A Managerial Model to Assess the Industrial Readiness for Successful Technology Transfer
"A Case-Study of Iranian Automobile Industry"

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ABSTRACT: Today, automotive industry plays a significant role in the economic development of countries around the world. But the results of numerous studies have revealed that despite the substantial efforts made to employ efficient models for successful technology transfer, the effective implementation of such models in developing countries including Iran has faced many challenges due to the inadequacy of related infrastructure particularly managerial performance. Therefore, it is of great importance for the managers in the field of automotive industry in particular and the other industries in general to carefully assess the present state and to develop a managerial model to evaluate the readiness of the industry for successful transfer of necessary technologies that will ultimately facilitate the growth of this industry in the competitive markers.

For this purpose, the necessary indices for the evaluation of readiness of Iranian automotive industry for the effective technology transfer and the therapeutic strategies to reach the ideal state were identified and formed into a questionnaire that was administered to experts inside and outside Iran. Data obtained from the questionnaire were codified and entered into Concept System for concept mapping and into LISREL for path analysis. Then, the criteria that are believed to be important in the evaluation of the readiness of the automotive industry for a successful technology transfer were identified along with their significant coefficients and total values. And finally, based on the determining categories, criteria, and indices, a model was developed to evaluate the capabilities of the automotive industry for the successful technology transfer. The results of the causal analysis revealed that the model enjoyed a high index of goodness-of-fit ($X^2 = 0.0128$, PMSR = 0.00) at the 0.05 level of significance.

Key words: effective technological transfer, automotive industry, foreign direct investment, joint venture, process of technological transfer, Iranian automotive industry, management of technology

Introduction

It is obvious that without managerial evaluation of the receiving country’s or company’s readiness, the technology transfer not only will not result in its successful implementation, but it may also result in waste of time and resources and the disappointment of those involved in the industry. Unfortunately, experience has shown that due to the technology importers’ failure to account for this determining factor, even those technologies are been carefully evaluated and selected are not successfully transferred and the importers usually face numerous problems in both the development and the exploitation of the purchased technology. Therefore, since the world automotive industry and the related technologies are changing rapidly, the Iranian automotive industry, in
addition to the employment of effective strategic management for technology transfer, has to constantly evaluate its own present readiness and subsequently improve it for the successful transfer of the new technologies.

Indices Used in the Evaluation of Readiness for successful Technology Transfer (TTI)
To identify the determining indices and criteria in the evaluation of readiness of the automotive industry for the successful technology transfer, to develop a practical managerial model to carry out such an evaluation, and to propose therapeutic strategies to reach the ideal state, a questionnaire consisting of 4 categories, 15 criteria, and 92 indices was developed and administered to experts and university professors inside and outside Iran.

Research Findings in order of the Research Questions:

Question 1: What are the major barriers to technology transfer in Iranian automotive industry?
The analysis of data obtained from the first questionnaire revealed that the major barriers to the effective technology transfer in Iranian automotive industry are as follows:
1. Shortage of qualified managers (human resource in general)
2. lack of appropriate contracts
3. lack of cooperation between the industry and the universities
4. failure to account for the compatibility of the imported technologies with the actual state of country and industry
5. failure to allocate adequate funds for research
6. lack of well-established polices concerning the technology transfer in the automotive industry

Questions 2: What are the major components of successful technology transfer in Iranian automotive industry?
Based on the review of the related literature, the results of the extensive research on different models, and the analysis of data from the first questionnaire the following were identified as the major components of successful technology transfer in Iranian automotive industry:
1. macro-environmental factors
2. the process of technology transfer
3. communication systems
4. research and development
5. foreign direct investment
6. joint ventures
7. innovation
8. technology transfer center
9. management of technology transfer

Question 3: What are the determining criteria and indices in the evaluation of readiness for successful technology transfer in automotive industry?
To evaluate the readiness of automotive industry for successful technology transfer, 4 major categories, 15 criteria, and 93 indices were identified based on the conceptual framework of the model and formed into a second questionnaire which was administered to experts and university professors inside and outside Iran, and then using Concept System and LISREL through concept mapping analysis their significance coefficients were determined.

Conducting Concept Mapping to Identify the Determining Categories, Criteria, and Indices Employed in the Evaluation of Readiness for successful Transfer:
For this purpose, the data were analyzed using Concept System and LISREL. A symmetric similarity matrix consisting of binary sets representing the respondents was developed.
and through statistical procedures of cluster analysis and multidimensional scaling the appropriate concepts were identified and their interrelation coefficient were estimated at the 0.05 level. The results of the second questionnaire determined 4 categories, 10 criteria, and 80 indices along with their weight coefficients that could be used in evaluating the readiness of Iranian automotive industry for successful technology transfer.

