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**THE ASSESSMENT OF THE TECHNOLOGICAL CAPABILITY LEVELS  
OF AIRCRAFT MAINTENANCE SYSTEM WITH PROVIDING  
SOLUTIONS FOR IMPROVEMENT: CASE STUDY OF AIRLINE OF THE  
ISLAMIC REPUBLIC OF IRAN, "HOMA"**

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**ABSTRACT**

Organizational success in today's competitive business environment depends on the use of advanced technologies. Thence performance of each firm is affected by recognition of proper technology and the ability of utilizing appropriate kind of it. Modern organizations are always in crisis to understand the technology, effective use, and also to keep their pace with rapid technological changes. Hence, as the technology improves, the need to identify novel technologies, the necessity to achieve a competitive advantage due to technology and the identification of vulnerable areas and importance of addressing the issue of technology assessment becomes apparent. Technology assessment is a tool that enables decision making process of the organization. In this paper, using the model of technological needs, the technological capabilities of the maintenance system of The Airline of the Islamic Republic of Iran "Homa" has been analyzed and developed strategies for compensating existing gaps in technology of this organization. This model using a questionnaire of 24 questions and 9 dimensions is assessing the capability levels of the organization and shows the position of the company in each indicating the technology gap.

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

**INTRODUCTION**

Nowadays the competitive advantage of nations has raised supporting technology and industry progress and economic development, and evaluating technologies as a forwarding tool in changing and developing technology (Chen Lo, 2010). The growing importance of technology and related topics has preoccupied policymakers in different countries for years. Policymakers in order to study the issues and make decisions about various aspects of the technology need tools to provide the necessary information for them and assist them in policy and decision-making in this area. Recently this issue has become more prominent, because of more sophisticated technologies and due to the increasing pace of change in technology (Qazi Noori, 2005). Since the aircraft maintenance industry, is a high-tech industry, along with the development of modern technologies in the context of intense competition, it is constantly dealing with rapid technological change and the emergence of advanced and new technologies. In these circumstances, success and remaining in competition for firms is dependent on their genuine perception and the proficiency to perform proper technology in the least possible time, using the simplest and least expensive method to create a competitive advantage and enhance the efficiency and effectiveness of the industry.

**Literature Review**

Technology is any applied and disciplined knowledge based on experience or scientific theory which is used in methods of production, organization or machinery (Qazi Noori, 2005). Technology is defined as

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all the knowledge, products, tools, and methods and systems that can be employed to provide the product or service. Technology is the procedure and the tool through which we accomplish our intention. Technology is practical knowledge and tools to assist human efforts (Khalil, 2000). Technology is seen as strategies and goals that produces subtly and effectively brings (Brown,1998). Technology is scientific application of technical and scientific achievements in order to fulfill one or more requirement(s)(Jordan et al, 2003).

As well assessing the technological capabilities is the analysis conducted to identify the strengths and weaknesses of technological assets and it aims to assess the situation and advanced technology of manufacturing company compared to competitors (Porter, 1998). In Lindsay's view point, assessing technological capabilities is the process of reviewing technological capabilities to aid organizations considering their long-term aims (Lindsay, 1999).

Assessing of technology has been investigated through various perspectives. In Unido's idea, technology need assessment is a tool and a frame work that is designed to detect and identify capabilities needed to implement the technology priorities in developing countries.(Unido, 2002)

These days technology has become one of the most efficient weapons in competitive war of firms (Qazi Noori, 2005). Technology does not simply include hardware and equipment, but it also concludes various components and dimensions. Core technological capabilities of an organization, contain a set of distinct skills (that is in human resources), organizational routines (that is applied in company level) and particular assets (developed production technologies, information systems, production using computer, etc.) that underpin competitive advantages of the organization. (Harrison and Samson, 2002)

Perhaps today the most important issue facing technology-driven companies is the effective use of technology, and certainly this trend will intensify in the future. (Megantz, 2002)

Therefore senior managements of economic firms with proper understanding of technologic capabilities of their organization, identifying technological developments in the world and over watching competitors' attempts to accomplish new technologies, constantly expand their organization's technological capabilities. Meanwhile a firm without the knowledge of it's strengths and weaknesses on one hand and the knowledge of environmental changes on the other hand, is not able to plan strategically for it's future (Khamse, 2012). Technology assessment is a form of policy research that is able to provide a comprehensive assessment of a technology for decision-makers (Sharif, 1983).

