A New Approach in Strategy Formulation using Clustering Algorithm: An Instance in a Service Company

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ABSTRACT

The ever severe dynamic competitive environment has led to increasing complexity of strategic decision making in giant organizations. Strategy formulation is one of basic processes in achieving long range goals. Since, in ordinary methods considering all factors and their significance in accomplishing individual goals are almost impossible. Here, a new approach based on clustering method is proposed to assist the decision makers in formulating strategies. Having extracted the internal and external factors, after setting long range goals, the factor-goal matrices are generated according to the impact rate of factors on goals. According to created matrices, clusters including goals and factors are formed. By considering individual clusters the strategies are proposed according to the current state of clusters for the organization. By applying this new method the opportunity of considering the impact of all factors and its interactions on goals are not lost. Strategy-factor and strategy-goal matrices are utilized to validate the proposed method. To show the appropriateness and practicality of our approach, particularly in an environment with a large number of interacting goals and factors, we have implemented the approach in Mahmodabad Training Center (MTC) in Iran. The resulting goal-factor, current and dated states of clusters, also, strategy-goal and strategy-factor matrices for model validation and route branch indices for finding out how the organization achieved each goal are reported.

1. Introduction

Goals, factors and strategies are known as three main elements in strategy formulation. The interrelationship among them should be considered as an integrated set, while in common methods these relationships are vague. The whole conventional method utilizes these elements in isolate or considers them fractionally, and in most cases do not consider the interrelationship among them accurately. The main objective of this paper is to present how to create developing strategies on a more accurate and objective bases by considering all the components and the significance of their impact on goals. The process begins with identifying whether the organization is intrinsically a production or a service company. Then, the environmental analysis including all opportunities and threats, in the light of organization's strengths and weaknesses, is performed. At this stage, the factor–goal

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matrix is formed by considering the impact of factors on every individual goal. Then, the proposed clustering approach is applied to cluster goals and relevant factors which are known as influential factors. This way, the goals with higher similarities are embedded within the same cluster. Unlike giant organizations having multi direction goals, the clusters have homogeneous goals. The appropriate strategies then would be generated from individual clusters. In this method, instead of applying system approach, looking top down, we apply process approach looking bottom up. By considering each cluster as a subunit of organization, it can lead to a significant saving in spending resources in implementing stage too. A comparison between the proposed method and an ordinary method will be performed. For validating the model, the strategy-factor and strategy-goal matrices would be made for constructing factor-goal cluster. If the elements of these clusters are in accordance to the first factor-goal cluster, then the model is valid. Otherwise, we should revise the strategies or the impacts. Finally, for attaining the amount of organization's achieving goals the route branch indices which also shows how the proposed strategies prioritize the goals would be calculated. The remainder of our work is organized as follows. Section 2 discusses literature review. In Section 3, we explain strategy formulation, and in section 4 the proposed clustering algorithm. In Section 5, the strategy generation is described. The case study is presented in Section 6, and a discussion is given in Section 7. Finally, we conclude in Section 8.

2. Literature Review

Strategic management is concerned with a set of decisions and actions taken by business managers in consultation with the hierarchy within the organization, to determine the long-term activities of the organization (Houben et al.,1999).

The way organizations formulate strategy has become one of the most congested areas of debate in the strategic management field. In the conventional approach (the so-called 'prescriptive' or design' school of thought), strategy development is mainly the result of a systematic, rational process of deliberate planning by a top management team, which is then communicated to the organization for implementation. In large companies, this process typically occurs through formal strategic planning systems (Gimbert et al., 2010). Strategy formulation is sometimes referred to as determining where you are now, where you plan to go, and finally how to get there. It consists of performing a situation analysis, self-evaluation and competitor analysis in both inside and outside the organization, while setting the objectives concurrent with the assessment. Many approaches and techniques can be used to analyze strategic cases in the process of strategic management (Dincer, 2004).