Concept mapping was conducted through the following phases:

1. **Codifying the data obtained from the questionnaire on indices**
   
   In this phase, each index (totaling to 80) was given a code and then entered into Concept System.

2. **Ranking the indices**
   
   In this phase, the weight (ranging from 1 to 5) of each index as given by the respondents was entered into Concept System.

3. **Classifying indices into criteria**
   
   In this phase, the 80 indices were analyzed and classified into 10 clusters by the software.

4. **Classifying the criteria into categories**
   
   In this phase, the 10 clusters determined in the previous phase were classified into 4 categories that function in the successful technology transfer.

5. **The Point Map**
   
   Based on the analysis conducted in phase 4, a point map was created which represents all the indices that are important in successful technology transfer at the 0.05 level (Figure 1-4).

6. **The Point Rating Map**
   
   In this phase, based on the analysis in phase 4, a point rating map was developed to represent the value and significance of each of the indices at the 0.05 level. (Figure 2-4).

7. **The Cluster Map**
   
   In this phase, based on the analysis in phase 4 and the point map, a cluster map was created that represents all the important clusters in the successful transfer at the 0.05 level.

8. **The Cluster Rating Map**
   
   In this phase, based on the analysis in phase 4 and the point rating map, a cluster rating map was created that represents the value and significance of all criteria at the 0.05 level.

9. **Category Map**
   
   In this phase, based on the analysis in phase 4 and the cluster rating map, a category map was created which represents all the important categories in the successful technology transfer at the 0.95 level. (Fig.3-4)
Question 4: What kind of managerial model can be proposed to evaluate the readiness of Iranian automotive industry for successful technology transfer?

Considering the results of the second questionnaire and the identified categories, criteria, and indices, the following model is proposed to evaluate readiness of Iranian automotive industry for successful technology transfer (Figure 4-4).

Conclusion
The most significant finding of this study was “the development of a managerial model to assess the readiness of Iranian automotive industry for successful technology transfer”. To this end, a questionnaire consisting of 10 criteria and 80 indices was developed and the significance coefficient of each criterion was determined through statistical analysis using related software. The results are presented in the following table. The total number of points for each criterion was estimated based on the maximum possible points (5 points each index) of its subset of indices.

As indicated in the table, the maximum number of points of the model is 400 which represent an ideal readiness of the industry for technology transfer. “Points * Weight Coefficient”, in the last column, results from the multiplication of “Significance Coefficient” and “Points”. It is interpreted as “Points”.

For instance, to evaluate the readiness of an automotive company, a questionnaire consisting of questions with 5 options is developed using the following format and then is administered to respondents. The points earned indicate the company’s Actual State and its different from the Ideal State (the maximum points possible) could be diagnosed and then appropriate therapeutic strategies might be proposed. The most valuable strategy in improving the Actual State is to promote the criterion which has the highest weight coefficient. This can reduce the different between the Actual State and Ideal State quickly. For example, as indicated in the following table, Establishing International Communications has a high weight coefficient of 11.2 and therefore should be among the first to be considered by the management of technology transfer.

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<table>
<thead>
<tr>
<th>Criterion</th>
<th>Significance Coefficient</th>
<th>Points</th>
<th>Points * Weight Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Consultation, Evaluation, Policy-Making for Technology Transfer</td>
<td>7/6</td>
<td>110</td>
<td>836</td>
</tr>
<tr>
<td>2. Cooperation between the Industry and the Universities</td>
<td>10</td>
<td>30</td>
<td>300</td>
</tr>
<tr>
<td>3. Fundamental Infrastructures for Technology Transfer</td>
<td>11/2</td>
<td>80</td>
<td>896</td>
</tr>
<tr>
<td>4. Legislative and Organizational Infrastructures</td>
<td>10/6</td>
<td>30</td>
<td>318</td>
</tr>
<tr>
<td>5. Economic, Cultural, and Social Infrastructures</td>
<td>10/8</td>
<td>25</td>
<td>270</td>
</tr>
<tr>
<td>6. Human Resource Development Plan</td>
<td>10/3</td>
<td>20</td>
<td>206</td>
</tr>
<tr>
<td>7. Improvement of Local Processes</td>
<td>11/2</td>
<td>35</td>
<td>392</td>
</tr>
<tr>
<td>8. Modification and Development of Imported Technologies</td>
<td>10</td>
<td>15</td>
<td>150</td>
</tr>
<tr>
<td>9. Establishment of International Communications</td>
<td>9/5</td>
<td>20</td>
<td>190</td>
</tr>
<tr>
<td>10. International Cooperation</td>
<td>8/8</td>
<td>45</td>
<td>396</td>
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<tr>
<td>Total</td>
<td>100</td>
<td>400</td>
<td>3954</td>
</tr>
</tbody>
</table>

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