



## Providing a Model for Assessment and Analysis of Technological Capabilities in Iran Petrochemical Industries Engineering Services (Case study: Hampa Energy Company)

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### ABSTRACT

One of the primary factors for failing the use of technology to acquire competitive advantage in firms, is their lack of knowledge, and understanding of the technological capabilities of firms and their use for comparative advantage. Evaluating models to measure the technological capabilities are tools that are applied to determine the capabilities needed for implementing the technological priorities. This measurement not only identifies the impoverished and problematic areas in a firm, but also identifies the comparative advantages of a firm, and recognizes them.

Hampa Energy Engineering and Design Company (HEDCO) is located in Shiraz and is active in the fields of principle engineering, detailed Engineering, and shopping services for oil, gas and petrochemical projects. The company has all of the engineering sections including process, piping, structures, reservoirs, machineries, electric and precision equipment. Hampa Energy Company, owns a unique technological software which is called (HTMS) Hedco Total Management System in order to manage its technological projects in the fields of engineering procurement, implementation, control and monitoring. One of outstanding technological and achievement of this company is the Hedco License for ammonia unit, catalyst reformers design, technical design of the cold reservoirs, guidance of Eram energy consortium policy, the new software platform, for the activities of AVEVA Engineering.

One of the primary factors for failing the use of technology to acquire competitive advantage in firms, is their lack of knowledge, and understanding of the technological capabilities of firms and their use for comparative advantage. Evaluating models to measure the technological capabilities are tools that are applied to determine the capabilities needed for implementing the technological priorities. This measurement not only identifies the impoverished and problematic areas in a firm, but also identifies the comparative advantages of a firm, and recognizes them.

The present study presents an indigenous model to measure and analyze the technological capabilities of petrochemical engineering services industry. And based on that, it analyzes the technological capabilities of Hampa energy firms as well. The study has been a survey type and been carried out by using a questionnaire, and sample population with Cochran test set as a tool.

**KEYWORDS:** Technology, Innovation, Technological Capabilities

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### INTRODUCTION

To remain in the competitive realm of today, organizations must inevitably change their technique, and develop advanced technologies. Nowadays, effective use of technology, is the most important issue facing technology-driven companies and certainly, this process will be intensified in the future. (Megantez, 2004). With the advancement of technology at different levels and also the necessity of using modern technology the need for technology assessment is greater than ever. Technological assessment is a tool or framework of thought, which helps better understanding of technology and making decision about it. Therefore, for the development and application of new technologies, first of all, the existing technology should be evaluated. Technology is not limited to hardware, and the equipment only, but it includes other dimensions, and many components. Essential

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technological capabilities of an organization consists of a set of distinctive skills (which is the organization's human capital), organizational roadster, (which is run at company level) and special assets, (Products advanced Technology, information system, computer aided manufacturing, etc.) which are all the underlying basis for organization's competitive advantage. (Harrison & Samson, 2002).

Since there is a direct relationship between development of technology and economic growth in an organization, then it is possible to use the rate and level of technological development of that organization as an indication of strength and authority. Therefore to expand the technological technique we must first achieve technological know-how, and then upgrade the percentage of it (Tabatabaieian, 2005).

In our country and at company level, very little attention has been paid to technological capabilities, specially to petrochemical engineering, and very little efforts has been taken towards this kind of culture as well. Even if organizations are willing to move in that direction, there are very little references and resources available to them.

On the other hand, the evaluation and audit of the technology is one of the tasks of strategic managers, who with regard to environmental conditions and their capabilities and strength, as well as their weaknesses conduct proper policies necessary, to achieve the goals of the organization.

Assessment of technology within the firm concludes which technology works better, improves production activities cheaper and easier compared to the other technologies, so as to achieve firm's competitive advantage. It also suggests whether this new technology is compatible with structure and culture, as well as with other technologies within the organizations, or not.

The technology assessment is a valuable decision-making tool in the industrial sector, and it causes a deployment of a framework, in which physical results of human, and information are embraced so it to maximizes its benefits and to minimize its ill-effects. Since up to present time, the engineering company of Hampa Energy has not taken any steps to study and analyze its technological capabilities, therefore, accomplishing such research in this study for the company, is necessary to design and implement its petrochemical industry projects in which the company is very active.

## REVIEW OF LITERATURE

The evaluation and assessment of technology can constitute a valuable tool for the company from several point of view. (Khalil, 2000).

- 1- As a recognition tool to determine the strengths and weaknesses.
- 2- As a method to identify and aim at the targets of improvement opportunities.
- 3- As a tool for comparative modeling against active competitors in technology with similar industries.
- 4- As an assessment tool for Progress and successfully implemented programs.
- 5- As a self-assessment tool which will be followed by proper technological planning.

