Strategic Development and SWOT Analysis for IT/ICT Programs in Universities of Mazandaran in Iran Using Digital Indices

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ABSTRACT

The rapid growth of information and communication technologies prompted the need for developing the strategic implementation framework of IT/ICT programs in universities. Here, we propose a strategic framework for the development of the IT/ICT programs in the universities of the province of Mazandaran in Iran. We use the SWOT analysis to assist the formulation of the strategy, where the Analytic Hierarchy Process (AHP) is applied to weigh the SWOT factors and the fuzzy TOPSIS is used to evaluate the strategic plans. Based on Iran and Mazandaran Digital Indices (DI) and considering the SWOT matrix, four strategies are identified. Finally, an analytical concept, namely *the strategy shooting, is* considered to show the role of SWOT factors and strategic plans on the performance of the system.

Key words : SWOT, IT/ICT program, Fuzzy TOPSIS, AHP, Digital Indices

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1. Introduction

Managing information technology (IT) can be conceptualized as an issue of aligning organizations with their IT to gain competitive advantages[14]. Researchers agree that strategic alignment or the fit between business strategy and IT is the most signifi cant issue facing IT[1][16]. Prior studies have found that IT alignment continuously varies with changes in the environment, strategy, organization structure, or technology itself. Therefore, achieving and sustaining strategic alignment are difficult and often frustrating[7]. In prior strategic alignment studies, scholars sought ideal alignment patterns among the various organizational elements[1]. The approach usually focused on strategy formulation but often neglected strategy implementation. Other alignment studies have been criticized because they have focused on the resulting business performance and not the alignment implementation process. Hirschheim and Sabherwal (2001) agree that the difficulties in achieving and sustaining alignment have been largely underestimated. Scholars had regarded strategic alignment as an on-going process and not as a short-term program with a beginning and an ending date[9][15]. Others agree that strategic planning for IT requires evolutionary approaches tailored to organizational needs at different stages of business growth or life cycles. Today, IT is a critical resource supporting daily operations within organizations. The IT strategy should direct managerial activities toward integration with IT resources. Exploiting IT and its functionality can be a distinct resource for IT strategy planning[2]. From the resource based view of the firm, IT assets are firm specifics. IT competencies are control led and used by firms to develop and implement strategies. While the strategic value of tangible IT resources (i.e., systems, hardware, software) has often been questioned[3], intangible IT abilities (i.e., firm's ability to integrate, build, and reconfigure IT assets to match business developments and environmental changes) are considered critical for IT effectiveness[17].

Strategic management has been widely used by many enterprises to withstand fierce market competitions. A strategic management process consists of three stages: strategy formulation, strategy implementation, and strategy evaluation[4]. SWOT analysis of external opportunities and threats as well as the internal strengths and weaknesses of the enterprises are important for strategy formulation and development. Strategic management can be understood as the collection of decisions and actions taken by business management, in consultation with all levels within the organization, to determine the long-term activities of the organization[10]. Many approaches and techniques can be used to analyze strategic cases in the strategic management process[5]. Among them, the Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis, which evaluates the opportunities, threats, strengths and weaknesses of an organization, is the most common[8]. SWOT analysis is an important support tool for decision-making, and is commonly used as a means to systematically analyze an organization's internal and external environments[11][12][13]. By identifying its strengths, weaknesses, opportunities, and threats, the organization can build strategies upon its strengths, eliminate its weaknesses, and exploit its opportunities or use them to counter the threats. The strengths and weaknesses are identified by an internal environment appraisal, while the opportunities and threats are identified by an external environment appraisal[16]. SWOT analysis summarizes the most important internal and external factors affecting the organization's future, which are referred to as strategic factors[11]. The external and internal environments consist of factors outside and inside the organization, respectively. A comprehensive environmental analysis is important in recognition of the variety of internal and external forces with which an organization is confronted[10]. The obtained information can be systematically represented in a matrix; different combinations of the four factors from the matrix[6] can aid in determining the strategies for long-term progress[5].

2. The SWOT analysis

Here, we propose a strategic framework to develop the IT/ICT programs in universities of Mazandaran based on SWOT analysis in order to assist the formulation of the strategy as shown in Figure 1.

2.1 Determining SWOT factors

The SWOT analysis is the process of analyzing organizations and their environments based on their strengths, weaknesses, opportunities and threats. This includes the environmental analysis−the process of scanning the business environment for threats and opportunities (external factors), and the organizational analysis−the process of analyzing a firm's strengths and weaknesses (internal factors). The analysis of SWOT is the matching of the specific internal and external factors, which creates a strategic plan. It is essential to note that the internal factors such as operations, finance, marketing, and many more are within the control of the organization. On the contrary, the external factors such as political and economic factors, technology, competition, and many more are out of organization's control. Here, we apply the SWOT analysis to develop the IT/ICT programs in universities of Mazandaran. At the first step, the environment of our work is identified. The universities in Mazandaran and research centers corresponding to IT/ICT technology have been considered as the internal environment while the enterprises of the province have been considered as the external environment. After defining the SWOT factors by the expert committee, Analytic Hierarchy Process (AHP) is applied to weigh the SWOT factors. Internal and external factor evaluation (IFE and EFE) matrices consisting of two items have been formed: the first item is the weight of each factor that would be obtained by the AHP algorithm and the second item is the score of each factor that could be identified by an IT/ICT expert. To create the development strategies, all aspects of environment should be considered; i.e., the current situation of the system, interaction of the SWOT factors, interconnections between internal and external factors, priority of development, the point of view of the experts in universities and other relevant parameters. To prioritize the proposed strategies, a fuzzy TOPSIS approach is applied.

2.2 Prioritizing the strategies

The basic principle of the TOPSIS is that the chosen alternative should have the "shortest distance" from the positive ideal solution and the "farthest distance" from the negative ideal solution. Here, we apply fuzzy TOPSIS according to the following steps.

Algorithm: Fuzzy TOPSIS.

Step 1 : Obtain the weights of criteria (or attributes), $\tilde{w}_j, j=1,...,n$, using AHP. Based on the strategy-criteria matrix, R, and the vector of weights of the criteria, $\tilde{w}$, obtained by the AHP, configure a new matrix as follows: $\tilde{R}=\left[\tilde{r}_{ij}\right]_{m\times n}$, where, $B\subseteq\{1,...,n\}$ is the index set corresponding to the benefits and $C\subseteq\{1,...,n\}$ is the index set corresponding to the cost criteria and $d_j^* = \max_i d_{ij}, j\in B$,

$$a_j^- = \min_i a_{ij}, \quad j\in C \quad ;$$

$$\tilde{r}_{ij}=\left(\frac{a_{ij}}{d_j^*},\frac{b_{ij}}{d_j^*},\frac{c_{ij}}{d_j^*},\frac{d_{ij}}{d_j^*}\right), \quad j\in B \quad ;$$