Among several existing approaches, strengths, weaknesses, opportunities, and threats (SWOT) analysis, evaluating each of the indicated terms in an organization, is the most acclaimed (Hill, and Westbrook, 1997). SWOT analysis is the most significant part of strategic formulation. By identifying the strengths, weaknesses, opportunities, and threats, the organization can build strategies upon its strengths, eliminate its weaknesses, and exploit its opportunities or utilize them to encounter the threats. The strengths and weaknesses are considered as an internal organization environment appraisal, while the opportunities and threats are considered as an external organization environment appraisal (Dyson, 2004). The obtained internal and external information can be systematically represented in a SWOT matrix (Ulgen and Mirze, 2004). However, a SWOT analysis is not error free and without weaknesses in its assessment steps (Hill and Westbrook, 1997; and McDonald, 1993). In conventional SWOT analysis, the magnitude of the factors is not quantified to determine the effect of each factor on the proposed plan or strategy (Masozera et al., 2006). In other words, SWOT analysis does not provide an analytical means to determine the relative importance of the factors, or the ability to assess the appropriateness of decision alternatives based on these factors (Kajanus et al., 2004). Several methods such as the traditional SWOT analysis (Bellman and Zadeh, 1970), analytical SWOT method (Chen et al., 1992), resource-based view (RBV) (Paiva et. al, 2008; and Gordon et. al, 2005), and quantitative SWOT methods (Chen and Hsieh, 2000; David, 2001; and David, 1998), fuzzy quantified SWOT (Kuo-liang and Shu-chen, 2008), are used to support decision making in competitive environment in a given organization.

Quantitative SWOT analysis methods such as external factor evaluation matrix (EFE), internal factor evaluation matrix (IFE) and competitive profile matrix (CPM) aim at analyzing data statistically, differing from the qualitative estimations that lie behind the traditional SWOT analysis (David, 2001; and David, 1998). RBV was largely introduced by Wernerfelt (Wernerfelt, 1984) in the 1980s, and became a dominant framework in the 1990s (Hoskisson et al., 1999). The core concept of RBV concerns the organization's internal strengths and weaknesses in contrast to industrial organization economics, which focuses on a firm's external opportunities and threats (Porter and Millar, 1985; Porter, 1990; and Grant, 1991). When the external environment is dynamic, the firm's own resources and capabilities may be easier to control (Barney, 1991; Barneyet al., 2001; Foss and Eriksen, 1995; and Olavarrieta and Ellinger, 1997).

Many other fields in management now use strategy as a prefix (e.g., strategic marketing, strategic HR) and people at all organizational levels are encouraged to think and act strategically (Cummings and Daellenbach, 2009). A literature review identifies a considerable variety of coping strategies, and Engau and Hoffmann (2011) apply unique data from a

worldwide cross-industry survey to categorize each into one of three types offensive, defensive or passive.

After emerging computer technology and cyber space, the science of data mining has been evolved and spread in different field of knowledge. Clustering is an attractive and important task in data mining that is used in many applications. Clustering refers to grouping together data objects so that objects within a cluster are similar to one another, while objects in different clusters are dissimilar (Hatamlou et al., 2012). Clustering is a method that divides a dataset into groups of similar objects, thereby minimizing the similarities between different clusters and maximizing the similarities between objects in the same cluster. Clustering is widely applied in data mining (Zhang and Cao, 2011), such as in document clustering and Web analysis. Classic clustering approaches include partition-based methods, such as K-means, K-medoids, and K-prototypes (Huang, 1998 and Kanungo et al., 2002); hierarchy-based methods, such as BIRCH (Zhang, 1996); density-based methods (Aliguliyev, 2009 and Duan et al., 2007); grid-based methods (Yue et al., 2008); and model-based methods, such as neural networks and self-organizing map (SOM) (Rangarajan et al., 2004 and Brugger et al., 2008). One of the most important areas is clustering which has been applied in variety of scientific subjects. Cluster analysis takes a sample of elements and groups them such that the statistical variance among elements grouped together is minimized, while between-group variance is maximized. Specifically, cluster analysis permits the inclusion of multiple variables as sources of configuration definition.

So, cluster analysis can give us a good description of configurations without over specifying the model. Clustering methods have been used in many contexts and disciplines such as data mining (Han and Kamber, 2006), information retrieval (Hammouda and Kamel, 2004), pattern classification (Filippone et al., 2008), machine learning (Filippone et al., 2008; Grabmeier and Rudolph, 2002; Parsons et al., 2004; Xu and Wunsch, 2005; Hammouda and Kamel, 2004; and Al-Omary and Jamil, 2006). The clustering algorithms have been categorized in different ways depending on different criteria.