Perspectives and different model are available and introduced in connection with the technology assessment, which are grouped in three main categories are:

- 1- Models to determine the technological gap.
- 2- Models to assess the causes of the technological gap.
- 3- Models in order to offset the technological gap.

Models and methods that are used to assess the technologies within the companies, should have two important features:

- 1- Be simple and understandable.
- 2- Have the ability to deliver reasonable results in short time.

Different technologies, and various constitutional systems affect human environment, in the surrounding areas, and these constitutional systems, in turn, have their own reactions, therefore, technology assessment should be done with a general look and attitude. In investigating the advantages and constraints of technology, criteria should be only limited to the effectiveness of technical and economical benefits. However, evaluation should also consider the surrounding human environment, technology assessment, is in essence to minimize the positive effects, and the development of consistent technologies to the surrounding environment. (Jafar-Nezhad, 2006).

Another dimension of evaluation, is addressing technological capabilities. Technological capabilities has a broad concept, which contribute to the ability to use technology effectively, and the ability to make changes and innovation in the technology (kianwie, 2003).

Technology assessment includes all permanent efforts to identify, analyze and evaluate the effects of applying of existing or new emerging technologies on different sectors of society. The results of these efforts is set forth as

a guideline and is meant to select the most appropriate technologies available in the hands of decision makers. According to this definition it could be inferred that, technology assessment is a continuous and permanent effort. And for technological development, nothing is more important than evaluating it. It should be noted that, any assessment and action in this area, requires to perform a series of initial operations to identify the main indicators. In this type of assessment, all technology components including the brain-ware, software and hardware, organizational-ware, and management should also be evaluated. (Ghazi Nouri, 2004).

Technological capability assessment is a process in which the current level of competency and technological capabilities of an organization is measured to identify the strengths and improvable parts in an organization and also by comparing technological capabilities of organization with competitors and with ideal level, then the technological gap be identified. (Putranto, 2003).

Technological capability gap, indicates that the existing gap between the company's current technological capabilities and the needed level of technological capability in future (Tsukamoto, 2008).

**Methodology and Research Model:**

With respect to the fact that the results of this paper will be advantageous to the engineering company of Hampa energy and also other petrochemical industrial companies, this study aims to be an application type, and since for collection of data, we had to refer to the different companies, therefore, it is a field type research, and also considering that for data collection we had to use questionnaires, thus the method of this study is procedural type. And since this was prepared in engineering company of Hampa energy then this research is a case study.

The conceptual model of this research is as in Figure 1, and the tree structure used to design questionnaires and indices are as in Figure 2. Also, the validity of questionnaires is based on content analysis method, and its reliability with Cronbach's alpha coefficient has been approved to be 0.87.

