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The Assessment of Technological Capabilities of Wagon and Locomotive Manufacturing Industries of Urban Trains (Case Study: Tehran Wagon Manufacturing Company)

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Abstract. One of the significant factors in failures of applying technology in attaining competitive advantage of developing countries firms is the lack of knowledge of the level of technological capabilities of the firm and the lack of using competencies to achieve relative advantages. The evaluation of technologic requirements is an instrument which is utilized in order to determine the needed requirements for the implementation of technological proprieties. The assessment of technological requirements not only identifies the weak and problematic fields of the firm but also highlights and determines its relative advantages. By utilizing the model of assessing technological requirements, in the present paper, we attempt to cast light upon the level of technological competencies of Yasan Steel Structure Company. This model evaluates the capability level of the firm from nine dimensions and in each status, it determines the condition of the firms. Besides, it provides some suggestions to reduce the existing gap.

Keywords: Technology, technology assessment, evaluative model of technological requirements

1. INTRODUCTION

The Assessment of Technological Capabilities of Wagon and Locomotive Manufacturing Industries of Urban Trains (Case Study: Tehran Wagon Manufacturing Company)

Due to the fact that technological development is directly associated with economic development of an organization, one can regard the technological development level of an organization as a sign of its power. To develop a technology, an organization must be obtained at first and then its progression must be taken into account. In this regard and because of high significance of technology, the top managers of economic firms should possess a proper understanding of technological capabilities of their organization, identify global technological changes, and observe the efforts of competitors to obtain new technologies so as to enhance the organizational capabilities of their organization. The assessment model of technological requirements is an instrument to detect and determine the necessary capabilities for realization of technological priorities in developing countries.

2. LITERATURE REVIEW

The contemporary technological developments in different levels and necessity of using modern technologies show the increasing need for the assessment of such technologies. The technology assessment is an intellectual framework or instrument which contributes to better understanding of technology and proper decisions on it. Therefore, the development and application of new technologies should be accompanied by assessment of current technological conditions. The technological audits endeavor to determine and assess the gap (current and ideal

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technological level), highlight the factors affecting the technological gap and evaluate the ability of a firm to promote problems (Brown, 2004). The innovative and technological capabilities in an industry consist of technical, managerial and institutional skills as a combination of knowledge and competencies of firm members during time. The innovative competencies constitute only one aspect of technological capabilities. The technological competencies refer to the way that an organization combines its different elements such as skills, learnings, educational qualifications and technologies used in machineries so as to act like an organization. This process is accompanied by consistent interaction among the members, efficient flow of information, decision making and cooperation (Lal, 2007). In Iran, the assessment of technological capabilities at the firms' level is overlooked. Even if the organizations are willing to consider this part, there are few references and resources available for investigating. To remain in competition arena, the organizations should inevitably move towards technological development and creation of modern technologies. But the question raised in this regard is the choice of the best way to decrease technological gap (Jafarnezhad, 2007). Another associated dimension of assessment is dealing with technological capabilities. These capabilities represent a common concept about effective usage of technologies and ability to generate technological innovation and changes (Kianwie, 2003).

Table 1. The Classification of Assessment Models of Technological Capabilities (Khamseh, 2011).

Models of Determining Technological Gap	Models of Assessing Reasons of Technological Gap	Models of Provision of Solutions to Overcome Technological Gap
Atlas Model of Technology	Ford's Model	Ford's Model
Porter's Model	Lindsey's Model	Lindsey's Model
Panda and Ramanason's Model	Atlas Model of Technology	Fal's Model
Floyd's Model	Floyd's Model	Garcia Arola's Model
Model of Technology Needs Management	Model of Technology Needs Management	Lin's Model
Technology Content Assessment Model	Technological Capabilities Levels Model	Model of Technology Needs Assessment
Model of Technology Position Assessment		Model of Information Systems of Science and Technology Management
Model of Economic Value Added		Model of Technology Needs Management

2.1. Tehran Wagon Manufacturing Company

The Tehran Wagon Manufacturing Company was found in 2004 to develop and expand rail transportation, especially the urban section to solve the complicated and new problem. The Tehran Wagon Manufacturing Company as the manufacturer of self-propelled trains and trailer provides maintenance and overhaul services for electric railway fleet, offers technical and engineering services for projects of railway industries and cooperates with a large group of experts of railway transportation industry. In Iran, it plays a significant role in national railway industry so that since its establishment, Tehran Wagon Manufacturing Company has had significant achievements with the help of its efficient, experienced and expert human resources. With usage of experiences of prominent international companies and reproducing, localizing and management of the obtained knowledge, the company has successfully progressed towards self-sufficiency of the industry of railway transportation systems.