Nowadays, to remain in competitive environment, organizations must inevitably turn to the evolution of technology and the creation of advanced technologies. But the question which arises is that in the path of technology, what is the best way to reduce the technological gap? (Jafar Nejad, 2007)

It seems that the appropriate tools to verify and authenticate the subjective estimates, are technological capability models. Experience shows that the models and methods that are employed in a company, should have two basic specifications. Primarily, they should be simple and understandable, and furthermore, they should provide the result in a short and acceptable time. On the other hand, technology assessment and certification is one of the tasks of strategic managers that should be done according to the environment and their own capabilities as well as examining weaknesses, strategies, and necessary policies to achieve the goals of the organization (Tabatabaian, 2006).

### **Classification of Different Models of Technology Capability Assessment**

These days, several models are proposed in relation to the assessment of technological capabilities. these perspectives and models are classified in three general parts as described in Table 1.

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**Table1: Classification of technological capabilities assessment models (Khamse, 2012)**

| Gap Determining Models   | Cause of the Gap Models   | Solution Provider's for the Gap   |
|--|---|---|
| WIPO Model<br>Porter Model<br>Panda and Ramanatan Model<br>Floyd Model<br>Technological Needs Management Model<br>Technological Content Assessment Model<br>Technology Position Assessment Model<br>Economic Added Value Model | Ford Model<br>Lindsay Model<br>WIPO Model<br>Floyd Model<br>Technological Needs Management Model<br>Capability Levels of Technology Model | Ford Model<br>Lindsay Model<br>Fall Model<br>Garcia and Areola Model<br>Lien Model<br>Technology Need Assessment Model<br>Management Information Systems Of Science and Technology Model<br>Technology Needs Management Model |

**INTRODUCING THE UTILIZED MODEL IN THIS STUDY**

In the present study in order to assess the technological capabilities of the organization, technological needs assessment model has been employed. Pursuant to this model, firms' capabilities are measured through 9 dimensions, via a 24-questions questionnaire. Categorization of technological capabilities in this model are shown in Figure 1:



**Figure 1: Categorization of technological capabilities(Innosutra, 2007)**

Awareness: it means the ability and awareness of the company in recognizing the need to improve technology.

Search: the capability of the company in detecting technological opportunities and threats.

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**Building & Core Competence:** it is the company's ability to build core competences (differentiation between competitors).

**Technology Strategy:** the ability of the company in developing a proper strategy to support the business.

**Assessing and Selecting Technology:** it means the capacity of the company in assessment and selection of a suitable technological solution.

**Technology Acquisition:** the Company's proficiency to obtain and utilize a technology.

**Implemental on and Absorbing Technology:** it indicates the company's ability in the implementation and effective use of technology.

**Learning:** In order to improve the company's ability to learn from previous experiences to use new technologies and products.

**Exploiting External Linkages and Incentives:** it is the company's ability to correspond with the network of contractors and external links (universities, working with consultative and research institutions, governmental incentives, etc.).

**Table2: Determination of the Results of Technology Needs Assessment (Innosupport, 2006)**

| The overall audit results  | Sum of Scores | Capability Level | Classification of firms | Partial ranking |         |
|--|---------------|------------------|-------------------------|-----------------|---------|
| Your organization is incompetent in all important domains and needs improved program for recovery.   | 1-120         | 1                | Passive (A)             | 1-40            | Novice  |
|  |               |                  |                         | 41-80           | Halfway |
|  |               |                  |                         | 81-120          | Pioneer |
| Your company in most of strategy, research, acquisition and capacity buildings is poorly developed and many elements are needed for reconstruction.  | 121-240       | 2                | Reactive (B)            | 121-160         | Novice  |
|  |               |                  |                         | 161-200         | Halfway |
|  |               |                  |                         | 201-240         | Pioneer |
| Your organization is relatively strong in internal capabilities and has a strategic approach to technology.  | 241-360       | 3                | Strategic (C)           | 241-280         | Novice  |
|  |               |                  |                         | 281-320         | Halfway |
|  |               |                  |                         | 321-360         | Pioneer |
| Your company has fully developed technological capabilities and can identify the boundary of the National Technology. In a number of areas has a creative and pioneering approach and uses technology to gain competitive advantage. | 361-480       | 4                | Innovative (D)          | 361-400         | Novice  |
|  |               |                  |                         | 401-440         | Halfway |
|  |               |                  |                         | 441-480         | Pioneer |

According to this model and based on the categories in Table 2, firms are divided to four types in terms of the technological capabilities:

The first kind of firm (passive agent): the first type of agent is not conscious of its requirements for transmission of technology or environmental improvement and does not know which technological

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capabilities need improvement; such an agent is unlikely to be able to have a stable policy in critical environment.

