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## **MEASUREMENT AND ANALYSIS OF TECHNOLOGICAL CAPABILITIES IN STEEL INDUSTRY IN IRAN: CASE STUDY: KUZESTAN OXIN STEEL**

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### **ABSTRACT**

Today, technology is an essential tool for all firms. This tool not only allows the conversion process, but in the integrated and global economy, provides infrastructure to firms' survival and business growth. Scientific and industrial communities have come to the conclusion that the main cause of technology is providing the main route to differentiated products, reduces costs; create new business opportunities and facilitator, and to support strategic changes. In this article we assess technological capabilities in Khuzestan Oxin steel company in each dimensions and indexes of technological capabilities and specify the extent of gap in technological capabilities to determine dimensions.

**Keywords:** Technology, Technological Capabilities, Capacity

### **1. INTRODUCTION**

Since the development of technology and economic in an organization are directly related, to whatever the technology create a competitive advantage in an organization is important, more important is the development of that technology for the organization correspondingly, on the contrary if a technology is not effective in raising the competitiveness and creating advantages for company, its development is worthless, so continually is not supported by the collection. (Malekzade, 2005)

Technology measurement is a term for the processes of collecting, interpreting and evaluating information, and offer lookout about different technology options, to invest, strategy or policy making. (STEPS, 2011)

In this regard, due to the importance of technology development, senior managers of business firms should have a good understanding of the technological capabilities in their organization, identify the technological developments in the world and also consider the efforts of competitors to achieve new technologies, to promote their organization technological capability. Technological needs assessment model is developed, as a tool to detect and identify capabilities needed to implement the technology priorities in developing countries. (Jafar -Nejad et al, 2006)

### **2. REVIEW OF LITERATURE**

Today, due to technological advances in various levels of industry and the need for deployment of new technologies, place and importance of technological assessment in business firms strategic planning is inevitable. One of the important tasks of managers in the areas of technology assessment in firms' technology management is the issue of which technology can work better, cheaper and easier than other technologies to create a competitive advantage for the firm, also it announce is such technology compliant with structure, culture and organization's technology or not.

Technology as a systematic knowledge in producing a product or providing a service in the industry, agriculture or commerce and also for the installation or maintenance of an industrial plant or equipment, or for the management of a company or industry is applied. (WIPO, 2010)

Porter believes analytical assessment of technological capabilities are in order to identify the strengths and weaknesses of the organization's technology assets and aim to evaluate the company's technological position in comparison to competitors and advanced technology. (Porter, 1998)

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Technology is knowledge, products, tools, and methods and systems that can be employed to provide a product or service. Technology is the process of transferring and converting resources into products through knowledge, experience, information and tools. (Khalil, 2000)

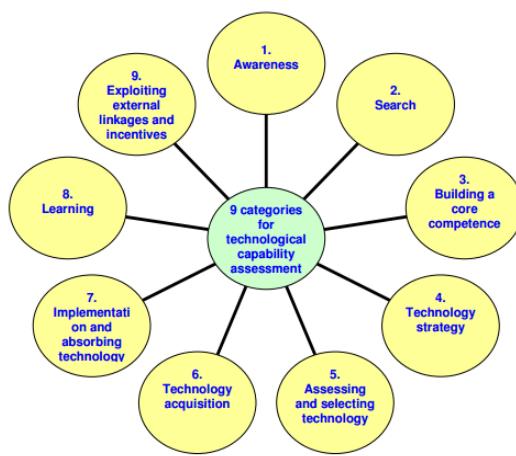
Also technology components include:

- a. Hardware: Physical structure and installation logic of all necessary physical facilities to carry out conversion operations or production, such as tools, equipment and machinery, buildings and so on.
- b. Software: knowledge of using hardware and technology embedded in the documents that contain all of the information and data required to carry out production activities. Such as knowledge of using plans, maps, math and scientific theories machines.
- c. Knowledge ware: technology embedded in the people, like the expertise, skill, innovation, creativity and etc.
- d. Organization ware: technology embedded in the organization, such as systematic processes to organize and manage the work.

Capabilities and technology assessment is a process in which the current level of technological capabilities and abilities are measured to identify the strengths and weaknesses of the organization and the technology gap is determined to compensate of unwanted items.

