

## Assessment and Analysis of Technological Capabilities in Iranian Oil & Gas Industries

(Case study: Oil And Energy Industries Development Company of Qeshm)

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### ABSTRACT

One of the key factors in failure of technology application for gaining competitive advantage in the firms in developing countries is lack of knowledge and understanding of the firm technological capabilities and using them for achieving relative advantages. Assessment of technological needs is something which is used for the purpose of determining required capabilities for implementing technological priorities. Technological assessment not only identifies weak and problematic areas of the firm, but also takes relative advantages of the firm into consideration and defines them.

Current research study attempts to investigate technological capabilities of Oil and Energy Industries development Co. Using technological needs assessment model. This model evaluates capability level of the firm from 9 aspects, and determines the situation of the firm in each and every one and suggestions in order to reduce the existing gap are offered.

**Keywords:** Technology, Technological Capabilities, Technology Need Assessment (TNA)

## 1. INTRODUCTION

Technology management is one of them main issues in production and service knowledge development in today challenging arena of technology development. Technology management is a type of systemic management which is a combination of science, engineering, management, quality, and even service. In wealth production in recent centuries that speculation was turned into industrial production, technology has become the major factor for wealth creation after World War II and especially during three recent decades. It can develop technical knowledge, human resources, natural resources, capital and even management, which will definitely improve the standard of life.

Considering high importance of technology development, top managers of economic institutions should attempt to promote their organization's technological capabilities by proper understanding of technological capabilities of their organizations, identifying technological changes in the world and considering competitors' effort to achieve latest technologies. Manufacturing firms and institutions are always involved in many administrative issues including buying, selling, supply of raw materials, accounting matters, and insurance ... as well as drastic changes in the competitive environment. Thus, using long models and methods of technological assessment are not useful in such institutions. In other words, technical managers and experts of the companies are able to determine capability of the firm in

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KAMSEH ET AL.: Assessment and Analysis of Technological Capabilities in Iranian Oil & Gas Industries (Case study: Oil And Energy Industries Development Company of Qeshm)

various fields of technology considering their past experiences. It seems that the appropriate tool for verifying and supporting these mental assessments is using technological capability models. Experiences indicate that the models and methods which are used in the firm should have two basic properties: they should be simple and comprehensible, and they should provide acceptable results in short time. On the other hand, technology assessment and auditing is one of the strategic tasks of the managers. They define

necessary strategies and policies for the organization development and realization of its goals considering their environmental conditions and capabilities as well as identifying weak points (Tabatabaeian, 2005).

Technology assessment is a term used for processes of data collection, interpretation, and evaluation and providing opinions about different options of the technology in order to investment and strategy or policy making (STEPS, 2011).

## 2. REVIEW OF LITREATURE

Technology is defined as practical element of knowledge and experience in production of goods or delivery of services (Khalil, 2000). Technology is the process for resource transfer and transformation process through knowledge, experience, information and tool (Khalil, 2000). In addition, technology need assessment is a framework and tool which is designed for determining and recognizing capabilities required for implementing technology priorities in developing countries (Unido, 2002).

Technological capability assessment has been studied from various perspectives. According to Lindsay, Technological capability assessment is a process by which the organization investigates its technological capabilities considering long term goals (Lindsay,1999). Technological capability assessment is a process in which the current level of the organization's technological capabilities are measured so that its weak and strength points are identified, and the organization's technological capabilities are compared to competitors and measures are taken to improve them (Tabatabaeian, 2005).

Porter argues that technological capability assessment is an analysis for identifying weak and strength points of the organizations and its aim is evaluating the firm's technological situation

compared to the competitors and latest technologies (Porter, 1998).

Considering technology development in different levels as well as necessity for using modern technologies, technological assessment is crucial. Technological assessment is a tool or conceptual framework which helps better understanding about technology and making decision about it. Thus for development and application of new technology, firstly status of the current technology should be assessed.