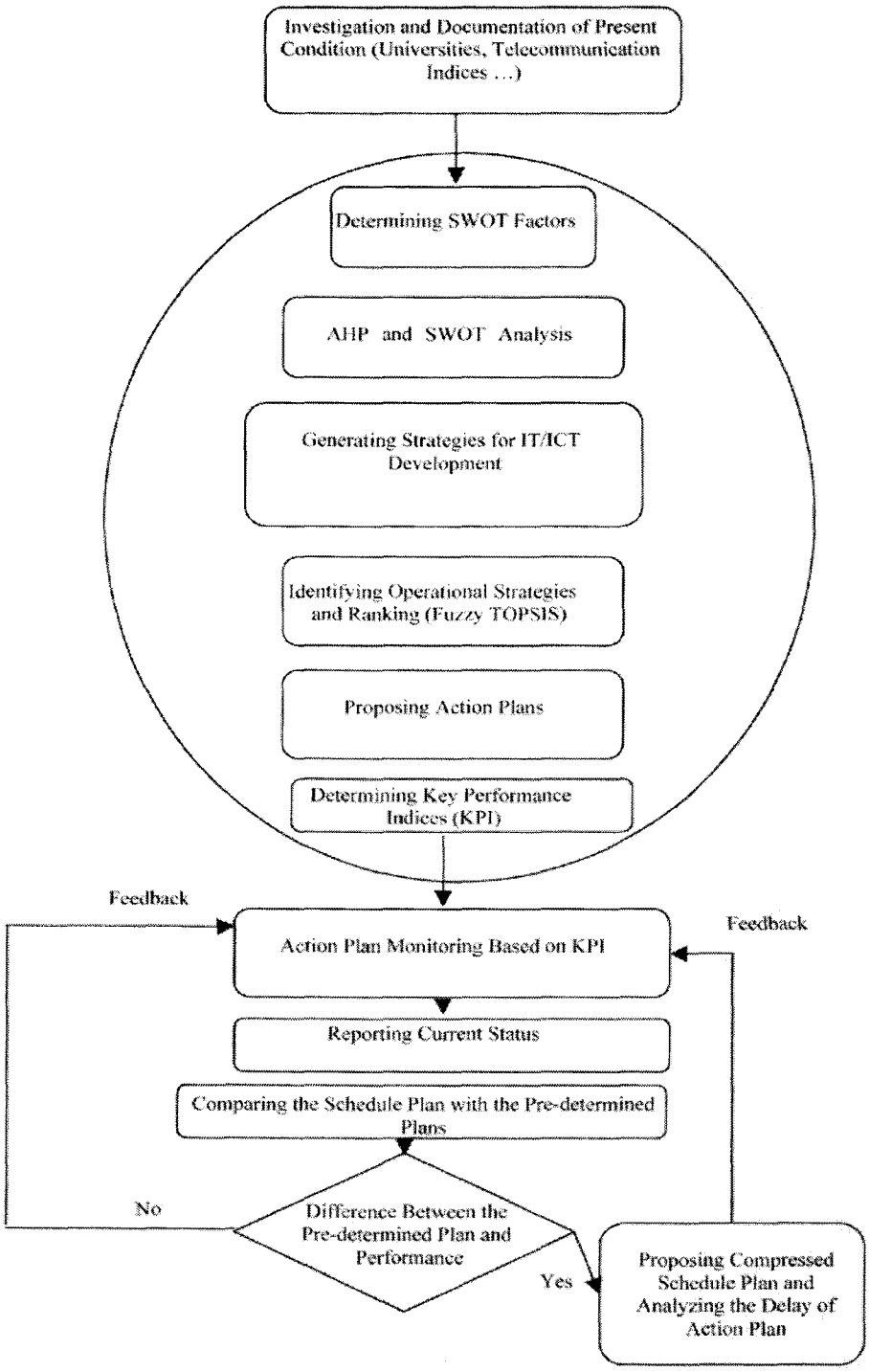
$$\tilde{r}_{ij}=\left(\frac{a_j^-}{d_{ij}},\frac{a_j^-}{c_{ij}},\frac{a_j^-}{b_{ij}},\frac{a_j^-}{a_{ij}}\right), \quad j\in C \text{ . Therefore, the weighted}$$

matrix is configured to be:

$\tilde{V}=\left[\tilde{v}_{ij}\right]_{m\times n}$, $i=1,2,...,m$, $j=1,2,...,n$,

where, $\tilde{v}_{ij}=\tilde{r}_{ij}\otimes\tilde{w}_j$.

Step 2 : Determine the fuzzy positive ideal solution $\tilde{v}_j^*$ and the fuzzy negative ideal solution $\tilde{v}_j^-$ by:



〈Figure 1〉 Strategic Planning Flowchart

$$\tilde{v}_j^* = \begin{cases} \max_{i=1,\ldots,m} \tilde{v}_{ij}, j \in B \\ \min_{i=1,\ldots,m} \tilde{v}_{ij}, j \in C \end{cases} \qquad \tilde{v}_j^- = \begin{cases} \min_{i=1,\ldots,m} \tilde{v}_{ij}, j \in B \\ \max_{i=1,\ldots,m} \tilde{v}_{ij}, j \in C. \end{cases}$$

(We note that the max and min operators used for the definitions above are to be operated on the ranking values of the operands, obtained by use of a ranking function, to determine the results of the corresponding operations.) Let

$FPIS = \{\tilde{v}_j^* \mid j = 1, ..., n\}$ and

$FNIS = \{\tilde{v}_j^- \mid j = 1, ..., n\}$.

Step 3: Use the $D_{p,q}$ -distance, a nonnegative function indexed by parameters and , between two fuzzy numbers $\tilde{a}$ and $\tilde{b}$,

$$D_{p,q}(\tilde{a},\tilde{b}) = \begin{cases} \left[(1-q) \int_0^1 \left| a_\alpha^- - b_\alpha^- \right|^p d\alpha + q \int_0^1 \left| a_\alpha^+ - b_\alpha^+ \right|^p d\alpha \right]^{\frac{1}{p}}, & p < \infty, \\ (1-q) \sup_{0<\alpha\le 1} \left(\left| a_\alpha^- - b_\alpha^- \right| \right) + q \inf_{0<\alpha\le 1} \left(\left| a_\alpha^+ - b_\alpha^+ \right| \right), & p = \infty. \end{cases}$$

and compute measures from the positive and negative ideal solutions, respectively as:

$$D_i^* = \sum_{j=1}^{n} D(\tilde{v}_{ij}, \tilde{v}_j^*), \quad i = 1, ..., m,$$

$$D_i^* = \sum_{j=1}^{n} D(\tilde{v}_{ij}, \tilde{v}_j^*), \quad i = 1, ..., m.$$

Step 4: Compute the relative closeness to the ideal solution. The relative closeness index of the i-th strategy is defined by: $CI_i = \frac{D_i^-}{D_i^- + D_i^*}$, $i = 1, ..., m$.

Step 5: Rank the preference order using the CI_i.