A need to select an appropriate technology is for the benefit of the community and the institution and its proper evaluation. Technology is in a human environment, and therefore different technologies with the physical environment and different human systems environment, including economical, social, cultural and political systems and its other constituent systems interact. In other words , different technologies ,affect different systems of the human environment around and these systems , in turn , have a reaction , so technology assessment should be undertaken with an overall view , in examining the advantages and limitations of technology criterion not only the technical effectiveness and economic benefit . But its relationship with human environment surrounding to investigate the concept of technology assessment, to maximize the positive effects of technology development is compatible with the surrounding environment (Jafar -Nejad et al, 2006)

### 3. INTRODUCE THE MODEL USED IN THIS STUDY



**Figure 1: Nine categories for technological capability assessment**

In this study, the model of technological needs assessment was used according to this model, the firm's capabilities after 9 is measured with a questionnaire. Categories of technological capabilities in this model include (Innosutra, 2007):

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These are nine main activities, involved in assessing a firm's particular strengths and weakness or Technological capability these include:

1. Awareness- refers to the ability of senior management to recognize the role of technology in competitiveness and the dangers of 'standing still' in today's highly competitive environment.

2. Search- is the ability of the firm to scan or monitor external technology events and trends, which might affect the firm or provide opportunities for growth and competitiveness.

Large, advanced, companies often have a group of individuals permanently working on this task. In smaller companies, the managing director or a senior engineer may be responsible.

3. Building a core technological competence- this category refers to the success of a company in defining its individual technological strengths and building up a unique advantage in specific areas. A company with a strong technological competence will understand how its distinctive technological strengths differ from its competitors and how to further develop its skills and knowledge to remain competitive. It will have well developed methods for protecting and exploiting its intellectual property.

4. Technology strategy- formulating a technology strategy is a key part of the overall business strategy of any leading firm. This is the process by which visions, objectives and priorities are set and communicated within the company. Even the best-resourced organization cannot do everything with respect to technology, so part of the strategic challenge lies in choosing which technology activities to conduct in-house and which to outsource to technology partners.

5. Assessing and selecting technology- leading companies are able to gather information on the range of technological options available, chose quickly among competing solutions (e.g. different machines, approaches or suppliers) and identify the

most appropriate source which 'fits' with their needs. A leading firm is able to make a comparison between (or benchmark) the various options available and can reliably select the most appropriate option, based upon this comparison.

6. Technology acquisition- once a new technology option is decided upon, a firm needs to deploy the resources to exploit it (e.g. by creating technology by in-house R&D, or by acquiring it through a joint venture, or technology licensing, etc.). In some cases, this may be a simple matter of buying off-the-shelf, or it may involve exploiting the results of research already carried out. In other cases it might require extensive search and research to acquire the technology. Most leading firms have well-developed skills in negotiating for the transfer of technology from external sources and for developing technology in-house.

7. Implementing and absorbing technology- having acquired technology, a firm needs to implement the technology within the organization which may involve various stages of further development to final launch, as in the case of a new product or service in the external market place, or a new manufacturing process or method within the organization.

This often involves further innovation as the technology is adapted and reconfigured. A leading firm will usually need well-developed project management capabilities to ensure implementation is effective and efficient.

8. Learning- an important part of building technological competencies involves reflecting upon and reviewing technology projects and processes within the firm, in order to learn from both successes and failures. In leading firms this learning process can become conscious and formal, leading to continuous improvements in effectiveness, efficiency and strategy formulation. In order to learn how to manage technology processes better, firm needs to systematically capture relevant knowledge from its own (and other firms') experience and act on this knowledge.

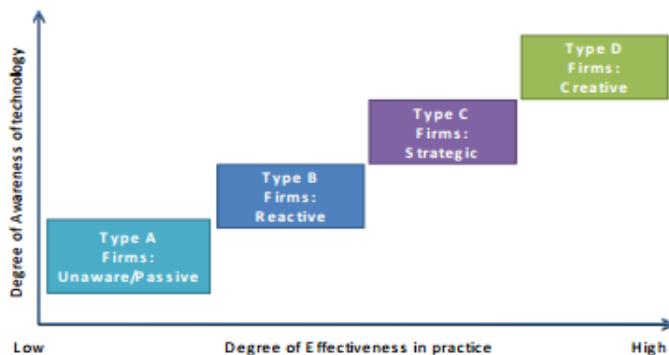
9. Exploiting external linkages and incentives- in each of the 8 key technology activities above, firms can and, in some cases, should make use of external suppliers of technology and related services.

Table 1 gives a short explanation of each technological capability levels and the score achieved in the questionnaire above will help you assess your firm's capability level.