Using for meeting society interests and its appropriate evaluation are requirements for selection proper technology. Technology exists in a human environment and thus technologies are in interaction with different systems in human environment including economic system, social system, political system and cultural system and other its constituent systems. In other words, different technologies influence different systems of their surrounding human environment and these systems react. Hence, technology assessment should be done with general view. In investigating the benefits and limitations of the technology, the criterion should not be just technical effectiveness and economic efficiency; rather its surrounding human environment should also be examined. Meaning of technology assessment is minimizing positive effects and

KAMSEH ET AL.: Assessment and Analysis of Technological Capabilities in Iranian Oil & Gas Industries (Case study: Oil And Energy Industries Development Company of Qeshm)

development of technologies which are compatible with the surrounding environment.

Additionally, technology auditing seeks for determining and evaluating the gap (assessment of the current technological level and measuring the gap with optimal level), evaluating reasons and effective factors in developing the technological gap and assessing the firm's capacity to overcome the gap (Ernest, 2003).

Technology assessment has been rarely considered in our country at firm level and thus there is not appropriate culture regarding it. Even if some organizations are willing to move in this direction, there are rare sources available for them. In order to survive in the competition area, the organizations are forced to adopt technologic change and advanced technologies. However, the question is: what is the best way for reducing the technological gap for achieving the technology? (Jafarnejad, 2006). It seems that the appropriate tool for verifying and supporting these mental assessments is using technological capability models. Experiences indicate that the models and methods which are used in the firm should have two basic properties: they should be simple and comprehensible, and they should provide acceptable results in short time.

### 3. METHODOLOGY AND RESEARCH MODEL

In order to assess technological capabilities of the firm in this work, technology needs assessment model was used. Technological capabilities are classified as follows in this model (Innosutra, 2007):

Capability of Awareness: it means ability and awareness of the firm in recognizing need for technological improvement.

Capability of Search: it means ability of the firm in identifying technological opportunities and threats.

Various models in relation with innovation and technology assessment are categorized in three general parts (Tabatabaeian, 2005):

#### Models determining gap including:

- ❖ ATLAS Technology Model
- ❖ Porter Model
- ❖ Panda and Ramanathan Model
- ❖ Floyd model
- ❖ Technology Needs Management Model
- ❖ Technology Content Assessment Model
- ❖ Technology Situation Assessment Model
- ❖ Economic Value Added Model
- ❖ Models evaluating gap factors including:
- ❖ Ford Model
- ❖ Lindsay Model
- ❖ Atlas Technology Model
- ❖ Floyd Model
- ❖ Technology Needs Management Model
- ❖ Technological Capabilities Model
- ❖ Models proving solution for compensating the gap including:
- ❖ Ford Model
- ❖ Lindsay Model
- ❖ phaal Model
- ❖ Garcia – Arrola Model
- ❖ Lane Model
- ❖ Technology Needs Assessment Model
- ❖ Science and Technology Information Management System Model
- ❖ Technology Needs Management Model

Capability of Building and Core Competence: it means ability of the firm in creating and building core competence (Differentiation between competitors)

Capability of Technology Strategy: it means ability of the firm in developing an appropriate strategy for supporting business.

Capability of Assessing and Selecting Technology: it means ability of the firm in assessing and selecting an appropriate technologic solution.

KAMSEH ET AL.: Assessment and Analysis of Technological Capabilities in Iranian Oil & Gas Industries (Case study: Oil And Energy Industries Development Company of Qeshm)

Capability of Technology Acquisition: it means ability of the firm in acquiring and utilizing the technology.

Capability of Implemental on and Absorbing Technology: it means ability of the firm for implementing and effective use of technology.

Capability of Learning: it means ability of the firm in learning from experiences to be used in improvement of technology and products.

Capability of Exploiting External Linkage and Incentives: it means ability of the firm in communicating with the external linkage supply and utilization network (universities, cooperation with advisory and research institutions, governmental incentives, etc.).

Following completion of questionnaire by experts, its scores were summed and total score were compared to the values in Table 1, result of which shows level of the firm's capabilities (Khamseh, 2010).