2.2. The Model for the Present Study

To evaluate the technological capabilities of a firm, the present study used the assessment model of technological needs. Based on this model, the capabilities of a firm are analyzed through a questionnaire and from 9 dimentions. The classification of categories of technological capabilities for this model includes:

1. Awareness: Ability and knowledge to endeavor in understanding the need to improve technology
2. Search: Ability to identify technological opportunities and threats
3. Meritocracy: Ability to create meritocracy (distinguish among the competitors)
4. Technological Strategy: Ability to develop a proper strategy to support business
5. Technological Evaluation and Selection: Ability to evaluate and select a proper technological solution
6. Obtaining Technology: Ability to obtain and use a technology
7. Application and Integration of Technology: Ability to effective implement and use technology
8. Learning: Ability to learn lessons from previous experiences to improve technology and produce new products
9. Utilization of External Links: Ability to establish connections with supply network and using external bonds (i.e. with universities, consultation institutes, governmental sponsorship entities, etc.).

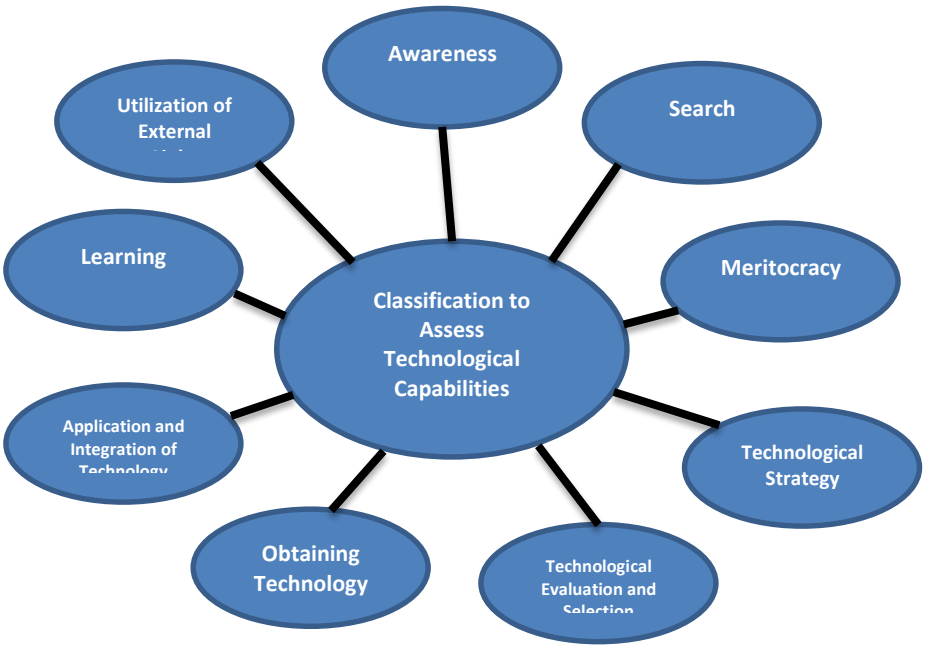

Figure 1. Classification of categories of technological capabilities.

After filling in the questionnaire by the experts, its scores were summed up and the total score was compared with the values in Table 2. The result of this comparison shows the level of capabilities of the firm. To increase the accuracy, the sum of scores are multiplied by 5.

Table 2. General Classification of Companies in Technological Capabilities.