2.3 Action plans

The implementation strategy is the most detailed component of the proposed IT/ICT program development implementation framework. This step requires the definition of robust actions, the evaluation of budgetary requirements, the study of time and organizational constraints, the elaboration of human resource issues, management and plan coordination, migration and diffusion, etc. In addition, the action plans need to be examined concerning its risks, strategic importance and harmonized integration within the overall evolution of the specific organization. There are two main stages to the development of the implementation strategy: (a) definition of action plan elements which must be clearly defined before elaboration of these plans can take place, and (b) elaboration of action plan; once the definition and role of action plans are established, the action plans can be detailed. Activities that need to be undertaken in stage (a) include: (1) inventory of actions, (2) study of implementation procedures (budgetary constraints, organizational constraints, types of financing, etc.), and (3) action prioritization with reference to strategic importance. Activities that need to be undertaken in stage (b) include: (1) study of each action element (objectives, work breakdown structure, anticipated results, etc.), (2) time dimension (constraints, precedence, control points, etc.), (3) cost dimension (purchase costs, development costs, maintenance costs, etc.), and (4) analysis of human resource issues (training, support, etc.). Elaboration of action plans will ensure that the IT/ICT program development implementation strategies are well documented and can be readily followed.

2.4 Monitoring plans and short and long term goals

Developing a strategic implementation plan for an IT/ICT program does not guarantee its successful implementation. Consideration should be given to the continual performance monitoring of the implemented IT/ICT programs over their lifecycles, while monitoring plans should consider performance measures and data collection strategies required for their implementations by the organization. To assess the IT/ICT program development, one must select an easily definable and a limited number of performance measures with a mixture of short and long term goals. Here, we define some attributes/indices to monitor the implementation of the proposed action plan by considering short-term and long-term objectives.

3. Case Study

Here, we present and discuss a case study of developing IT/ICT programs in universities of Mazandaran based on our proposed approach. The Mazandaran province is located in the north of Iran at the southern shores of the Caspian Sea. Because of the special situation of Mazandaran, the development of IT/ICT programs is very crucial considering the capabilities being offered by tourism, farming, fishing, transportation and international trade. A main issue facing the Governor and the decision makers of the province concerns the training of needed IT/ICT experts in universities and R&D centers. Therefore, the province has a policy to develop IT/ICT program in universities and research centers. The vision of the Governor is to expand IT/ICT enterprises and satisfy e-government rules. This vision provides a suitable way for conducting the organization, while the mission of the IT/ICT ministry is to provide the requirements for developing electronic affairs to facilitate the transactions in the shortest time. Therefore, universities play significant roles in the process of training the users and educating the experts to gain the goal. One substantial stage in strategic planning is the internal and external evaluations of the environment. External evaluation results in finding the threats and opportunities which form the critical factors for success in an organization, while the internal evaluation signifies the strengths and weaknesses of the system.

3.1 Iran's and Mazandaran's status based on digital indices

Using the proposed methodology, Iran's and Mazandaran's digital indices (DI) status have been analyzed in the year 2007. For DOI, there existed eleven sub-indices in four categories as affordability, access paths, infrastructure and quality as shown in Figure 2a. For other indices some sub-criteria existed which lead to computation of some principal elements. Other discussed digital indices are e-government readiness, e-readiness, ICT diffusion, and knowledge economy index as indicated in Figures 2b, 2c, 2d, and 2e, respectively.

3.2 SWOT factors

After analyzing the status of universities in Mazandaran, the following factors were extracted. Public enterprises and involved firms in IT/ICT were identified to be the effective external factors for

〈Table 1〉 SWOT factors

Opportunity	
O1	appropriate laws related to IT/ICT
O6	existence of numerous corporations in the field of IT/ICT
O9	desirable expansion of internet network in Mazandaran
O12	suitable share of IT/ICT in the general budget of Mazandaran
O17	desirable development of optical fiber
Threat	
T1	lack of experts in the field of IT/ICT
T9	traditional consideration of some managers
T11	lack of research centers in the field of IT/ICT
T13	low rate of ADSL diffusion in Mazandaran
T14	low rate of personal computers among families
Strength	
S3	appropriate trend of scientific articles related to IT/ICT in international conferences and journals
S4	relatively appropriate quantity of IT/ICT programs in Mazandaran
S6	existence of IT/ICT macro plans in universities of Mazandaran
Weakness	
W2	lack of IT/ICT teachers in universities
W6	low quality of IT/ICT programs in Mazandaran
W15	lack of e-library in universities
W25	lack of budgets for implementing IT/ICT projects

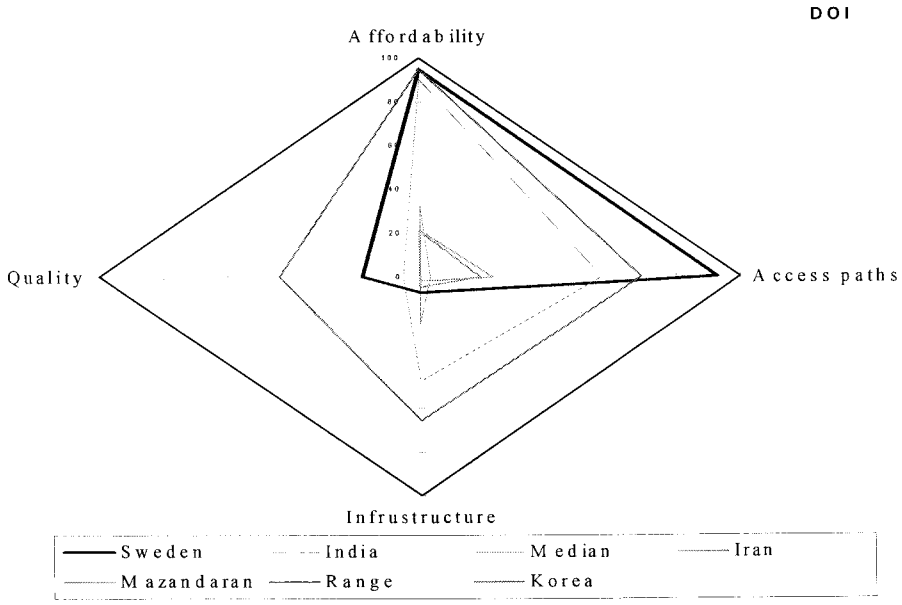
developing IT/ICT programs in universities. When an investigation was fulfilled on the external factors, the 18 opportunity and 15 threat factors were extracted. The same procedure was done for the internal factors; i.e., 7 strength factors and 25 weakness factors were extracted. Some of the selected factors are illustrated in Table 1.

3.3 Determining the current status of educational centers

To identify the coefficients of internal and external factors (strength, weakness, opportunity, and threat), the pair-wise comparisons matrices were configured. The entries of these matrices were filled by the numbers 1, 2, and 3, where 1 corresponds to equal importance, 2 indicates more and 3 represents much more importance. Then, the matrices were normalized and the coefficient for each factor was obtained. In the next stage, a value from 1 to 5 was assigned to each factor. The linguistic equivalent of these numbers for strength and opportunity are neutral, least effective, moderately effective, effective, and most effective, respectively. Also, for weakness and threat the numbers correspond to much less, less, moderate, critical, and very critical. To identify the final score of each factor, the score was multiplied by the coefficient. Finally, the weights of weakness, strength, threat and opportunity were achieved. After identifying the scores for internal and external factors, the summation of each was computed. The current status of the system is illustrated in Figure 3. According to the SWOT matrix, the system is located at critical status of WT obliging us to configure a defensive strategy. Here, with respect to the internal factors of strength-weakness and external factors of opportunity-threat, four strategies were extracted based on the meetings of a group of experts using Brain storming and Delphi methods. The strategies and their related factors are shown in Table 2.