Table 1. Form for determining technology needs assessment

General auditing results	Scores	Capabilit y level	Classificatio n of firms	Partial classification	
Your firm is poor and inefficient in all major areas including utilization, acquisition and development of technology and needs a main and urgent improvement plan	1-120	1	Passive (A)	Beginner	1-40
				On the Middle Way	41-80
				Leading	81-120
Your firm is developed poorly in all areas including technology strategy, research, acquisition and capacity building and it needs many capabilities for reconstruction of these areas.	121-240	2	Reactive (B)	Beginner	121-160
				On the Middle Way	161-200
				Leading	201-240
Your firm is relatively capable in internal capabilities and has a strategic approach to technology	241-360	3	Strategic (C)	Beginner	241-280
				On the Middle Way	281-320
				Leading	321-360
Your firm is a technological developed capable complex and it is able to identify boundary of national technology. In some areas, it has leading and creative approach and takes advantage of technology for gaining competitive advantage	361-480	4	Creative (D)	Beginner	361-400
				On the Middle Way	401-440
				Leading	441-480

KAMSEH ET AL.: Assessment and Analysis of Technological Capabilities in Iranian Oil & Gas Industries (Case study: Oil And Energy Industries Development Company of Qeshm)

According to this model and based on classification in Table 1, the firms are classified into four types in terms of capability (Innosupport, 2006):

Firm Type I (Unaware\Passive): it is such a firm which is not aware of its needs for technology transfer or environmental improvements and it doesn't know which of its technological capabilities should be promoted. It is improbable such firm can have a stable policy in a critical environment. In addition, their competitive forces are highly vulnerable. For example, if there are competitors with low cost or higher quality market demand, they are not able to select appropriate signal or rapid reaction. Even if they are able, probably they would waste their resources by selection improper goals.

Firm Type II (Reactive Firm): these firms recognize necessity for technological capabilities improvement in order to achieve development goals, however, they only react to environmental threats because of their limited internal resources (absence of key skills and individual experiences) and they are not able to utilize and take advantage of the events. Their external networks are poorly

developed. They take their practical technological knowledge mostly from their suppliers and observing behavior of other firms in the industry.

For example, this group just considers signs of the problems, not their origins.

Firm Type III (Strategic Firm): such firms are well aware of the way of promoting their technological capabilities, they have strategic perspective and they have high ability in implementing their projects. They have clear idea about implementing their priorities including time and actors for them. In addition, they possess strong internal capabilities in both management and technology fields. Overall, such firms have strong internal capabilities and think about technology strategically in long and midterm.

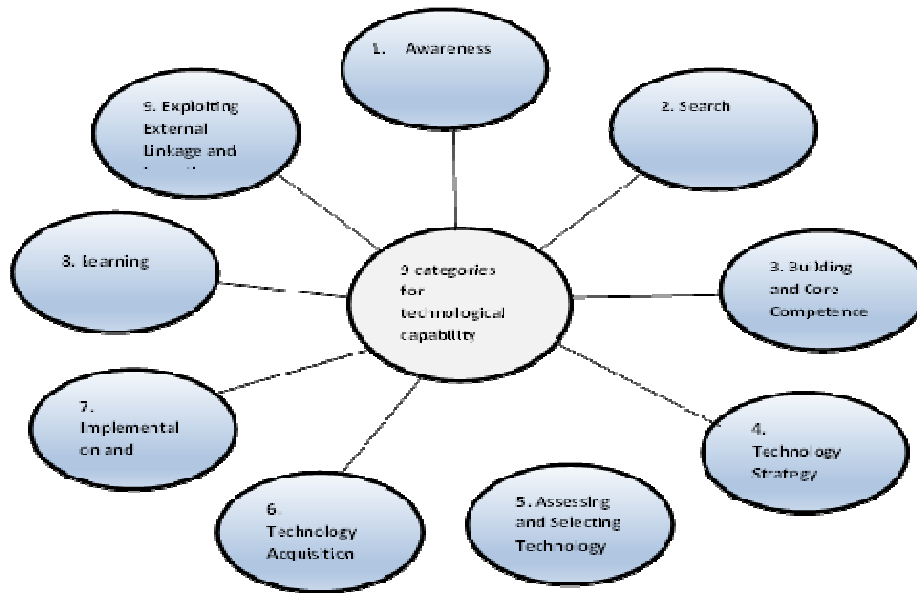
Firm Type IV (Creative Firm): such firms (such as Microsoft, Ford, etc.) have high or mid-level incomes and act rapidly in improving their technological capabilities. They have high ability in implementing new projects and adopting a strategic procedure in ongoing innovation process.