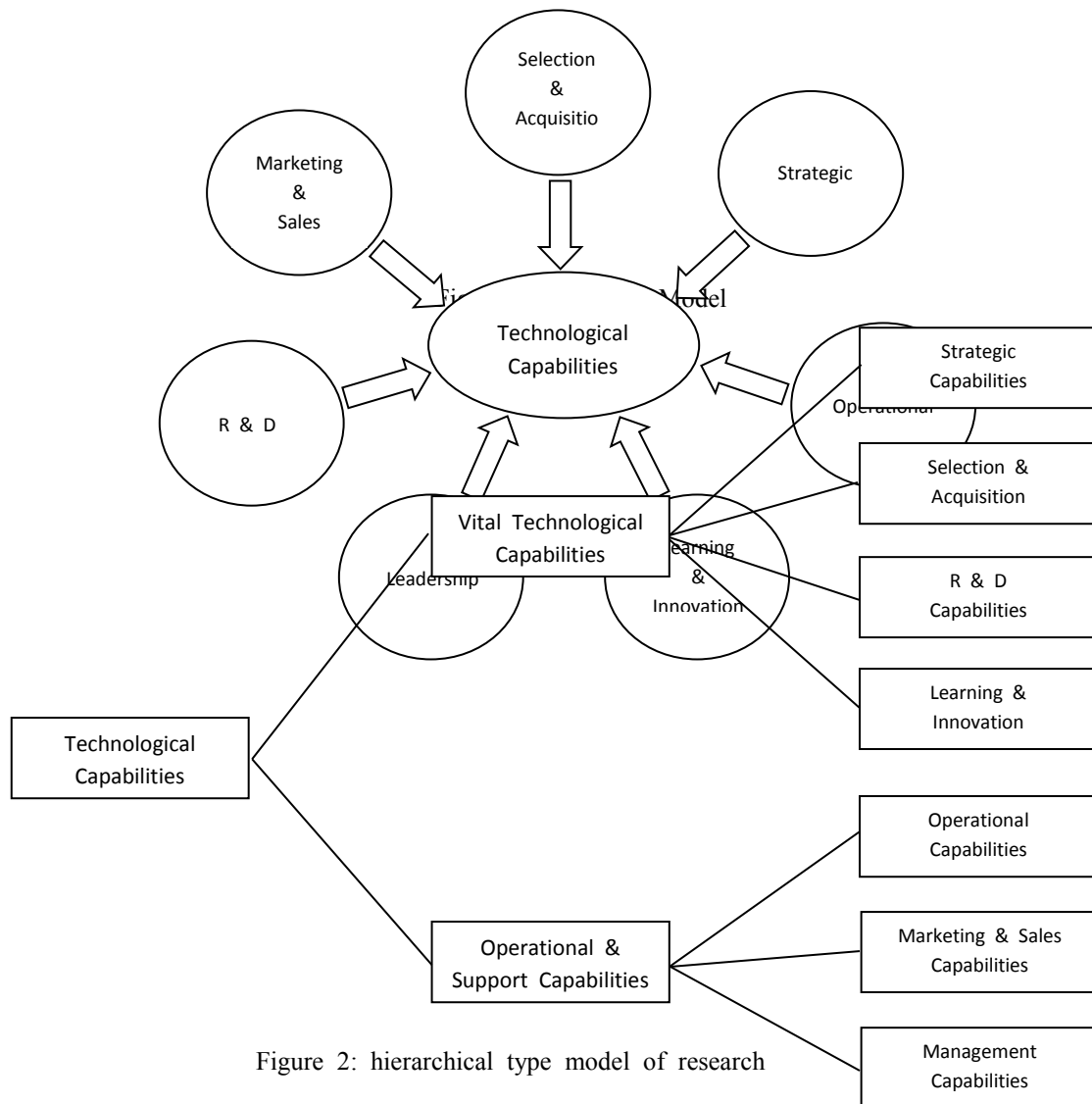


Figure 2: hierarchical type model of research

**Questions and hypotheses of research:****Questions:**

- 1- What are the total technological capabilities of firms, and in which technological capabilities a technological gap exists?
- 2- How are the ranking of technological capabilities in engineering and design company of Hampa Energy Company?

**Hypothesis:**

- 1- Technological capabilities of Hampa Energy Company is at the proper level.

**The population and sample size:**

Middle managers and senior experts of Hampa Energy Company, with Master degrees and Bachelor degrees, with more than 7 years of working experience acting as experts, form the population of research samples.

Population of research samples was organized during the investigation, and with regards to the company conditions. Experts have been selected from the company's technological units, such as quality control unit, mechanics, project engineers, and project managers. Sample population size, has been specified using the Cochran's *Test*. Recognition of research demographic profile is as in Table 1.

**Table 1: Educational records and work experience of sample population**

% of total	Number	Education degree
56%	14	Bachelor
36%	9	Masters
8%	2	PHD
100%	25	total

**Summarizes the research findings:****First research question:**

Comparable levels of technological capabilities of the company and the present gap in each dimension have been shown in Table 2 and Diagram 1.

**Table 2: Comparison of technological capabilities at various aspects.**

Existing gap (%)	Existing capability (%)	Secondary dim	Main dim
26.63	73.37	Strategic capability	Vital technological skill capability
27.03	72.97	selection and acquisition capabilities	
23.75	76.25	R & D capability	
22.93	77.07	Learning & innovative capability	
27.34	72.66	Operational capability	Operational supportive skill capability
24.53	75.47	Sales & marketing capability	
26.19	73.81	Leadership capability	
<b>25.75</b>	<b>74.25</b>	Total average	

