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EVALUATING TECHNOLOGICAL CAPABILITIES IN IRAN'S SUGARCANE INDUSTRY; A CASE STUDY IN AMIRKABIR AGRO-INDUSTRY, KHUZESTAN

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ABSTRACT

In developing countries, knowledge about technological capabilities and also using them are success factors for utilizing technology in business, and creating or maintaining a competitive advantage in firms. Technological needs assessment is a tool used to determine the required capabilities. Technological needs assessment identifies firms' weak and problematic areas and also considers competitive advantage. This paper aims to assess and evaluate the level of technological capability of Amirkabir sugarcane agro-industry using technological needs assessment model in nine criteria of the firm's capability. Some suggestions towards narrowing the existing gaps are also presented.

Keywords: *Technology, Technological Needs, Technological Capabilities Assessment*

1 -- INTRODUCTION

Technology management is a type of system management and is a mixture of different sciences such as engineering, management, quality and even services. In the last three decades, technology has been the most important source of wealth creation, which in turn can lead to the development of technical knowledge, workforce, natural resources, capital and even management, which definitely plays a profound role in improving standard of living.

Given the importance of technology development, firms' senior managers must have a good understanding of the technological capabilities of their organization, identify the technological developments in the world, monitor competitors' attempts to achieve new technologies, and continuously try to promote technological capabilities of their firms.

Manufacturing companies and enterprises are often involved with large administrative tasks such as purchase, sale, procurement of raw materials, accounting, insurance, etc., as well as drastic changes in the competitive environment. Therefore, they cannot employ long-term methods to assess their firm's technological level. Experience has showed that first of all, the model should be simple and understandable. Secondly, it should yield desirable results in an acceptable short term. However, the audit and assessment of technology is an important task of strategic managers, who by considering environmental situations and their capabilities and investigating weaknesses develop appropriate policies aimed at the progress of their organizations and realization of their objectives. (Tabatabaieian, 2005)

2 – Literature Review

Technology is defined as the practical component of knowledge and experience in the course of manufacturing products or providing services, as well as transferring and transforming resources into products using knowledge, experience, information and tools.

In developing country, technology needs assessment is a framework and a tool for detecting and identifying the capabilities required to implement the designed priorities.

Technological capability assessment is a process which helps organizations assess their technological capability considering long-term objectives. Technological capability assessment is a process measuring

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the existing level of technological capability in an organization in order to highlight technological weaknesses and strengths on one hand, and on the other hand, to compare the existing technological level with the ideal one to make actions towards compensating undesirable issues. It is an analysis towards identifying weaknesses and strengths of the firm's technological assets and aims towards evaluating the company's technological position compared to competitors and the most advanced technologies.

Technology assessment is an intellectual tool or framework, which helps to better understand technology and make decisions about it.

Using appropriate technology towards fulfillment of community and institution's interests and its proper evaluation is one of the necessities of selecting a technology. Technology lies in a human environment, and therefore, technology interacts with physical environment, as well as different systems of the human environment, including economic, social, cultural and political and other constituent systems. In other words, different technologies affect various systems of the human environment surrounding them, and these systems in turn, have a reaction, so the technology assessment should be conducted using an overall perspective. In evaluating the technology's advantages and limitations, technical efficiency and economic benefit should not be the only criterion and it has to be reviewed in relation to the human environment. The aim of technology assessment is to maximize positive effects and to develop technologies compatible with the surrounding environment. Additionally, technology audit seeks to determine and assess the gaps (to measure the gap between the existing and ideal technological level) to evaluate the causes and contributing factors in the creation of the technological gap.

In our country, the assessment of technological capabilities in firms has not been of much attention and has not become a culture. Even if organizations are willing to move in that direction, very few resources are available. Nowadays, to remain competitive, organizations must inevitably turn to developing advanced technologies and evolving them. This raises the question that in the path of acquiring technology, which is the best path to narrow the technological gap? It seems that models of technological capabilities are proper tools to confirm these subjective estimations. Experiments show that the models and methods used in the company should have two fundamental properties. Firstly, they should be simple and understandable, and secondly, they should produce desirable results in an acceptable short term. Several models are available in assessment of innovational and technological capabilities. This approaches and models can be categorized in the following three general categories:

A) Models for determination of the gap:

- Technology atlas model
- Porter model
- Panda and Ramanathan model
- Floyd model
- Technological needs management model
- Technology content assessment model
- Technological position model
- Economic added value model

B) Models for the assessment of causes of technological gap:

- Ford model
- Lindsay model
- Technology atlas model
- Floyd model
- Technological needs management model

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- Technological capability levels model
- C) Models providing a mechanism to narrow the gap:
 - Ford model
 - Lindsay model
 - Fall model
 - Garcia –Arolla model
 - Lin model
 - Technology needs assessment model
 - Science and technology information systems management model
 - Technology needs management model

3 – An introduction to the investigated company

Amirkabir sugarcane Agro-industry Company is one of seven subsidiaries of sugarcane Development Company, which is located 60 km south of Ahwaz with a cultivated area of 11,000 hectares and an annual yield of about 60 Tons of sugarcane per hectare. Employees of the company are either employed or hired through contract by contractors. There are a total number of 1350 personnel.

4 - Model

Technology needs assessment model was used to assess the nine categories of technological capabilities of the mentioned firm. These nine categories are:

1. Awareness capability: the ability and awareness to recognize the need to improve technology.
2. Search capability: the ability to identify technological opportunities and threats.
3. Ability to create core competences: the ability to participate in the creation of core competences (distinguishment between competitors).
4. Capability of technology strategy: the company's ability to develop a good strategy to its support the business.
5. Capability of evaluation and selecting technology: the ability to participate in the evaluation and selection of a suitable technological solution.
6. Acquisition of technology capabilities: the ability to obtain and use a technology.
7. Capacity of utilizing and absorbing of technology: the ability to participate in the implementation and effective use of technology.
8. Learning capability: the ability to learn from experience and use them in improving technology and products.
9. Ability to utilize external links: the ability to communicate with an external supply network and external links utilization (universities, consultant and research institutions, state incentives, etc.).

After the questionnaire were completed the by experts, the scores were added together. The total score were compared with the values shown in table, and the total score were compared with the values shown in in Table 1. Finally, the results of these comparisons showed the firm's capabilities (Khamseh, 2010).

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Table 1: Results of technological needs assessment

Results of the final audit	Total score	Level of capability	Classification of the firms	Detailed ranking	
Your company is inefficient in all important areas including acquisition, utilization and technology strategy development. It needs an immediate and comprehensive improvement program	1-120	1	Passive(A)	1-40	beginner
				41-80	midway
				81-120	pioneer
Your company has been ill-developed in most fields of research strategy, acquisition and capacity-building. It requires many capabilities to compensate for the problems in these fields	121-240	2	Reactive (B)	121-160	beginner
				161-200	midway
				201-240	pioneer
Your company is relatively capable in internal capabilities and has a strategic approach towards technology	241-360	3	Strategic (C)	241-280	Beginner
				281-320	Midway
				321-360	Pioneer
Your company has a set of fully-developed technological capabilities and can identify national technology borders. In some fields, it has a pioneer and creative approach and uses technology to obtain competitive advantages	361-480	4	Creative (D)	361-400	beginner
				401-440	midway
				441-480	pioneer