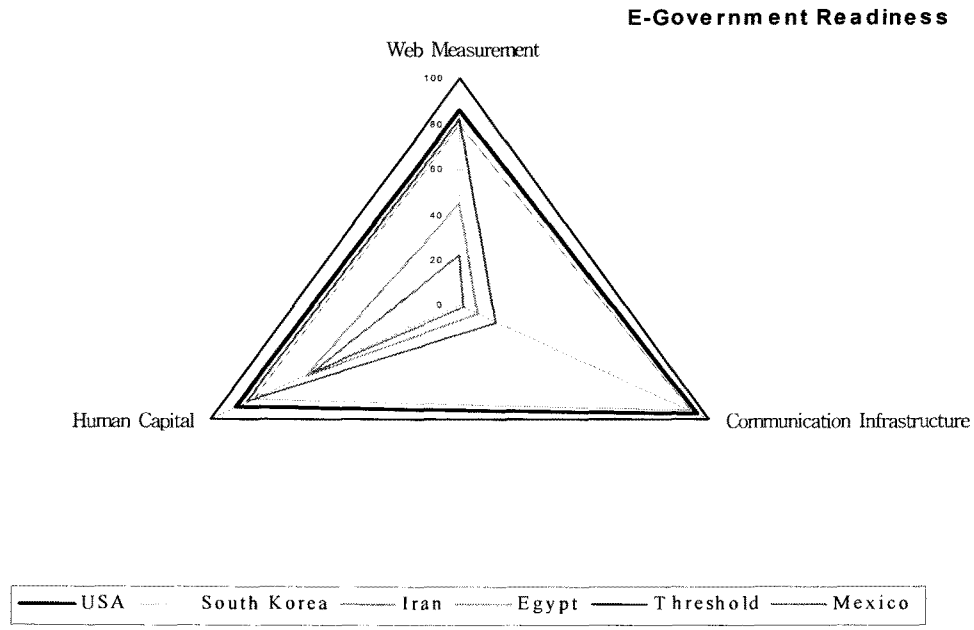
3.4 Operational strategy

The first strategy should be the development of IT/ICT training centers in Mazandaran. Developing IT/ICT related programs would not be possible in the absence of the IT/ICT training centers which are needed to educate the required manpower. The most significant activities related to the strategy of developing IT/ICT training centers are: (a) preparing IT/ICT inter-university development document, (b)

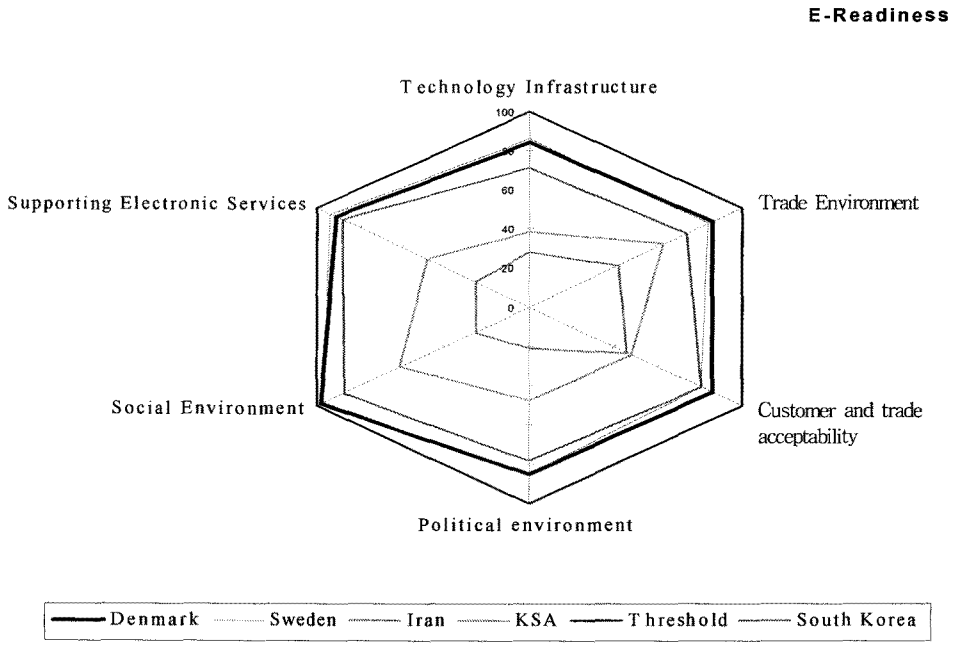


〈Figure 2a〉 DOI graph

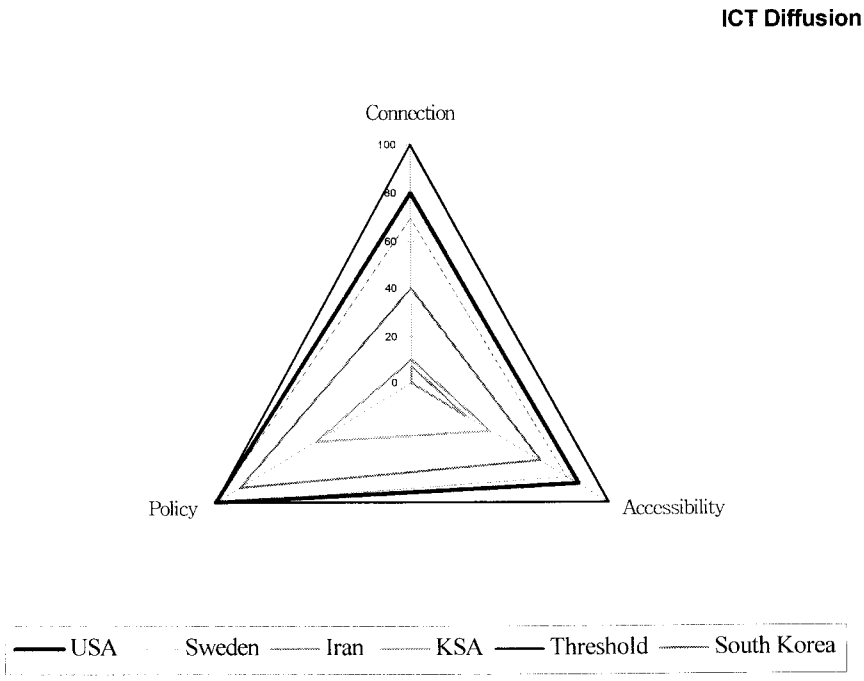
providing IT/ICT special train and research institutes in Mazandaran, (c) providing faculty members and special educated manpower in educational and research institutes of Mazandaran, and (d) increasing the scientific, research and practical capabilities of IT/ICT students in Mazandaran.