#### 4. RESEACH OBJECTIVES AND QUESTIONS

Fig 1 indicates classification of technological capabilities dimensions based on the technology need assessment model.

Relationship between indexes and dimensions are shown in this figure. Indexes are used in designing questionnaire for data collection.

KAMSEH ET AL.: Assessment and Analysis of Technological Capabilities in Iranian Oil & Gas Industries (Case study: Oil And Energy Industries Development Company of Qeshm)



**Fig 1. Classification of technological capabilities dimensions based on the technology need assessment model**

Aim of the current research is determining technological capabilities level in Qeshm Oil and Energy Industries Development Company. It is an applied survey research.

Research questions include:

- ❖ What is level of technological capabilities in Qeshm Oil and Energy Industries Development Company?

- ❖ What type of the firm is considered Qeshm Oil and Energy Industries Development Company in terms of technological capability level?
- ❖ What are levels of technological 9-capability dimensions of the Qeshm Oil and Energy Industries Development Company?

**5. INTRODUCTION OF STATISTICAL POPULATION**

Oil and Energy Industries Development Company of Qeshm (OEID) was established in order to develop technical knowledge of oil upstream industries in the country and by focusing on collecting and producing technical knowledge through powerful and extensive presence in doing domestic and international projects in the field of oil and gas upstream industries. One of the main subject matters of the company includes doing services in terms of general contracting and doing

all engineering, designing and executive activities and operations related to projects of oil industries (including earth’s surface and underground). Therefore, it can be stated that according to its mission and activity type in oil industry, OEID Company is of active companies in the field of activities in oil upstream industries and performs oil projects as management services, designing and making EPC, contract management, general contractor and consulting services.

KAMSEH ET AL.: Assessment and Analysis of Technological Capabilities in Iranian Oil & Gas Industries (Case study: Oil And Energy Industries Development Company of Qeshm)

Top and middle managers and specialists in Qeshm Oil and Energy Industries Development Company with associate degree to MA degree with over one year of working experience included the research statistical population. Statistical population was

specified at the time of research considering conditions of the company. **Table 2** indicates working experience and educational level of the population.

**Table 2- Characteristics of the statistic population**

		Number	Percent
Education	Bachelor	11	31%
	MS	20	57%
	PHD	4	12%
Sum		35	100%
Average work experience	3≤record≤5	6	17%
	6≤record<10	18	51%
	11≤record≤14	8	22%
	record≤15	3	10%
Sum		35	100%

**6. SUMMARIZATION OF RESEARCH FINDINGS**

Data were analyzed in two ways.

Statistical Analysis: collected data are classified using statistical indexes.

**Expert Judgment-based** Analysis: using expert judgment for data analysis is one of the main ways

of decision making in such research works which are very important in terms of findings usage and error probability or high error percent in other data analysis methods may reduce their reliability. This method was used for data analysis in the current work.

**Findings for Q1:**

Table3 indicates average percent of capability level in technological dimensions.

**Table 3. Average of scores and percent of capability in technological dimensions**

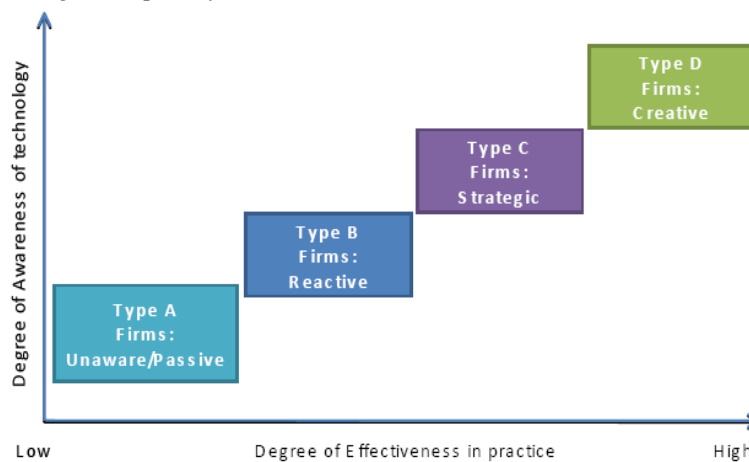
KAMSEH ET AL.: Assessment and Analysis of Technological Capabilities in Iranian Oil & Gas Industries (Case study: Oil And Energy Industries Development Company of Qeshm)