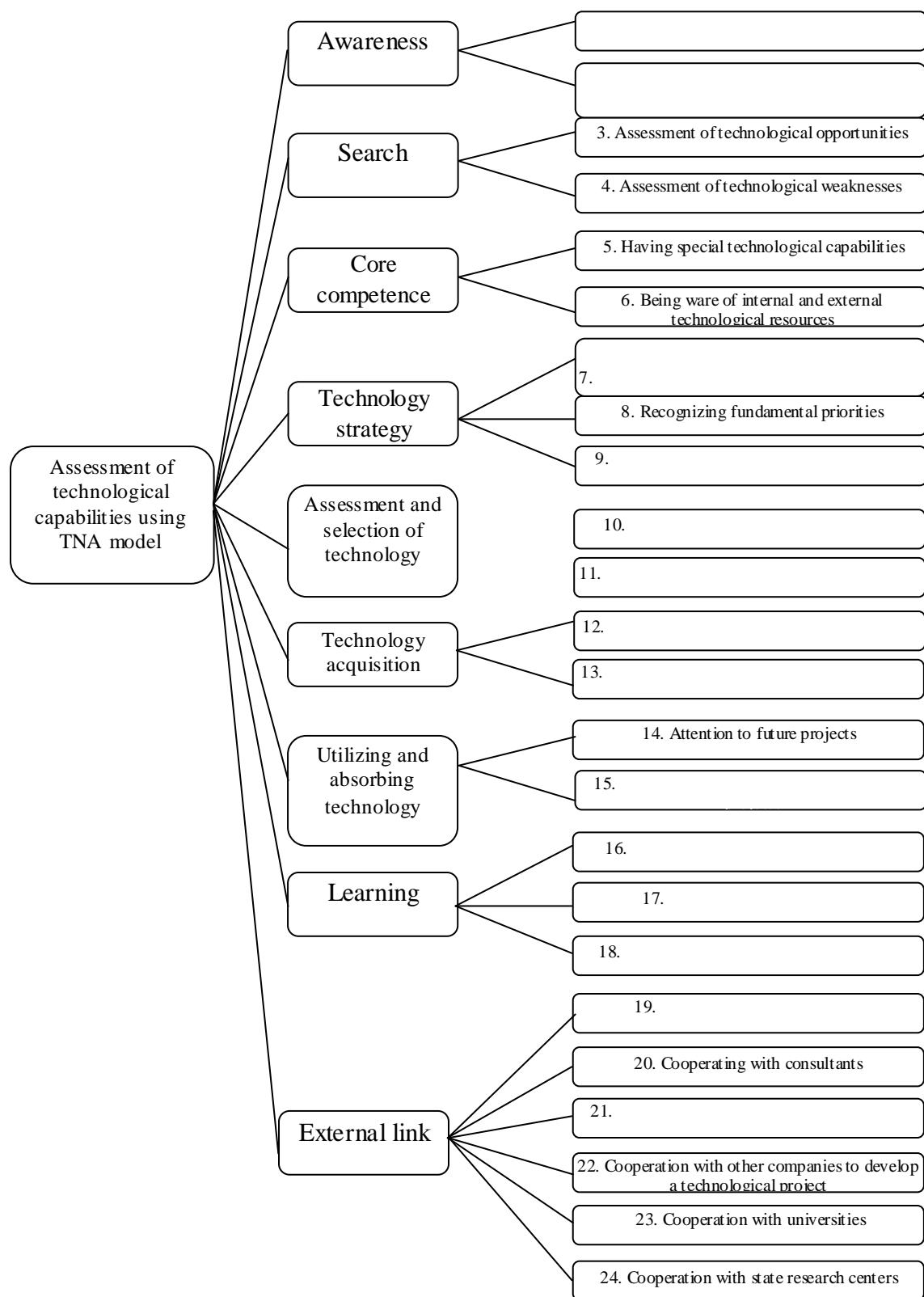


Figure. 1 Classification of technological capabilities based on the technological needs model needs (Khamseh, 2012)

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5- Objectives and questions

The purpose of this study was to determine the technological capabilities of Amirkabir sugarcane agro-industry. This is an applied research in terms of objective and a survey research in terms of methodology. The research questions are:

1. What is the level of technological capabilities of Amirkabir sugarcane agro-industry?
2. Regarding technological capabilities levels, what is the ranking of Amirkabir sugarcane agro-industry?
3. What is the ranking of each of the 9 criteria of technological capabilities of Amirkabir sugarcane agro-industry?

6-Statistical population

Statistical Population consisted of middle and senior managers and experts in Amirkabir sugarcane agro-industry Company in Ahwaz with from associate degrees qualifications to master's degree with work experience more than 5 years. Due to the limited number of experts, population size was defined by census.

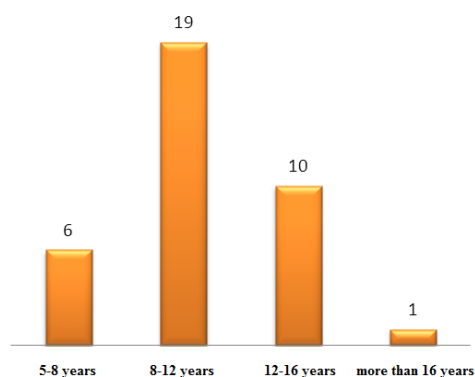


Figure 1: Work experience of the studied population

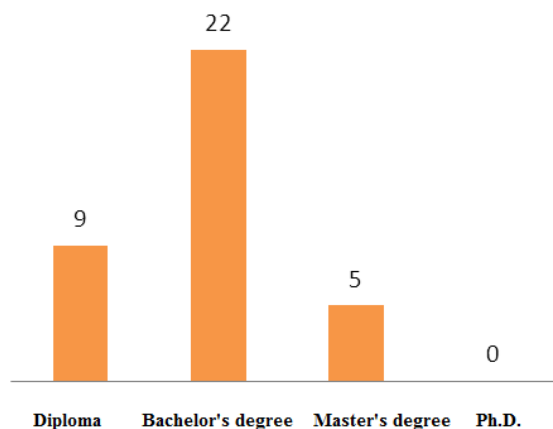


Figure 2: The Educational qualification of the studied population

7- METHOD OF ANALYSIS

Two different methods were used to analyze the survey data:

- A) Statistical analysis: The collected data was analyzed and classified using statistical indices.