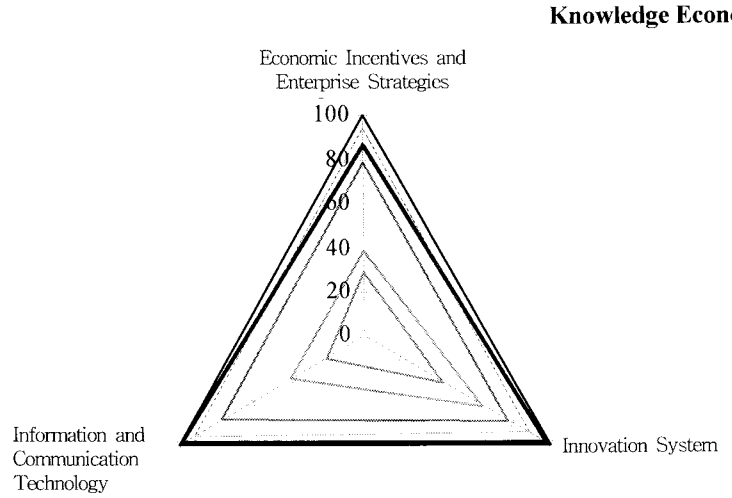
〈Figure 2b〉 e-government readiness



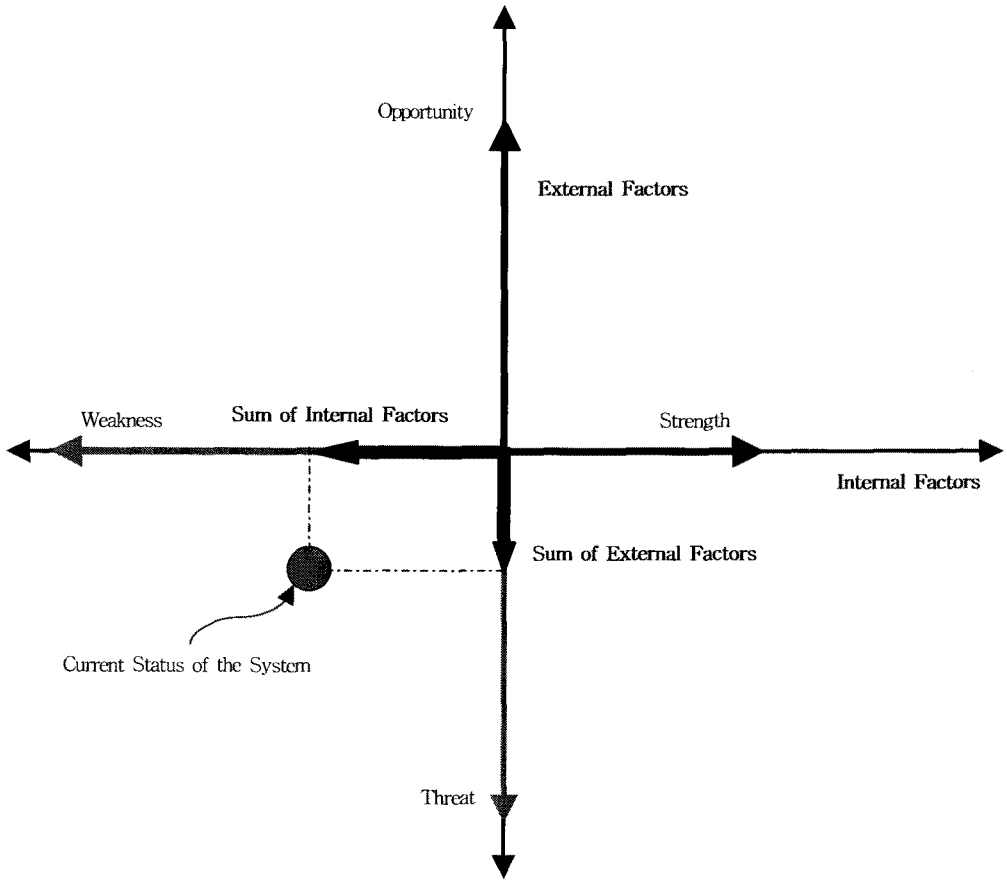
〈Figure 2c〉 e-readiness



〈Figure 2d〉 ICT diffusion



〈Figure 2e〉 Knowledge economy index



〈Figure 3〉 Current status of the system

〈Table 2〉 Strategies and related factors

Code	Strategy	Dependent Factors
ST1	strategy of developing IT/ICT training centers in Mazandaran	S1-S7, W1-W25, O2-O5, O9, O11-O13, O17, O18,T1-T4, T6, T11
ST2	strategy of developing IT/ICT based businesses in Mazandaran	S4, S7, W4-W7, W9, W22, O1-O3, O5-O8, O11, O12, T1,T2, T4-T6, T9, T11
ST3	strategy of providing requirements to configure Mazandaran as an electronic province	S1, S3, S4, S7, W2-W9, W12, W14 , W15, W17, W20, W22-W24, O3, O5, T1,T2, T4, T7-T10, T12-T15
ST4	strategy of developing IT/ICT hardware infrastructure in Mazandaran	W8, W10-W16, W21, O9, O16-O18, T1,T4, T11-T13, T15

Developing IT/ICT based businesses in Mazandaran was identified as the second strategy. The extent of the development of IT/ICT programs may depend on the demand for employing the graduating students from these programs. On the other hand, knowing industry trends towards applying IT/ITC in their processes such as CRM and SCM, the need for manpower is essential. The most important activities to precede this strategy are: (a) preparing a cooperation document amongst universities and SMEs, (b) constructing IT/ICT parks in Mazandaran and (c) supporting active IT/ICT firms in Mazandaran. Public organizations and people are the two sides of the electronic province. Public organizations should try to provide suitable services to gain the objectives of the e-government and also people should learn how to use these services. Therefore, developing IT/ICT programs in Mazandaran by training special manpower causes the increase of

the level of firms' serviceability and the knowledge of consumer. So, providing the requirements to configure Mazandaran as an electronic province has been defined as the third strategy. The crucial activities associated with it are: (a) expanding IT/ICT related research, (b) preparing cultural understanding for IT/ICT in Mazandaran, and (c) obligating the organizations to offer IT/ICT services. Undoubtedly, the development of IT/ICT hardware infrastructure is an essential strategy for developing the IT/ICT. Without a suitable infrastructure such as stable and mobile phones, data, wireless systems and so on, expecting improvement in the IT/ICT is vain. Developing the IT/ICT hardware infrastructures in Mazandaran and in universities is identified as the fourth strategy.