Dimension	Index No.	Average capability score
Awareness	2	80.28%
Search	2	74.86%
Building and Core Competence	2	73.40%
Technology Strategy	3	77.36%
Assessing and Selecting Technology	2	74.72%
Technology Acquisition	2	72.43%
Implemental on and Absorbing Technology	2	70.07%
Learning	3	72.87%
Exploiting External Linkage and Incentives	6	67.75%
Average total score	24	69.95%

**Findings for Q2:**

sum of means for 24 questions give the value 349,75. Considering table 3 and diagram 1, which shows area of techonlgiacial capability of the firms,

the firm is leading place of type III. In other words, it is a strategic firm.



**Diagram 1. Area of technological capabilities of the firms (Innosutra, 2007)**

**Findings for Q3:** Findings for classification of technological capabilities dimensions based on the

technology need assessment model are given in Table 4.



KAMSEH ET AL.: Assessment and Analysis of Technological Capabilities in Iranian Oil & Gas Industries (Case study: Oil And Energy Industries Development Company of Qeshm)

**Table 4. Technological capabilities dimensions**

Item	Dimension	Index	Indexes	Score (%)	Average score (%)
1	Awareness	1	Information technology trade	80%	80.28%
		2	The role of technology in business strategy	80.56%	
2	Search	3	Assessment of technological opportunities	75.14%	74.86%
		4	Assessment of technological weaknesses	74.58%	
3	Building and Core Competence	5	Having specific technological capabilities.	60.28%	73.49%
		6	Awareness of external and internal information technology resources	86.53%	
4	Technology Strategy	7	Company management skills in defining technology strategy	71.39%	77.36%
		8	Understanding the basic technological priorities	76.81%	
		9	Having a vision for technology development	83.89%	
5	Assessing and Selecting Technology	10	Technology selection knowledge	75.42%	74.72%
		11	Awareness of the best technology resources	74.03%	
6	Technology Acquisition	12	Effective acquisition of technology from foreign sources	74.72%	72.43%
		13	Communication with external suppliers of technology	70.14%	
7	Implemental on and Absorbing Technology	14	Proper organization of technological activities of firms	65.14%	70.07%
		15	Transparent process of technological projects	75%	
8	Learning	16	Appropriate system of technology assessment	70%	72.87%

KAMSEH ET AL.: Assessment and Analysis of Technological Capabilities in Iranian Oil & Gas Industries (Case study: Oil And Energy Industries Development Company of Qeshm)

		17	Considering future technology projects.	83.33%	
		18	Ability to learn from one technology to another technology	65.28%	
9	Exploiting External Linkage and Incentives	19	Using government incentive policies	65.28%	67.75%
		20	Using Consultants for Assessment of Technology	74.58%	
		21	Using of outsiders to develop technology	75%	
		22	Using other companies' technology strategy	78.82%	
		23	Using cooperation of universities	66.39%	
		24	Using cooperation of governmental research centers	50.56%	

### 7. RESULT

Technological capability of this company is in Type II firms and near to Type IV. Firms Type III (strategic firms) has proper view about the way of promoting their technological capabilities. They have high ability in implementing their projects and they have strategic look at capacity making. In addition, because of their clear prioritizing attitude, these firms are able to formulating strategies and increase their increasing internal capabilities in managerial and technological fields.

Although firms Type III are able to react rapidly and effectively to new environment-friendly technological regulations, they need new policy for increased innovation in leading areas. Additionally, they may need better access to capital and service goods. Firms Type II take advantage of their