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B) The analysis based on expert’s judgment: using expert’s judgment to analyze information is one of the most important decisions in research methods whose results are of special importance and possibility of occurrence of faults or a high percentage of error in other methods of analysis may reduce the validity of the results. This method of analysis was used to analyze research questions.

8- Summarizing the findings of research questions

Findings of the first research question represent the percentage of the average level of technological capability.

Table 2: Average score and the capability percentage of different criteria of technological capabilities

Criterion	Number of indices	average level of capability
Knowledge	2	65.07
Search	2	59.48
Core competences	2	64.79
Technology strategy	3	61.09
Assessment and Selection	2	60.83
Technology acquisition	3	54.17
Utilization and absorption	2	54.51
Learning	3	59.17
External links	6	51.16
Mean total score	24	58.91

The findings of the second research question: Sum of mean values of 24 questions of the questionnaire gave 277.04, which according to Table 2 and Figure 3, shows the positioning of the company regarding technological capabilities. The company lies in the pioneer class of type-C firms, or in other words, strategic firms.

Findings from the third research question were derived from the 9 criteria of technological capabilities.

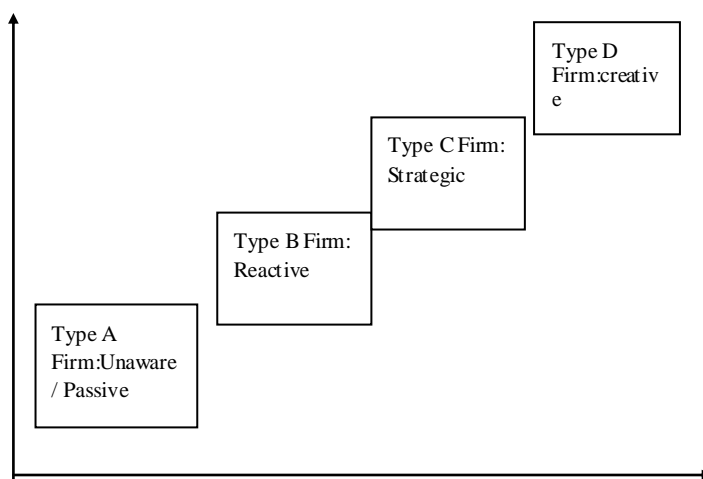


Figure 3: The position of the firms’ technological capabilities (Innosutra, 2007)

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Table 3: Technological capabilities levels in 9 criteria

Question	criteria	Index	Indices	Score	Mean score
1	Awareness	1	Being aware of business technologies	63.19	65.07
		2	Role of technology in business strategy	66.49	
2	Search	1	Assessment of technological opportunities	60.49	59.48
		2	Assessment of technological weaknesses	58.54	
3	Establishing core competence	1	Having special technological capabilities	65.14	65.79
		2	Being ware of internal and external technological resources	64.44	
4	Technology strategy	1	Management skill in developing strategy	58.61	61.02
		2	Recognizing basic technological priorities	64.58	
		3	Having a proper vision for development of technology	59.86	
5	Evaluating and selecting technology	1	Knowledge about selecting technology	60.83	60.83
		2	Being aware of the best technological sources	60.83	
6	Technology acquisition	1	Relations with external technology providers	55.42	54.17
		2	Making relationships with important external suppliers	52.92	
7	Utilizing and absorbing technology	1	Attending to future projects	53.06	54.41
		2	Transparency of process for technological projects	55.97	
8	Learning	1	Proper technology assessment system	56.11	59.17
		2	Attention to future projects	54.77	
		3	Learning capability across technologies	66.67	
9	External links	1	Using state incentive policies	53.47	51.16
		2	Cooperating with consultants	53.06	
		3	Using expert consultants from outside the firm for technological development	56.94	
		4	cooperating with other companies to implement technology strategy	56.25	
		5	cooperating with universities	38.06	
		6	cooperating with state research centers	49.17	

9 - RESULTS ANALYSIS

Technological capabilities of the company's industrial group lies at pioneer class of type-C companies, near the improver class of type-D companies. Type-C (strategic) companies have a true understanding of how to promote their technological capabilities. They have a high capacity to implement projects, as well as a strategic perspective about their capabilities. Also, due to their priority-oriented attitude, these companies are able to formulate strategies and enhance the increasing capabilities in technical and managerial fields. Although, type-C companies are able to respond quickly and effectively to new environmental technology-oriented rules, they need new policies to boost innovation in leadership. They may also need better access to capital and service goods. Type-C companies benefit from strategy awareness focused on latest technologies needed for medium-term and long-term needs. They may require the support of other companies and institutions to develop technology between small, medium and

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other less-developed companies. These companies cross the technological boundaries in most fields, and slowly make way towards type-D companies, which are very innovative and creative.