The second type of firm (active agent): These firms identify the necessity to improve technological skills to attain development objectives, but due to their inadequate internal funds (lack of key skills and personal experiences), only respond to environmental pressures and are unable to exploit of the occasions.

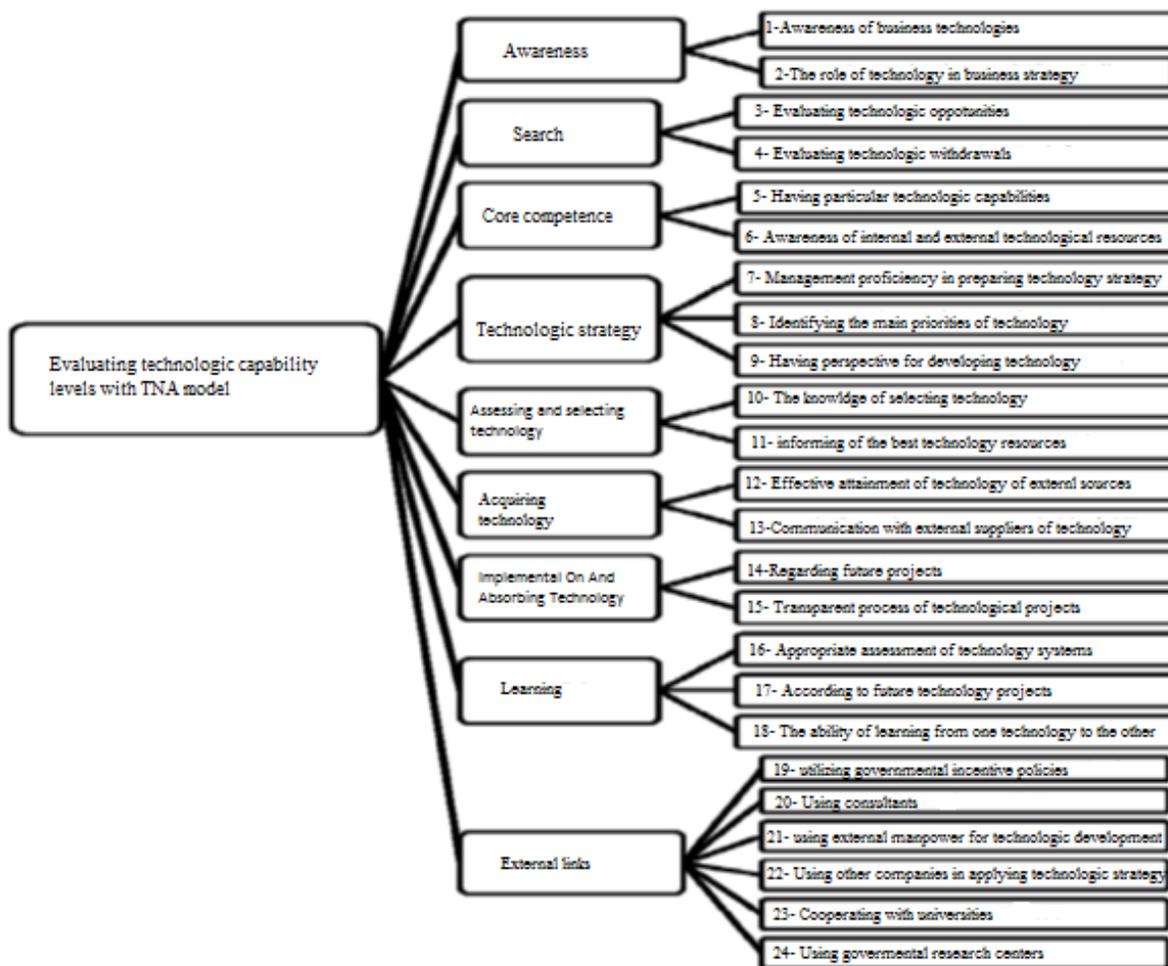
The third kind of firms (strategic agent): These firms are well aware of how to expand their technological capabilities, have a strategic sight and a high capacity to accomplish their projects.