Results of General Audit	Sum of Scores	Level of Capability	Classification of Firms	Partial	Classification
The technological strategy is weak and efficient. It needs an immediate improvement plan.	1-120	1	A (Passive)	1-40	Inexperienced
				40-80	Moderately
				81-120	Pioneer
The company has weakly developed in most domains of strategy, research, technological obtainment and innovation. It needs high abilities to revive such fields.	121-240	2	B (Reactive)	121-160	Inexperienced
				161-200	Moderately Experienced
				201-240	Pioneer
The company is relative able in internal capabilities and has a strategic approach to technology but it is still lagging in most domains.	241-360	3	C (Strategic)	241-280	Inexperienced
				281-320	Moderately Experienced
				321-360	Pioneer
The company has a completely developed set of technological capabilities and can identify the boundary of national technology. In some fields, it has a pioneering and innovative approach and uses technology to obtain competitive advantages.	361-470	4	D (Creative)	401-420	Inexperienced
				421-440	Moderately Experienced
				441-480	Pioneer

Based on this model and classification of Table 2, the firms can be divided into four types:

2.3.1. Firm of First Type (Passive)

These firms are not aware of its requirements to transfer technologies or environmental improvements. They do not know which technological capabilities are in enhance status. It is unlikely that these firm can have a fixed and stable policy in a critical environment.

2.3.2. Firm of Second Type (Reactive)

These firms can properly perceive the necessity to improve the technological capabilities to attain the objectives of growth and development but due to limitation of internal resources (e.g. lack of key skills and lack of personal experiences in technological domains), they only can respond to environmental threats. They cannot use these events to their benefits.

2.3.3. Firm of Third Type (Strategic)

These firms are well-aware to enhance their technological capabilities. They have a strategic outlook and high ability to execute their projects.

2.3.4. Firm of Fourth Type (Creative)

These firms (e.g. Microsoft, Ford, etc.) have moderate to high levels of income. They can quickly improve their technological capabilities.

The objective of present study is to determine the levels of technological capabilities in Tehran Wagon Manufacturing Company and highlight the technological gap in each level.

2.3. The Research Questions

1- What is the level of different metrics of technological capabilities of Tehran Wagon Manufacturing Company?
2- Based on the levels of technological capabilities, where is the rank of Tehran Wagon Manufacturing Company?
3- What solutions can be suggested to remove the technological gap?

The statistical population included top, middle-rank and executive managers of Tehran Wagon Manufacturing Company with bachelor and master degrees working in the company during the present study. The sample consisted of 30 individuals selected through simple random sampling method. The size of the sample was determined through Cochran's method.

Table 3. Descriptive Parameters of Statistical Population

Row	Level of Education	Number	Mean Experience (Year)
1	Master Degree	8	8
2	Bachelor Degree	22	6
Sum		30	14

3. FINDINGS

Q 1. What is the level of different metrics of technological capabilities of Tehran Wagon Manufacturing Company?

Based on summing the scores, the answer to the first research question of the questionnaire is shown in Table 2.

Table 4. Scores of Capability for Each Metric

Items	Row	Question	Mean Percentage of Metric
Awareness	1	Our company is aware of the most significant technologies for its business.	71%
	2	Technology plays a critical role in business strategy of our company.	68%
Search	3	Our company is well-prepared for evaluation of technological opportunities.	57%
	4	Our company can evaluate technological problems without any problem.	58%

Meritocracy	5	Our company has distinctive technological capabilities to benefit from.	71%
	6	Our company is aware of its internal and external technological resources.	72%
Technological Strategy	7	The management team of our company has the essential skill to codify a technological strategy to attain its business objectives.	64%
	8	Our company knows its top technological priorities.	65%
	9	Our company has a proper perspective to develop its technology.	64%
Technological Evaluation and Selection	10	Our company knows how to select its needed technology.	68%
	11	Our company is aware of the best technological resources.	69%
Obtaining Technology	12	Our company acts effectively in obtaining technology from external sources.	72%
	13	Our company has relationships with foreign suppliers of important technologies.	70%
Application and Integration of Technology	14	The technological activities of our company (i.e. engineering, research and development) are effectively organized.	59%
	15	Our company has a clear process to do technological projects.	58%
Learning	16	Our company has a proper system to evaluate technological projects.	59%
	17	Our company pays attention to future projects and reviews them.	73%
	18	We have the ability to transfer the lessons learnt from one technology to another.	75%
Utilization of External Links	19	The state policies encourage us to invest more in technology.	60%
	20	We use consultation institutes/ consultants for technological assessments.	57%
	21	We use the help of individuals from out of the company to develop our technologies.	58%
	22	We use other companies to execute our technological strategy.	61%
	23	We use universities to execute key technological projects.	51%
	24	We cooperate with governmental research centers to execute significant projects.	77%

Table 5. Levels of Capability for Each Dimension and Level of Gap.