3.5 Prioritizing the strategies

To rank the strategies, we applied the fuzzy TOPSIS approach, considering ten attributes/ indices that have been identified based on the expected development of IT/ICT framework in universities in Mazandaran and satisfying the vision and the mission of legal documents with possibility of SWOT factors interaction. Using the fuzzy TOPSIS, we identified the priority of strategies. The weight of each attribute/index was obtained by the AHP to form the TOPSIS weighted decision matrix. Then, the distances of each strategy from the positive and negative ideal solutions were calculated. Finally, the relative closeness to the ideal solution and ranking of strategies were obtained by fuzzy TOPSIS as shown in Table 3.

3.6 Short term objectives

The main short-term objectives in developing IT/ICT related programs in Mazandaran are decided to be:

1. Providing and fortifying IT/ICT programs, in two universities of Mazandaran, each year.
2. Increasing IT/ICT related faculty members in Mazandaran, 20 percent each year.
3. Twenty percent increase in IT/ICT infrastructures in universities (including bandwidth, person-computer, person-internet).
4. Supporting IT/ICT experts by provision of scholarships, 6 persons each year.
5. Allocating annual budgets to IT/ICT programs in universities based on the development of plans in pilot universities.
6. Providing:
(a) LAN in pilot universities in the first year, and
(b) extranets and other intra-university networks in universities within a 4 years period.
7. Courses having content dealing with practical issues of IT/ICT in 3 years period.

3.7 Long term objectives

The main long-term objectives for developing IT/ICT related programs in Mazandaran are identified to be:

1. Increasing the ratio of faculty members to students (up to 1 faculty to 30 students) at IT/ICT related programs in Mazandaran.
2. Increasing the participation of universities in implementing electronic province projects.
3. Increasing the IT/ICT service level in universities.
4. Fortifying technologies related to IT/ICT in other programs.
5. Increasing budgets for IT/ICT programs in universities.
6. Developing IT/ICT related businesses.
7. Thirty percent increase of the electronic services in Mazandaran.

〈Table 3〉 Strategy ranking by fuzzy TOPSIS

Strategy	D^*	D^-	Fuzzy TOPSIS Score
ST1	2.309578	4.228307	0.646739
ST2	3.603137	2.987936	0.45331
ST3	2.979795	3.601806	0.547254
ST4	3.594635	2.986966	0.453836

4. Discussion

4.1 Internal and external factor movement trend graphs analysis

Here, we intend to investigate the movement variation trend of the internal and external factors based on the optimal policy elements in implementing the proposed strategies. In Figure 4.a, the movement variation trends of strength and weakness are shown. While the scores of the weaknesses are stable, the scores of each strength in the worst and the best status are compared with the sum of the weakness scores. In the beginning, the S7 factor (appropriate decision making for functional development of IT/ICT programs in universities) has the most effect in the trend improvement, but after a while the effect is decreased in the trend improvement of the current status of the system. Also, the S6 factor (existence of IT/ICT macro plans in universities) is not satisfying at the beginning, but after a while it excels S7. Obviously, the interval movement trend graphs provide appropriate tools for the decision makers about the IT/ICT program development policies in universities.

As stated above for the movement variation trend of strength, the movement variation trends of weaknesses are illustrated in Figure 4.b. Here, the scores of the strength internal factors are stabilized and the amount of weakness factor score variations is computed. In this graph, in the beginning, W2 (lack of faculty members in IT/ICT related programs in universities) shows the most effect, but after a while W25 (lack of budget provision for implementing IT/ICT plans in universities) indicates a better trend; i.e., in the short term employing more faculty members could be useful, but because of the loss in the structure of investment the forward movement of the organization is harmed, in the long run.

After investigating the internal factors, here we analyze the same trends for external factors of opportunity and threat. To analyze the opportunity movement trend, the threat sum is stabilized and the effect of each opportunity factor is investigated as shown in Figure 4.c. Most noticeables are the three break points; i.e., at first the O2 factor (the appropriate place of IT in the global plans of the government) is more effective than other opportunities, but after that the O8 factor (appropriate financial allocation for developing IT/ICT in different organizations) shows more effectiveness. The third break occurs in O12 (appropriate share of IT/ICT in the general budget of Mazandaran). As opportunities are external factors and the current status is threat-weakness, undoubtedly, a defensive strategy in SWOT matrix should be applied to escape the threats and use the opportunities to move to the weakness-opportunity and finally to strength-opportunity, to be discussed in the following section.

The threat interval movement trends are shown in Figure, 4.d. In this graph, no break point is considered. The threat factor T8 (lack of IT/ICT application culture in Mazandaran) indicates the highest movement trend. After that, the T9 factor (traditional view points of people and managers on IT/ICT) and T15 (inadequate expansion of internet bandwidth in Mazandaran) are presented. As mentioned before, these graphs help the managers in the decision making process either before or during the implementation, to monitor the status of system variations in the future.

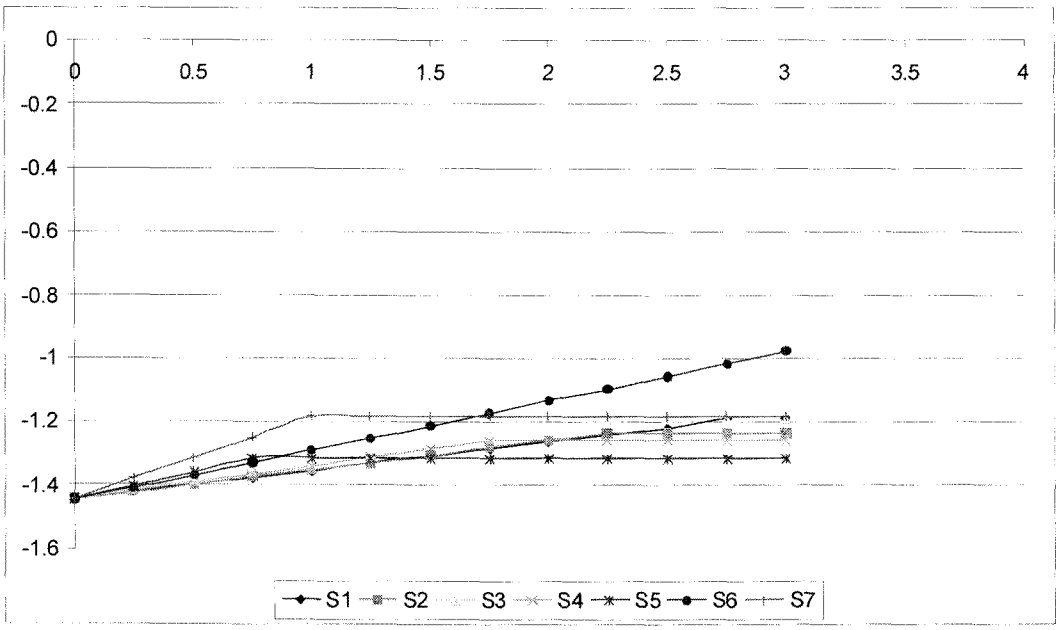
4.2 Strategy shooting analysis

Having analyzed interval movement trends, here we analyze the status of the system during and after the implementation of strategies for finding the best path to develop the IT/ICT related programs in universities of Mazandaran.