Fourth type of firms (creative agent): most of these firms (such as Microsoft, Ford, etc.) have huge amount of income and attempt promptly to expand their technological capabilities.

**Introduction of Indicators of The Research**

Figure 2 shows the classification of technological capabilities dimensions in accordance with technology needs assessment model.

Communication parameters and dimensions used in this study are shown in the figure. These indicators were used in designing the questionnaire for gathering the data about the research questions.



**Figure2: Categorization of technological capabilities based on technological needs model**

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### The Purposes and Questions of The Research

The purpose of this study was to determine levels of technological capabilities of airline of the Islamic Republic of Iran "Homa" and also determining the extent of the gap in order to enhance the company's technological capabilities. This study is operational in purpose and in method is survey.

Research questions include:

1. What level is each of the 9 indicators of technological capabilities of the company?
2. What is the extent of the company's technological capabilities?
3. Based on the levels of technological capabilities, this company is included in ranking of which kind of classification of companies?
4. What is the extent of the existing gap between the different aspects of technological capabilities with the desirable level?

### Participants

Airline of the Islamic Republic of Iran, "Homa", was established in 1962. It's head office is located in Tehran, but in order to provide more complete services, it has numerous branches in other cities, as well as stations in other countries. Coverage and flight services to most parts of the world and Iran are of the major activities of the company. Likewise, the company is able to repair any type of it's own aircrafts and perform light and heavy checks of flight. The company besides the wide range of knowledge, skills and available equipment, has well -trained and skilled personnel that enable it to provide aircraft maintenance for other airlines.

Middle and senior managers and specialists, as well as engineering, research and development, maintenance, planning and production control departments also, the engineering & maintenance training department of the Islamic republic of Iran, "Homa", with bachelor degrees to Doctorate, with over three years of experience as specialists and experts are the population of this study.

According to the company's limited population of the experts and the situation of the company at the time of the research, the total numbering method has been applied for selection of the population of the study. (Table3).

**Table 3: Descriptive parameters of respondents**

|   | Educational situation | Number | Experience average (year) |
|---|-----------------------|--------|---------------------------|
| 1 | BS                    | 21     | 17.6                      |
| 2 | MS                    | 11     | 14.3                      |
| 3 | Ph.D.                 | 1      | 24                        |
|   | Total                 | 33     | 18.6                      |

### METHOD OF DATA ANALYSIS

Two different methods were used to analyze the research data:

- A. Statistical analysis: in this method, data collected by relevant statistical indicators are summarized and categorized.

The analysis based on experts' judgment: Using professional judgment of professionals to analyze the data, is one of the most significant methods of decision making in the studies which the usage of their conclusions are critical and the probability of inaccuracy or error in other analysis methods may decrease the validity of the findings.

### FINDINGS

#### Findings of the First Research Question

Table 4 shows the percentage of each of the 9 indicators of the study, according to the findings of the participants.

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**Table 4: The level of capability of the nine technological dimensions**

| Dimensions                              | Index | Indices  | Score Of Index (%) | Existing Gap (%) |
|---|-------|--|--------------------|------------------|
| Awareness                               | 1     | Awareness of the technologies of commerce                    | 73.18%             | 26.82%           |
|   | 2     | Technology's role in commercial strategy                     | 81.82%             | 18.18%           |
| Search                                  | 3     | Assessment of technological opportunities                    | 62.42%             | 37.58%           |
|   | 4     | Assessment of technological weaknesses                       | 68.33%             | 31.67%           |
| Building & Core Competence              | 5     | Having special technological capabilities                    | 74.39%             | 25.61%           |
|   | 6     | Awareness of internal and external technological resources   | 78.33%             | 21.67%           |
| Technology Strategy                     | 7     | Skill of management in preparation of strategy of technology | 58.79%             | 41.21%           |
|   | 8     | Knowing the company's technological basic priorities         | 70.61%             | 29.39%           |
|   | 9     | Having a proper vision for technology development            | 61.67%             | 38.33%           |
| Assessing and Selecting Technology      | 10    | Knowledge of selection of technology                         | 67.88%             | 32.12%           |
|   | 11    | Knowing the best resources of technology                     | 76.52%             | 23.48%           |
| Technology Acquisition                  | 12    | Effective acquisition of technology from external sources    | 66.82%             | 33.18%           |
|   | 13    | Relation with external suppliers of technology               | 62.88%             | 37.12%           |
| Implemental on and Absorbing Technology | 14    | Effective organization of firm's technological activities    | 63.33%             | 36.67%           |
|   | 15    | Clear process of performance of technological projects       | 54.55%             | 45.45%           |
| Learning                                | 16    | Appropriate system for assessing technology                  | 56.97%             | 43.03%           |