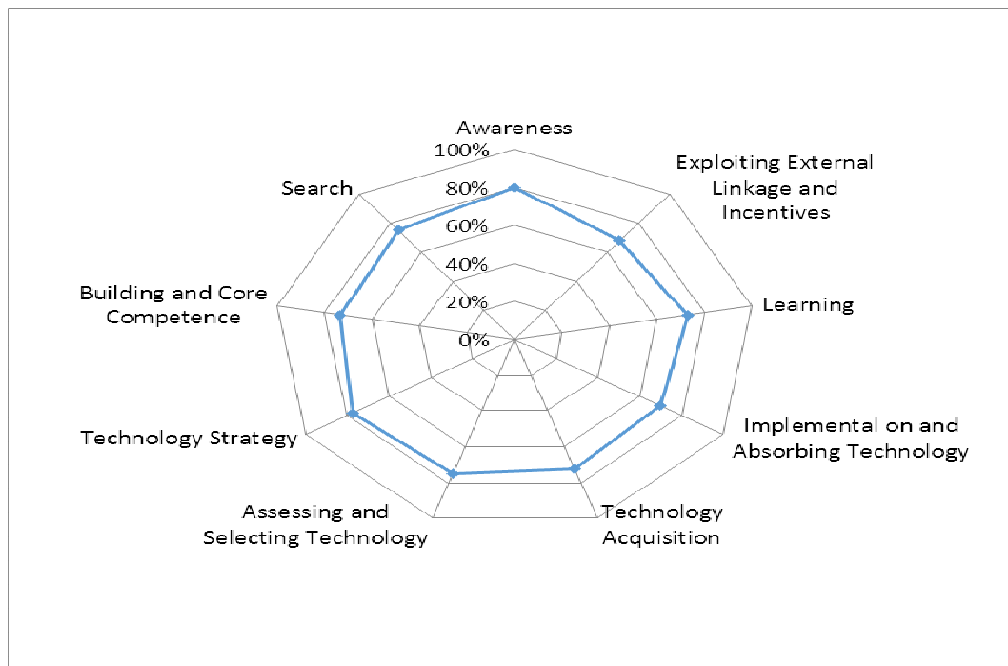
strategic awareness focused on the latest technologies for long and mid-term, and they may need support of other firms and institutions for technology development among small and medium sized firms as well as other less-developed firms. These firms move beyond technology boundaries in most areas and move gradually toward Firms Type IV; i.e. highly creative and innovation firms.

On the other hand, there is gap between optimal technological capability level (score 100%) and current level which is shown in Table 5 and Diagram 2.

**Table 5. Gap between optimal level and current level of technological capabilities dimensions**

KAMSEH ET AL.: Assessment and Analysis of Technological Capabilities in Iranian Oil & Gas Industries (Case study: Oil And Energy Industries Development Company of Qeshm)

Current Gap	Average Score	Index No	Dimensions
19.72%	80.28%	2	Awareness
25.14%	74.86%	2	Search
26.60%	73.40%	2	Building and Core Competence
22.64%	77.36%	3	Technology Strategy
25.28%	74.72%	2	Assessing and Selecting Technology
27.57%	72.43%	2	Technology Acquisition
29.93%	70.07%	2	Implemental on and Absorbing Technology
27.13%	72.87%	3	Learning
32.25%	67.75%	6	Exploiting External Linkage and Incentives
30.05%	69.95%	24	Total average score



**Diagram 2. Technological capabilities level in different dimensions**

Top leaders of the company can overcome technological gap by proper planning and defining improvement projects. Thus, considering research findings, following cases are suggested for

improving dimensions which have gap with the optimal level:

KAMSEH ET AL.: Assessment and Analysis of Technological Capabilities in Iranian Oil & Gas Industries (Case study: Oil And Energy Industries Development Company of Qeshm)

Considering 25.14% gap in search capability dimension versus optimal level, following measures are suggested:

The firm should run codified and periodical assessments considering its electronic opportunities and act for solving its technological problems as soon as possible with the minimum costs.

Considering 26.60% gap in core competence capability dimension versus optimal level, following measures are suggested:

The firm should be equipped with special technological capabilities and take advantage of them.

Considering 29.93% gap in technological application and absorption capability dimension versus optimal level, following measures are suggested:

Technology innovation and research and development department should be established in

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the firm and verbal processes for implementing electronic projects should be changed in structured processes.

Considering 27.13% gap in learning capability dimension versus optimal level, following measures are suggested:

Firm should act for improving appropriate systems for assessment of technological projects and increase its skill and capability for learning from one technology to other technology.

Considering 32.25% gap in external linkage utilization capability dimension versus optimal level, following measures are suggested:

The government should encourage firms by imposing incentive policies regarding investment in technology and the firms cooperate more with universities and other firms and governmental research institutes in developing and implementing their technological strategy.

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