Clustering algorithms being used can be simply classified into the following three categories in general: hierarchical, nonhierarchical and hybrid (Punj and Stewart, 1983, Filippone et al., 2008; Grabmeier and Rudolph, 2002; Jain et al., 1999; Parsons et al., 2004; and Xu and Wunsch, 2005). A comprehensive survey of the various clustering algorithms can be found in Filippone et al. (2008), Grabmeier and Rudolph (2002), Jain et al. (1999), Parsons et al. (2004),and Xu and Wunsch (2005).

Hierarchical clustering algorithms iteratively construct clusters by joining (agglomerative) or dividing (divisive) clusters using past iterations. Different

hierarchical algorithms for text documents have been discussed in Manning and Schutze (2002). Variations of hierarchical methods can be found in Aliguliyev (2009). Nonhierarchical algorithms mainly partition a data set into a prespecified number of clusters. Specific nonhierarchical methods vary slightly, but function in essentially the same manner (Hair et al., 1992). After selecting initial cluster centroids (the 'center points' of clusters along input variables), each observation is assigned to the group with the nearest centroid. As each new observation is allocated, the cluster centroids are recomputed.

Multiple passes are made through a data set to allow observations to change cluster membership based on their distance from the recomputed centroids. To arrive at an optimal solution, passes through a data set continue until no observations change clusters (Anderberg, 1973).

3. Strategy Formulation

Strategy formulation is the process of developing long-term goals for an effective management of environmental factors. Strategy formulation consists of two basic components, one is situation analysis which is the process of finding a strategic fit between external opportunities and internal strengths while working around external threats and internal weaknesses, and the other component is developing strategies based on goals. Here, we consider organizations as two general types: (1) Service organization and (2) Production organization. For each organization, according to its characteristics and nature of the problems of concern the key indicators based on priorities would be considered.

3.1. Data Gathering

Gathering data on factors was practiced at first in production companies. By emerging service companies, the significance of data gathering has spread to this ever increasing sector of the industry. So, data gathering is just as applicable to services as it is to production in general. Only live experiments with real customers and real transactions can provide the type of data needed for truly innovative services. But live tests are difficult to control and risky to both customer relations and firm creditability, and therefore most services are designed by brainstorming or trial-and error, with limited success.