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|  |    |  |        |        |
|--|----|--|--------|--------|
|  | 17 | considering future technological projects                  | 55.61% | 44.39% |
|  | 18 | The ability to learn from one technology to another        | 77.42% | 22.58% |
| Exploiting External Linkage and Incentives | 19 | Using governmental encouraging policies                    | 48.03% | 51.97% |
|  | 20 | Using consultants for assessing technology                 | 49.85% | 50.15% |
|  | 21 | Using external people for technological development        | 52.42% | 47.58% |
|  | 22 | Using other companies in performing technological strategy | 55.45% | 44.55% |
|  | 23 | Using universities' cooperation                            | 33.03% | 66.97% |
|  | 24 | Using governmental research centers' cooperation           | 35.91% | 64.09% |

**Findings of the Second Research Question**

Summing up the results of the questionnaires of population, the extent of the capability of each of the 9 dimensions based on summation of indices is obtained according to Table 5. As well the extent of company's technological capabilities is 65.34%.

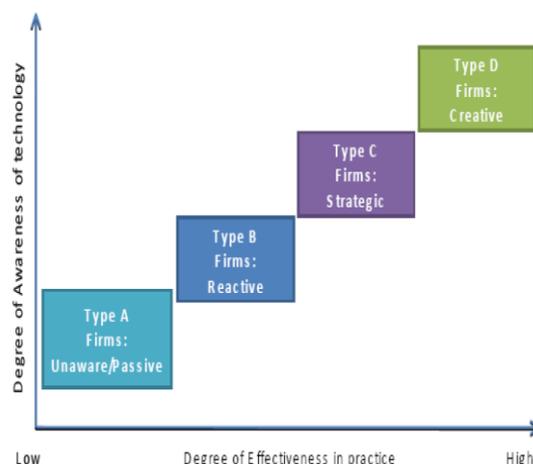
**Table 5: Average scores & capability percentage of dimensions of technological capability levels**

| Dimensions                              | Number of Index | Average Score of Capability Percentage (%) |
|---|-----------------|--|
| Awareness                               | 2               | 77.50%                                     |
| Search                                  | 2               | 65.38%                                     |
| Building & Core Competence              | 2               | 76.36%                                     |
| Technology Strategy                     | 3               | 63.69%                                     |
| Assessing and Selecting                 | 2               | 72.20%                                     |
| Technology Acquisition                  | 2               | 64.85%                                     |
| Implemental on and Absorbing Technology | 2               | 58.94%                                     |
| Learning                                | 3               | 63.33%                                     |
| External Links                          | 6               | 45.78%                                     |
| Average Total Score                     | 24              | 65.34%                                     |

**Findings of the Third Research Question**

The sum of averages of the 24 questions of the questionnaire based on Likert-scale is 297.24 that along with Table2 and Graph1 indicating the position of the company's technological capabilities; the company surveyed is in the category of strategic companies or halfway type C firm.

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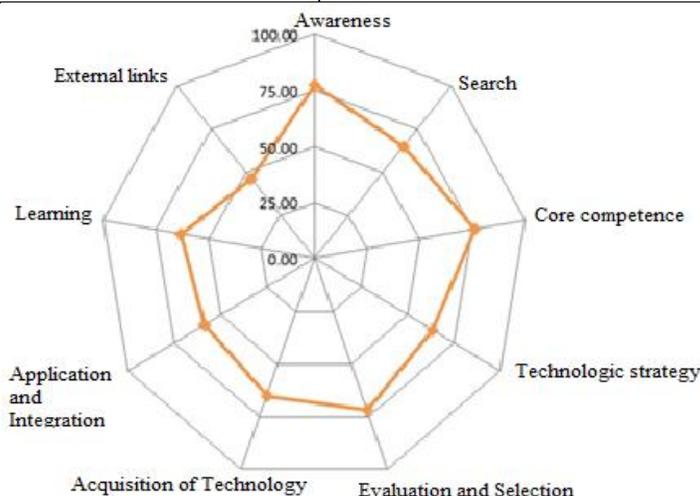
**Graph1: Graph of placement area of companies' technological capability (Innosutra, 2007)**