Dimension	Existing Capability	Gap Relative to Ideal Level	Gap Relative to Proper Level	Warning Level	Proper Level	Ideal Level
Awareness	69%	31%	7%	65%	77%	100%
Search	58%	43%	19%	65%	77%	100%
Meritocracy	71%	29%	6%	65%	77%	100%
Technological Strategy	64%	36%	12%	65%	77%	100%
Technological Evaluation and Selection	69%	32%	8%	65%	77%	100%
Obtaining Technology	71%	29%	6%	65%	77%	100%
Application and Integration of Technology	58%	42%	18	65%	77%	100%
Learning	69%	31%	8%	65%	77%	100%
Utilization of External Links	69%	40%	16%	65%	77%	100%

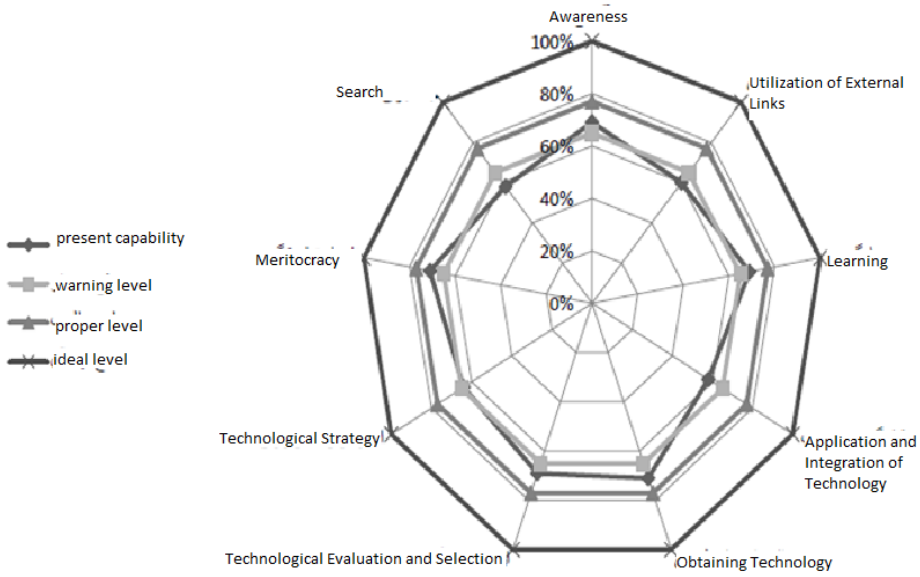

Figure 2. Level of capability in each dimension and existing gap.

Q 2. Based on the levels of technological capabilities, where is the rank of Tehran Wagon Manufacturing Company?

The mean values of all metrics representing the technological capabilities gave a total of 325 after multiplication of score 65 by the coefficient 5. In this regard, the capability level of Tehran Wagon Manufacturing Company is in the strategic rank of C (pioneer). But due to closeness of the obtained value to the last upper bound of detailed ranking, the company is ranked as moderately inexperienced.

Q 3. What solutions can be suggested to remove the technological gap?

The answer to this question is shown in the following section.

4. DISCUSSION AND CONCLUSION

The technological capability level of Tehran Wagon Manufacturing Company is in rank of companies of group (c) and due to obtained value of its partial ranking (i.e. 325), its strategic ranking is in moderate level. The C-type companies (i.e. strategic firms) have a proper understanding of their technological capabilities. They have the significant ability to execute their projects and possess a strategic outlook. Because of priority-based approach of these companies, they have the capability to formulate strategies and enhance their internal competencies in managerial and technical domains.

These companies need a new policy for innovation in leadership sections. In addition, they might need better access to capital and service-based products. The type-c companies possess the strategic awareness to develop middle-term and long-term plans. They might need the support of successful companies to promote technology among small, medium-sized and less developed companies.

With continuous knowledge-based efforts, these companies can surpass technological boundaries and can approach to D-type companies in regard to dependence upon creative innovation in this group of companies. As shown in the above tables, the gap in different dimensions of corporate capability in comparison with the proper level (especially in the aspects of application and integration, meritocracy, utilization of external bonds and technological strategy), the managers of Tehran Wagon Manufacturing Company should resolve the existing technological gap through proper planning and definition of improvement projects.

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