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**Table 1: Four categories of technological capability (khamseh, et al, 2014)**

Partial rankings		Classification of firms	Capability Level (1-4)	Total possible score	Overall audit result
Beginner	1-40	Unaware. Passive (A)	1	1-120	Your firm is weak and ill prepared in all major areas of technology acquisition, use, development, strategy and etc; a major improvement program is urgently needed.
The middle way	41-80				
Precursor	81-120				
Beginner	121-160	Reactive (B)	2	121-240	Your firm has poorly developed capabilities in most areas of technology strategy, search, acquisition and capability building. However, there is some strength upon which to build.
The middle way	161-200				
Precursor	201-240				
Beginner	241-280	Strategic (C)	3	241-360	Your firm has strong in-house capabilities and takes a strategic approach to technology. In some areas, the firm is behind the international technology frontier but has much important strength upon which to build.
The middle way	281-320				
Precursor	321-360				
Beginner	361-400	Creative (D)	4	361-480	Your firm has a fully developed set of technological capabilities. In many areas it takes a creative and pro-active approach to exploiting technology for competitive advantage.
The middle way	401-440				
Precursor	441-480				



**Figure 2: Staircase of technological capability levels**

After completing the questionnaire by experts, the scores are summed together and the total score is compared with the values stated in Table 1, which finally the result represents the capabilities of compared firm.

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### **4. OBJECTIVES AND RESEARCH QUESTIONS**

This study intends to assess technological potentialities of Khuzestan Oxin Steel Company and set it in the technological gap in each level. And determine what types of companies located in the rankings. The purpose of this study in terms of the type of application is a survey. The research questions are:

1. Each constituent index of technological capabilities in the Khuzestan Oxins steel company is located at what level?
2. Levels of technological capabilities of Khuzestan Oxin steel company are located at what level?
3. The gap in technological capabilities in each dimension of Khuzestan Oxin steel company with respect to the optimum level is how much?
4. Based on technological capabilities levels, Khuzestan Oxin steel company is classified as what type of companies?

### **5. PRESENTING THE KUZESTAN OXIN STEEL COMPANY**

Khuzestan Oxin steel company produces a wide sheet width in 480 cm. The company is the first company in the Middle East which its main product is crude material for pipe plants who produce the large-diameter pipe for transferring oil and gas. Another feature of the company's ability is rolled steel to X80 grade.

### **6. THE POPULATION**

Senior experts, technicians and associate degrees with at least three years working experience in the related units are chosen as technical experts in this survey, and regard to the company's fledgling career average is relatively low. Due to the limited number of relevant experts, the total number of methods has been used.

**Table 2: Academic profile and work history of completed questionnaires**

<b>Education</b>	<b>Number</b>	<b>Percent out of total</b>	<b>Average experience year</b>
MS.	14	46.67	5.3
BS.	16	53.33	6.1
sum	30	100	5.7

### **7. SUMMARY OF FINDINGS**

First research question: each constituent index of technological capabilities in the Khuzestan Oxins steel company is located at what level?

According to data gathered by questionnaires and their summation, the level of technological capabilities in the Khuzestan Oxin steel company in any of the parameters in Table 3 has been determined.

**Table 3: Level of technological capabilities in Khuzestan oxin steel company for each of the indicators**

<b>Technology activity area</b>	<b>Average %</b>	<b>Gap %</b>
1. My firm is well aware of the technologies most important to its business	76.10	23.90
2. Technology plays an important part in my firm's business strategy	66.70	33.30
3. My firm is well equipped to assess technological opportunities	67.50	23.50
4. My firm can assess technology threats without difficulty	60.45	39.55
5. My firm has special technological strengths which it is able to exploit	80.80	19.20
6. My firm knows which technologies to outsource and which to develop internally	71.25	28.75
7. Our management is skilled at formulating a technology strategy to meet business	64.70	35.30
8. Our firm knows its main technology priorities	69.55	30.45
9. Our firm has a well developed technology 'vision'	67.80	32.20
10. Our firm knows how to select the technology needed for its business	64.85	35.15