**Findings of the Forth Research Question**

There is a gap between the desirable level of company's technological capability (score 100 %) and available level that the extent of which is indicated in Graph 2 and Table 6.

**Table 6: The existing gap in different dimensions of technological capability with the desirable level**

| Dimensions                              | Average Score of Capabilities (%) | Existing Gap (%) |
|---|-----------------------------------|------------------|
| Awareness                               | 77.50%                            | 22.5%            |
| Search                                  | 65.38%                            | 34.62%           |
| Building & Core Competence              | 76.36%                            | 23.64%           |
| Technology Strategy                     | 63.69%                            | 36.31%           |
| Assessing and Selecting                 | 72.20%                            | 27.8%            |
| Technology Acquisition                  | 64.85%                            | 35.15%           |
| Implemental on and Absorbing Technology | 58.94%                            | 41.06%           |
| Learning                                | 63.33%                            | 36.67%           |
| External Links                          | 45.78%                            | 54.22%           |
| Average total score                     | 65.34%                            | 34.66%           |



**Graph 2: Levels of technological capability in different dimensions**

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According to Table 6 and Graph 2, it is observed that technological capabilities of the company have a gap of 34.66% with the desirable situation; the largest gap is in the exploiting external linkage and incentives dimension and the least gap is in the awareness dimension.

### **DISCUSSION AND CONCLUSION**

The technological capability level of the company located in the halfway type C firms. Companies of type C (strategic) have an accurate vision of the way to enhance technological capability of their company. They have a great capability in their projects and have a strategic look at the faculty making. Correspondingly due to the realistic prioritized attitude, these companies formulate strategies and are able to increase the company's core competence in the fields of technical and management. Although Type C companies are able to respond quickly and effectively to new environmental technology oriented laws, however these companies require a fresh policy for intensifying innovation in the leadership zone; they may also need to have better access to capital goods and services. Type C companies focused on the strategic awareness of the latest technology that is necessary for medium-term and long-term, benefit and may require the support by other institutions and companies for technology development. These companies pass almost all of the boundaries of technology in most areas and slowly move to type D which is a very innovative and creative type of company.

To reach these purposes, company leaders must define the proper planning and improvement projects in order to resolve the existing technological gap. Thus, according to the findings, the following recommendations for the improvement of the existing gap between technological capabilities dimensions and desirable situation is recommended:

- 1- Awareness dimension: The top manager's capabilities to recognize the role of technology to compete and risk in current competitive environment.

Due to the conclusion of the results of this dimension and observing the gap of 22.5% with acceptable condition; while, according to experts and senior managers in the technology industry, this dimension plays a major role in Homa and is stronger than other dimensions, however there still can be more awareness of the important technologies in the industry.

Accordingly, it is proposed that the company should reinforce this dimension even more with strengthening its own research and development group as well as participating in training courses and domestic and international seminars.

- 2- Search: It is applied to the company's capability to monitor foreign technological processes that may face the company with opportunities for growth and competition.

Large and developing companies like Homa should have a group of people to search and monitor constantly. Considering the outcomes of this dimension and the experts' point of view, there is a gap of 34.62% between the ideal situation and the presented one. Therefore, it is suggested that first the company hires some people to monitor the technological changes in the world continuously; second assesses the technological opportunities in terms of short-term credit in order to eliminate the technological weaknesses with faster and lower cost.

- 3- Core competence dimension: the ability to participate in the occurrence of technological strengths and create competitive advantages in the competitive landscape. Companies that have a competitive advantage, they must be compared with other competitors, identify their distinct advantages and then invest and develop that strong point.

Considering the outcomes of this dimension and the experts and senior managers' point of view, there is a gap of 23.64% between the ideal situation and the presented one, it is suggested that the company continuously observes the external and internal technological sources and as well defeats its current situation. Also, the company should focus on efforts of the acquisition of certain technological capabilities and benefits derived from their use.