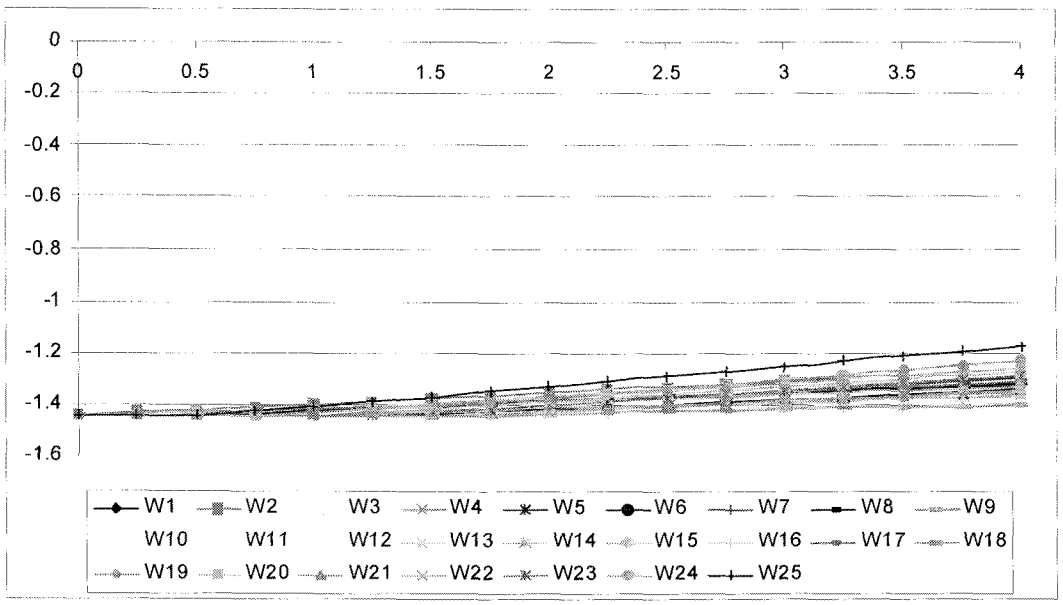
After implementing each effective strategy, the status of the organization or system environment is moved towards another area. This procedure is illustrated in figures 5.a to 5.d. The advantages of such graphs are:

1. Identification of the future status of the system by implementing the strategy,
2. showing the path of movement by strategic and operative plans, and
3. controlling the operative plan based on the guidelines.

According to the strategy shooting, we find out that if strategy four is applied then it moves from WT space to WO space. Also, strategies 2, 3, and 1 move to WO, SO, and SO spaces, respectively. Strategy 1 shows more movement changes than others. Regarding the amount of the shooting, it is possible to reach a logical conclusion about prioritizing of strategies based on the output of fuzzy TOPSIS. It is obvious that it is not possible to move from the undesirable status of WT to the desirable status of SO with one strategic plan. First, by taking a defensive policy, it moves from WT space to WO space, and then by a diversified strategy,