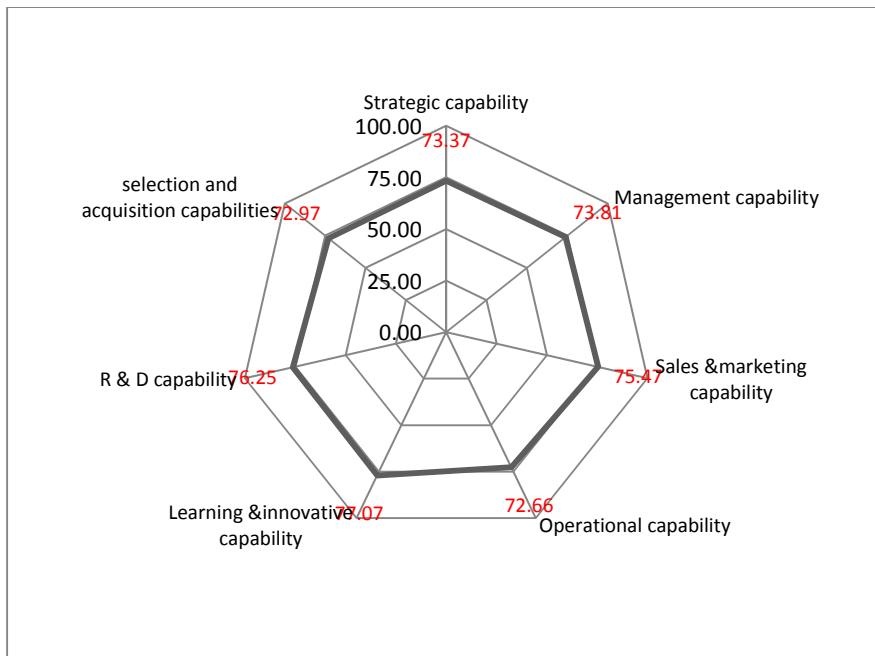


Diagram 1: Comparison of technological capabilities at various aspects

Second research question:

With the help of Friedman test, and using feedback from respondents, the dimensions of technological capabilities of Hampa Energy Company have been prioritized. Ranking of technological capabilities is shown in Table 3 and Diagram2.

Table 3: Prioritization of dimensions of technological capabilities

Ranking	Variables
3.39	Strategic capability
3.70	selection and acquisition capabilities
4.28	R & D capability
5.44	Learning & innovative capability
3.56	Operational capability
3.86	Sales &marketing capability
3.80	Management capability



Diagram2: Prioritization of dimensions of technological capabilities

In this research and according to Table 3, among the properties studied, learning capabilities innovation and research and development (R & D).

Were respectively, with the highest average ranking (4.28, 5.44) which puts them in the highest ranking position. Sales and marketing capabilities and with average ranking of 3.83 stayed at third priority.

### Research Hypothesis:

Single sample t test was used in order to respond to research hypothesis. The results of analysis has been shown in Tables 4 and 5.

Technological capability of the company is not at the appropriate level  $H_0 : \mu_R \leq 10$ ,

Technological capabilities of the company is at the appropriate level  $H_1 : \mu_R > 10$ .

Table 4: single-sample t-test statistics

single -sample t-test statistics				
Variables	No.	mean	deviation	Standard deviation error
Technological capability	32	14.891	1.814	0.321

Table 5: single-sample t-test

single -sample t-test						
Variables	t	Deg. Of freedom	Range of significance	Mean variance	tolerance	
					Lower limit	Upper limit
Technological capability	15.255	31	0.00	4.891	4.237	5.545

According to Table 5, if the significance level is smaller than 0.05 , and the result is positive and larger than +1.697, it could be said that, the mean technological capabilities are at desirable level, and in cases when the significance level is less than 0.05 and the resultant is negative and smaller than -1.697, and also if the observed significant levels is greater than 0.05 and the resultant obtained is between -1.697 and +1.697, it can be said that the average technological capabilities is below the appropriate level. Therefore, according to the above description, null hypothesis is rejected (sig = 0.00), so average parameters of technological capabilities of Hampa Energy Company is at the proper level.

## RESULTS

According to the results of Table 2, learning, and innovation capabilities, are with the maximum scores and the smallest gap and hold the best position among the technological aspects. The selection and acquisition capabilities as well as and operational capabilities are with the lowest rated capacity and the most gaps.

On the other hand, the company's total technological capabilities is equal to 74.25%, and according to Figure 1 the different technological capabilities in the company have a comparable symmetry and a balanced growth. As is shown in Table 3, learning Capabilities and innovation in the company have the highest priority which has the exact conformity with the potential corporate knowledge. However, the Strategic Capabilities has the lowest priority in the company, and this particular issue has attracted and demanded the attention of senior management in planning the suitable strategic technology and to promoting strategic vision.

In summery and with regards to the results of research hypotheses obtained from Table 4 and 5, the technological capabilities of Hampa Energy Company is at the appropriate level, which indicates and implies that the senior managers are fully aware of technological skills as a competitive advantage for the company.

According to the above presentation, the following suggestions are offered:

- 1- Establishing technological training courses for the company managers and experts.
- 2- Set forth the company's technological strategy.
- 3- Establishing technological management unit and constitute technological management approach.
- 4- Evaluation of a company's technological capabilities and defining the appropriate projects for improving the gaps.

5- Participation in National Technological Award.

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