On the other hand, there was a gap between the ideal level of technological capabilities (score of 100%) and the existing level, which is shown in Table 4 and Figure 4.

Table 4: Values of the calculated gap

Criterion	Number	Mean score	Existing gap
Awareness	2	65.07%	34.93%
Search	2	59.48%	40.52%
Core competence	2	64.79%	35.21%
Technology strategy	3	61.02%	38.98%
Assessment and selecting	2	60.83%	39.17%
Technology acquisition	2	54.17%	45.83%
Utilizing and absorbing	2	54.51%	45.49%
Learning	3	59.17%	40.83%
External links	6	51.16%	48.84%
Mean score	24	58.91%	41.09%

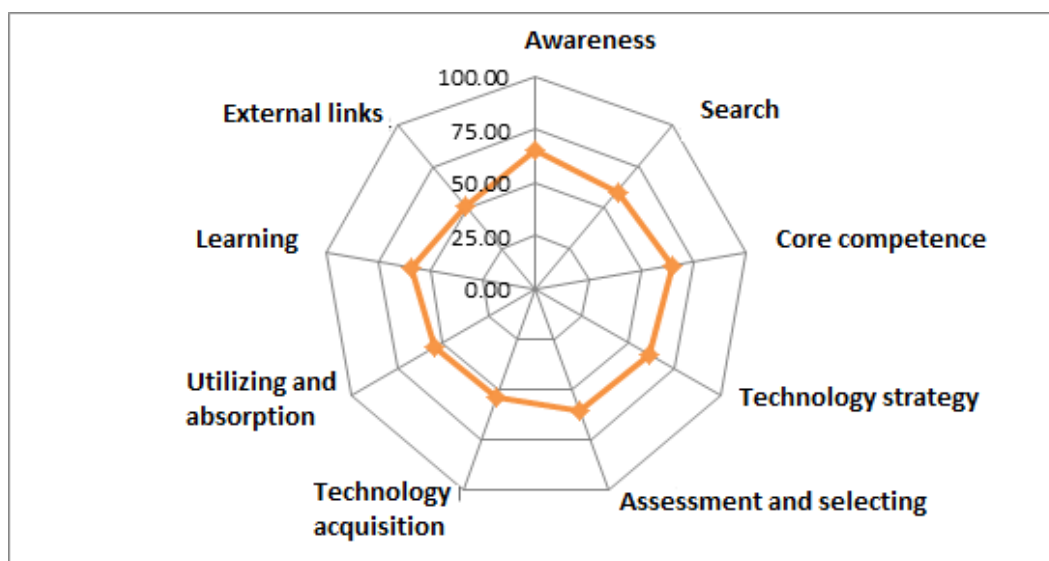


Figure 4: Diagram of technological capabilities in various criteria

Company’s senior managers must take steps towards narrowing the existing technological gaps using proper planning and improvement projects. Thus, according to research findings, the following recommendations regarding the improvement of technological capability gaps are presented:

1. Considering a 40.52% gap between existing and ideal levels of search, it is recommended that: The Company should periodically and systematically assess its technological opportunities and make actions towards quickly overcoming its technological problems by cost effective approaches.
2. Considering a 35.21% gap between existing and ideal levels of core competence, it is suggested that: The company should acquire particular technological capabilities and benefit from these capabilities.
3. Considering a 45.49% gap between existing and ideal levels of implementation and absorbing technology, it is suggested that: The company should establish a center of innovation, research and development of technology. It also must transform its verbal technological processes to structured ones.

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4. Considering a 40.83 % gap between existing and ideal levels of learning, it is suggested that: The company should take action to improve the systems used for assessing technological projects and improve skills and their ability to learn across technologies.

Considering a 48.84 % gap between existing and ideal levels of external links (the largest gap), it is suggested that: The government should assist these companies by establishing incentive policies related to investments. Also, the company should cooperate with universities and companies and state research centers more than ever to develop and implement its technological strategies.

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