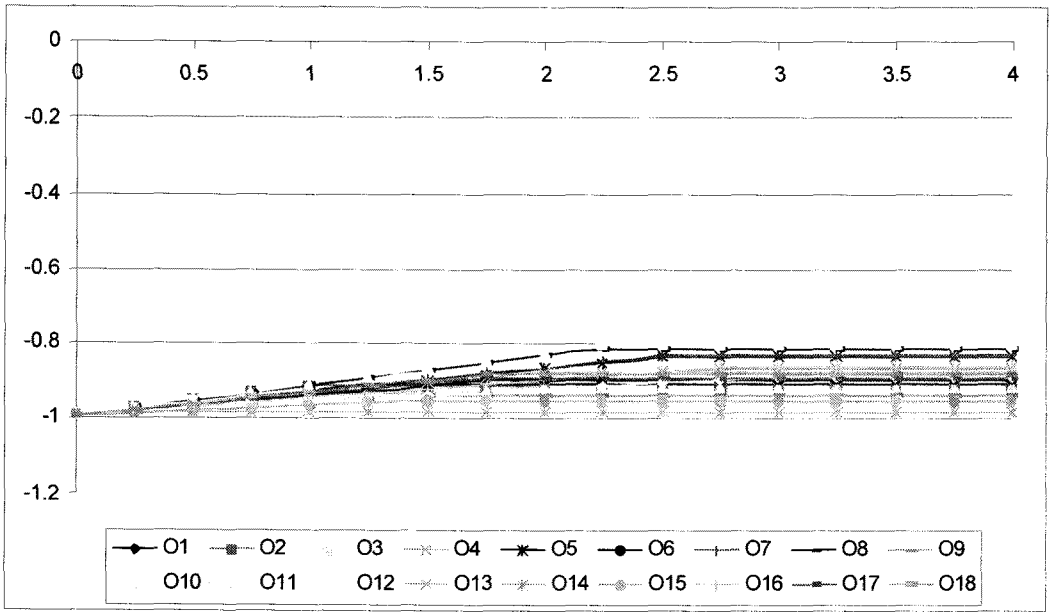


〈Figure 4a〉 Strength interval movement trend

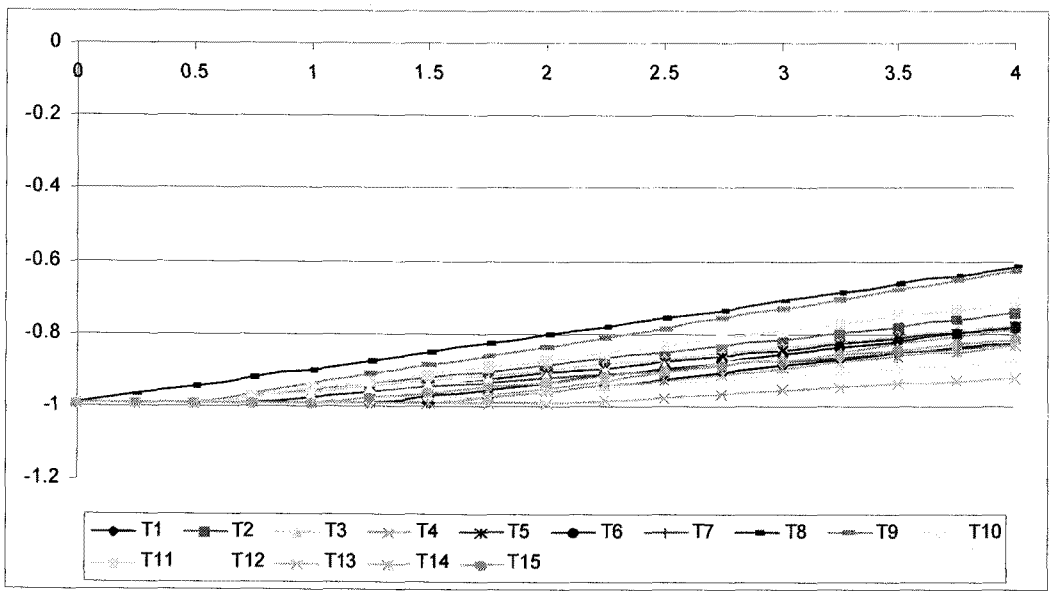


〈Figure 4b〉 Weakness interval movement trend

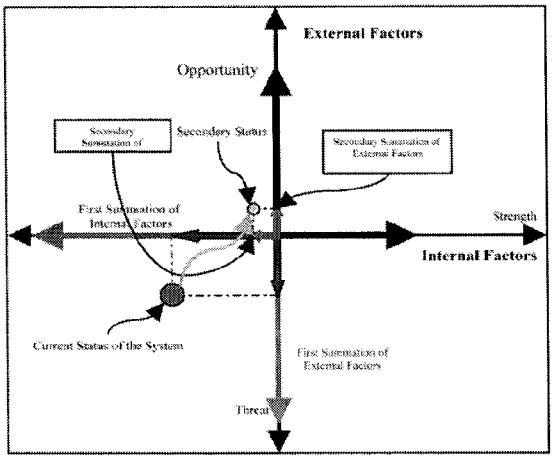
it moves to SO space. The movement trend in a 5 year implementation period and the transition path are presented in Figure 6. As opportunities are external factors and the current status is threat-weakness, undoubtedly, a defensive strategy in the SWOT matrix should be applied to escape the threats and use the opportunities to move to the weakness-opportunity area and finally to strength-opportunity space.



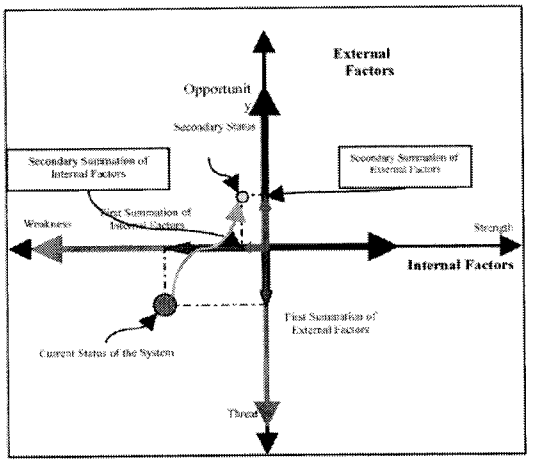
〈Figure 4c〉 Opportunity interval movement trend



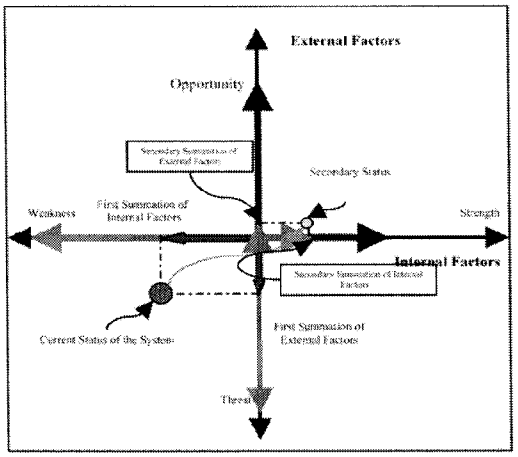
〈Figure 4d〉 Treatment interval movement trend



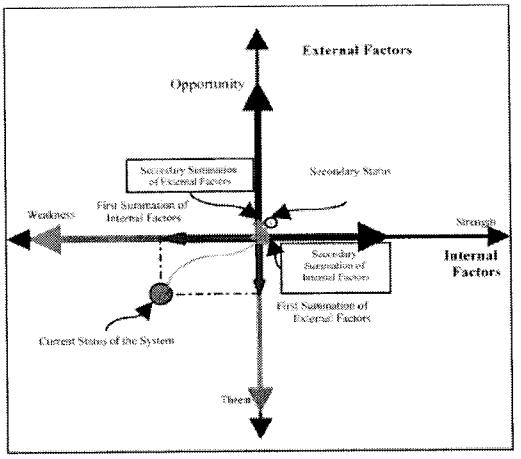
〈Figure 5a〉 The amount of shooting for the second strategy



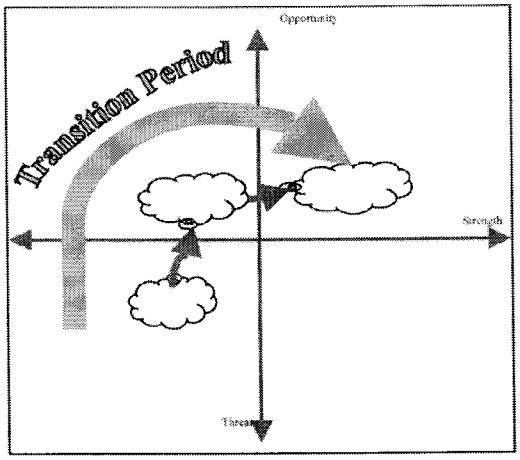
〈Figure 5b〉 The amount of shooting for the second strategy



〈Figure 5c〉 The amount of shooting for the second strategy



〈Figure 5d〉 The amount of shooting for the second strategy



〈Figure 6〉 The movement path and transition period

〈Table 4〉 The Comparison of fuzzy TOPSIS with strategy shooting position

Strategy	Fuzzy TOPSIS Rank	Strategy Shooting Position	Strategy Shooting Rank
ST1	1	$SO^{(a)}$	1
ST2	4	$WO^{(b)}$	4
ST3	2	$SO^{(a)}$	2
ST4	3	$WO^{(b)}$	3

The result of strategy shooting validates the fuzzy TOPSIS to prioritize the strategic plans. As shown in Table 4, the comparison of $SO^{(a)}$ and $SO^{(b)}$ indicates that $SO^{(a)}$ achieves more opportunity and also more strength than $SO^{(b)}$, and thus we could realize that the positions of $SO^{(a)}$ and $SO^{(b)}$ obtain ranks 1 and 2, respectively. There is a slight difference between $WO^{(a)}$ and $WO^{(b)}$. Using the opportunity viewpoint, $WO^{(a)}$ has a better performance, but considering the reduction of weakness as an internal factor, $WO^{(b)}$ has a better behavior. Here, we could realize that the positions $WO^{(b)}$ and $WO^{(a)}$ obtain ranks 3 and 4, respectively.

5. Conclusions

Due to the rapid growth of information and communication technologies worldwide, it is essential to pay more attention to IT/ICT. In this regard, training specialists in the field as a basic factor for the development IT/ICT is considered to be highly important. Hence, we applied the AHP and fuzzy TOPSIS quantification approaches to quantify the SWOT factors and rank the proposed strategies. After that, digital indices were discussed and illustrated graphically. The digital indices are tools which help a strategic analyzer to trace the amount of progress in a time period. We then introduced a new concept of strategy shooting and used it to trace the implementation of strategies. The result of strategy shooting showed the validity of the fuzzy TOPSIS approach to prioritize the strategy plans. Finally, the transition path from the critical status to the desirable status was presented to demonstrate the real movements of the strategy plans developed for the implementation of IT/ICT programs in universities of Mazandaran in Iran.

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