these centers to be increased.

According to the study results, the technological gaps are 36.87% in the awareness aspect and about 34.37% in the search aspect which is more than other aspects. Therefore, the management of NIDC should try to reduce the gap through enhancing awareness level about the latest technologies in drilling industry and observing them.

The size of technological gap in the aspect of competence-orientation building and learning is less than other aspects, so that building competence-orientation had the lowest gap with 23.82 percent.

According to the study results, there is a gap at all levels. Therefore, senior managers of NIDC should attempt to remove the existing technological gap through proper planning and defining improvement projects in order to achieve the desired position. Meanwhile, creating the technology management unit in NIDC can help to reduce the technology gap through identifying the strengths and weaknesses in different aspects.

REFERENCES

Khalil, Tariq (2002), "Management Technology", translated by Seyed Kamran Bagheri et al., Payam-e-Matn Publication

Tabatabaeeian, S. Habib, (2005), "Assessment of firm-level technological capabilities", Published by Aryan.

Technology Atlas, a general framework based on technology" (1990), First edition, published by PBO

Research Article

Jafarnejad, A., et al, (2006), "Technology Audit [assessment] and provision of proper solutions to reduce the technology gaps"

Brown, Ernest, (2003), "Technology Assessment and Forecast", translators: Bushehri A., Maleki Far, A., Future Strategic Institute, Tehran.

Khamseh, A., et al, (2010), "The article of assessment of Technological capability levels using technology need model (case study, Yasan metal structures)", Fourth National Conference on Management of Technology, Tehran, Iran.

Radfaret al, (2013), "Development of Technology strategy in the steel industry of Iran (case study: Esfahan Steel Company)", Journal of Industrial Technology Development
Technology Needs Assessment in developing countries www.unido.org , UNIDO 2002

Porter, M. (1998), Competitive Advantage: creating and sustaining superior performance, free press, New York.

New models of technology assessment for development from STEPS working paper 45, 2011