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- 4- In technology strategy dimension formulation of technological strategies is influential. Because technology strategy formulation, is the key part of business strategy which can be determined by company's prospects, purposes and priorities.

Since the outcomes of this dimension and the experts and senior managers' opinion, there is a gap of 36.31% between the perfect condition and the existing one that shows Homa Company is somewhat weakened in a technological perspective. Therefore, a company must draw a perspective of policy-making by it's senior managers. Then, senior managers using existing policies on the one hand and the experts on the other hand, try towards employing this important mission.

- 5- About assessing and selecting technology dimension it is obvious that modern and progressive companies are so skilled in collecting information in technological fields related to their status and are able to quickly and confidently choose the best alternative.

Due to the conclusion parameters of this dimension and according to experts and senior managers and also with the 27.8% gap, it is seen that Homa Company has a few weaknesses in the field of technology resources.

Consequently it is suggested that the company utilizing it's experts in technology management of it's own industry, eliminates the lack of technology resources and selects the best opportunity.

- 6- Acquisition dimension is around the topic that if a company chose a novel technology, it should be prepared to gain the capability to get the proper underlined conditions to utilize it.

Owing to this, the conclusion factors of this dimension and according to experts and senior managers' view point and also with the 35.15% gap, relative weakness of Homa Company in relation to external suppliers is felt. Hence, it is suggested that the capability of the company in taking technology from external sources should be reinforced in order to internal growth. Although it is possible that development of this dimension's parameters is difficult, due to dependency of this subject to governmental & national policies.

- 7- About implemental on and Absorbing Technology , the company after earning the technology needs to apply it in the internal space. That is likely to demand passing various levels to get the final result. With the results of this dimension and according to experts and senior managers' view point and the 41.06% gap with suitable state Homa Company's disability in this area is apparent. Accordingly, it is recommended to provide operational guidelines and forms to clarify technological processes same as quality management processes, so actions based on theoretical and practical activities of the organization be performed. In this context, the research and development department should be strengthened and cooperation needed, be done with this section.

- 8- Learning dimension is crucial in terms of surveying and reflecting the company's technological projects. This dimension is actually indicating participation in the actions of previous successes, failures and future project plans.

The company may use this dimension in continually improving the effectiveness and efficiency and preparing company's strategies in a conscious and regulated manner.

To perform this dimension the company should manage the process of improvement through a systematic way to capture it's own experimental and empirical knowledge and of course other companies.

On account of the result of factors of this dimension and according to experts and major managers' standpoint and also with the 36.67% gap with vulnerable situation, it is seen that Homa Company is suffering in the field of systematic assessment of it's technology projects.

Therefore it is endorsed that the company uses an exclusive method (such as technology need assessment method that was proposed in this study), in proper periodic time or after applying each novice technology project in order to assess it.

- 9- Exploiting external linkage and incentives dimension with taking 6 parameters underneath shows the importance and impact of the external dimension on the results of this method of technology assessment. In each of the previous 8 dimensions of technology, companies should use the

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services of external suppliers of technology. Consulting firms, governmental research institutes and universities are instances that companies can take advantage of their services. This dimension also indicates the level of openness and the ways of technological advances of the company and the quality of external support system of technological development called Innovation National System.

With the results of this dimension in hand and according to experts and major managers' standpoint and the 54.22% gap with suitable state it is witnessed that Homa Company has unfortunately a major problem in all areas of this fragment.

Subsequently it is recommended that government lays encouraging policies about investment in technology, to lead the company to this end and the company as well uses a strategic team in applying field and utilizing external links reinforces to improve and have a technological connection and preparation to performing strategic technology, also have more cooperation with universities and research centers so both the company and the center be benefitted.

According to the gathered results of the nine dimensions it is obvious that the company needs to put effort on raising the final score and reaching a creative company and to do this the company may focus on removing barriers of the ninth dimension. Though this requires a mutual effort by the company on the one hand, and the government and universities on the other hand and if they are reluctant, the attempt will not be fruitful.

Finally as Homa Company is in strategic companies' level and should move slowly towards innovative corporations, it is essential to invest more on innovation and creativity (funding and manpower), so with providing innovative and creative services reaches the higher level.

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