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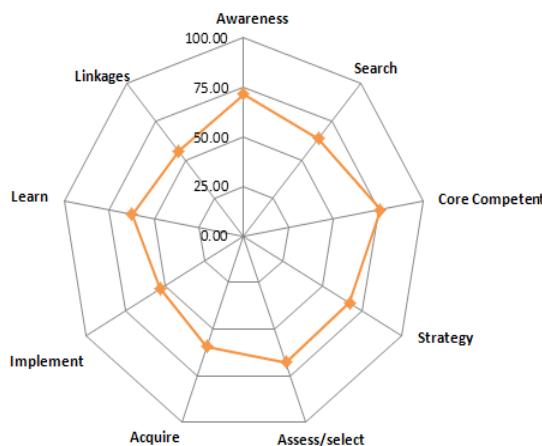
11. Our firm knows which are the best sources of technology	70.65	29.35
12. Our firm is effective at acquiring technology from external sources	62.50	37.50
13. Our firm has good links with important external suppliers of technology	55.80	44.20
14. Our technology activities (e.g. engineering and R&D) are organized effectively within our firm	54.20	45.80
15. We have clear processes for carrying out technology projects	51.70	48.30
16. Our firm has a good system for assessing technology projects	53.30	46.70
17. Our firm carries out post-project reviews	62.65	37.35
18. We are able to learn from one technology project to another	71.55	28.45
19. Government policies encourage us to invest in technology	54.85	45.15
20. We use external organizations (e.g. consultancy firms) to assist us with technology assessment	65.00	35.00
21. We use outside bodies to help us develop technology	60.65	39.35
22. External organizations help us assess our technology performance	56.90	43.10
23. We work with universities in key technology projects	48.15	51.85
24. We work with government research institutes in important technology projects	49.40	50.60

Second research question: Levels of technological capabilities of Khuzestan Oxin steel company are located at what level?

Comparison of existing technological capabilities, for each dimensions of technological capabilities, as well as total technological capabilities are provided in Table 4 and Diagram1.

**Table 4: The levels of technological capabilities for each dimension of technological capabilities**

Dimension	Average available capability (%)
Awareness	71.40
Search	63.98
Build competency	76.03
Technology strategy	67.35
Evaluation and selection of technology	67.75
Technology acquisition	59.15
Application and integration technology	52.95
Learning	62.50
Exploiting external links	55.80
Average of technological capabilities	64.1



**Diagram1: Firm's profile of capabilities**

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Third research questions: the gap in technological capabilities in each dimension of Khuzestan Oxin steel company with respect to the optimum level is how much?

Comparison of existing technological capabilities and desired level (100%) is considered and the gap for each dimension of study and technological capabilities is provided in Table 5.

**Table 5: Comparison of the gap in technological capabilities and the desired level**

Dimension	Average available capability (%)	average gap (%)
Awareness	71.40	28.60
Search	63.98	36.02
Build competency	76.03	23.97
Technology strategy	67.35	32.65
Evaluation and selection of technology	67.75	32.25
Technology acquisition	59.15	40.85
Application and Integration Technology	52.95	47.05
Learning	62.50	37.50
Exploiting external links	55.80	44.20
Average of technological capabilities	64.10	35.90

Forth research question: Based on technological capabilities levels, Khuzestan Oxin steel company is classified as what type of companies?

According to collected data by questionnaire and their summation, the total mean score from the continuous spectrum range (from 0 to 20) out of 24 questions, was 301, which indicates the area of technological capabilities, in other words the Khuzestan Oxin steel company according to Table 1 is placed in strategic area and company classification of group C in the middle of the way.

## **9. ANALYSIS OF RESULTS**

According to the results in Table 3, in the technological capabilities after "Application and Integration Technology" with score of 52.95percent, the most weakest and dimension of "build competency" with score of 76.03 percent, is the most strongest.

On the other hand , according to the results in Table 3 , among the indexes "university assistance in the implementation of key technological projects" with score of 48.15 percent and the index of "collaboration with public research centers in the implementation of key projects" with score of 49.40 percent, the lowest rating and index of "company utilization of the specific existing capabilities in technology" with a score of 80.80 percent and the index of "vital role of technology in business strategy" with score of 76.10 percent, get the highest rating among all technological capabilities index.

According to the results of Table 3, some of the projects listed below are recommended to improve technological capabilities.

1. Cooperation and sympathies with university centers in key technological projects.
2. Persuasion Masters and PhD students to prepare their dissertation and thesis in fields related to company technology and Innovation.
3. Regarding to the funding of research projects, can utilize government research centers in large and important projects.
4. Holding steady courses for personnel to be familiar with technological improvement projects.
5. Launch technology management at the company level.
6. Define technology improvement project by local experts at the company level.

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