Eventually, services are labor-intensive, while manufacturing is more capital intensive (Russell and Taylor III, 2006). Classification of organizations into two groups, production and service, has advantages of easily finding the factors and sub-factors and also prioritizing factors which is a key point for environmental analysis. For these two types of organizations, we can suggest the most important factors and sub-factors as shown in Figure1.
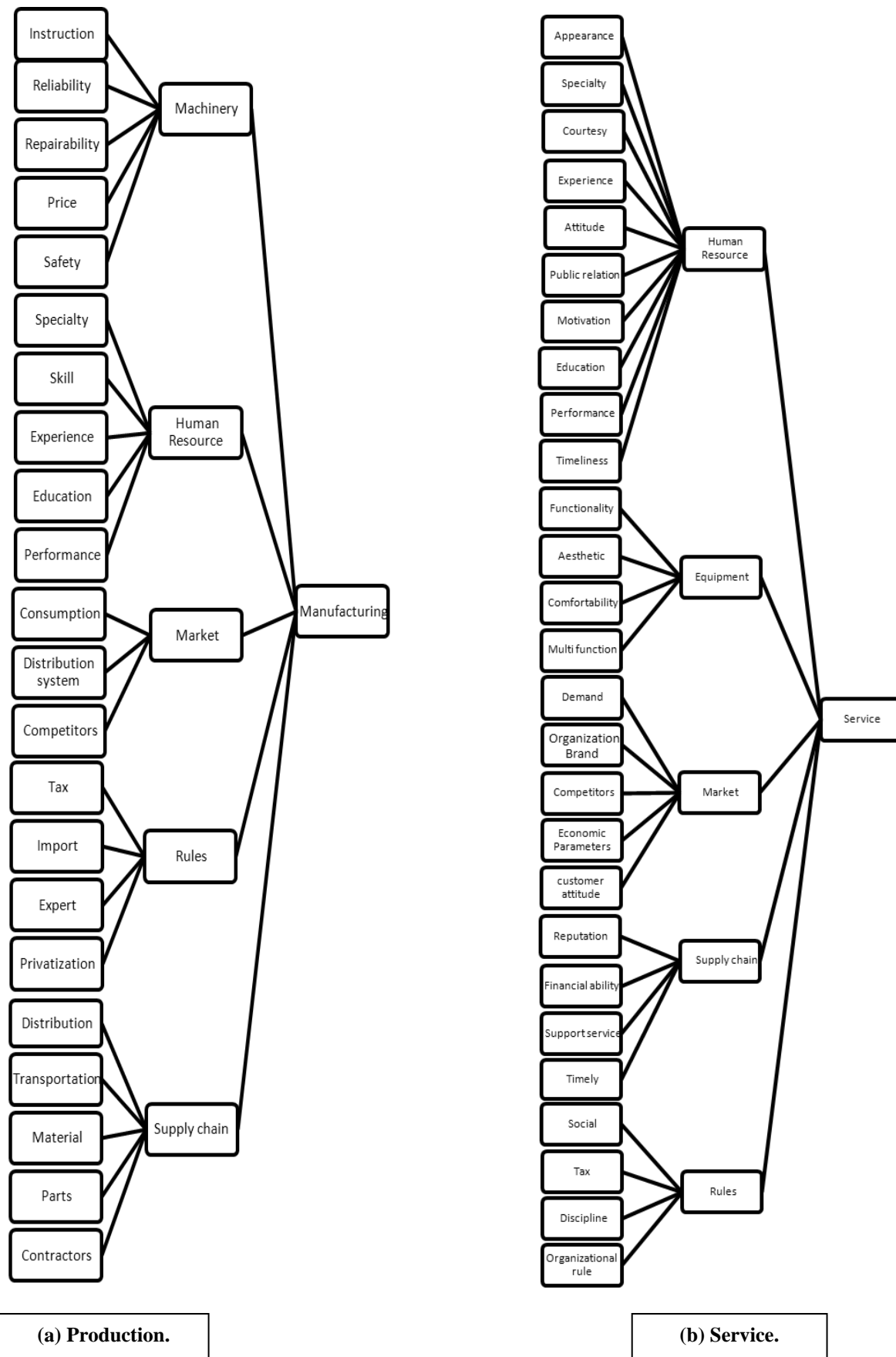
(a) Production.

(b) Service.

Fig. 1. Factors and sub-factors impacting an organization

Some main factors, as well as sub-factors may be the same for both types. But, the degree of significance of either the main factor or the sub-factor is different, or the main factor may be the same for both, but with different attributes for different sectors.

This way, the possibility of searching for the right data is not lost. A set of main factors and related sub-factors for both types of organizations are illustrated in Figure 1(a) for production and Figure 1(b) for service organization. As an example, machinery is of high importance for a production organization, while it is of less importance in a service organization. This is true for sub-factors as well.

3.2. Clustering
We discuss the systematic generation of strategies by applying clustering approach. At first, we appropriately cluster organization's goals associated with different factors determined from environmental scanning. After clustering, the developing strategies are extracted in a more accurate and reliable manner. The important point to be noted is that the long-term goals set by organization's experts, associated with factors having more effects on goals, are positioned in the same clusters. Factor-goal matrix which is the basis of our proposed clustering approach consists of the impact

rate of each factor on every individual goal. Proposed clustering algorithm is discussed in the following section.

4. Proposed Clustering Algorithm
To develop a clustering algorithm some issues have been considered in the literature such as the suitable level in the hierarchy, number of the clusters and cluster validity. Moreover, correlations among factors and goals which construct the clusters are of significant parameters in generating strategies. We have proposed a new clustering algorithm which handles the whole issue above.

Hence, we have introduced average distance value of factor in each cluster as the level of the hierarchy and used hierarchical agglomerative method to determine the number of the clusters. In addition, to validate the constructed clusters, the strategy-factor and strategy-goal clusters are built.

Finally, for considering the correlation among all factors and goals, the impact of factors on each goal are considered as input data of the clustering algorithm. And also, the logic of the clustering construction is based on the distance of the factor's impacts on each goal and the procedure is shown in figure 2.
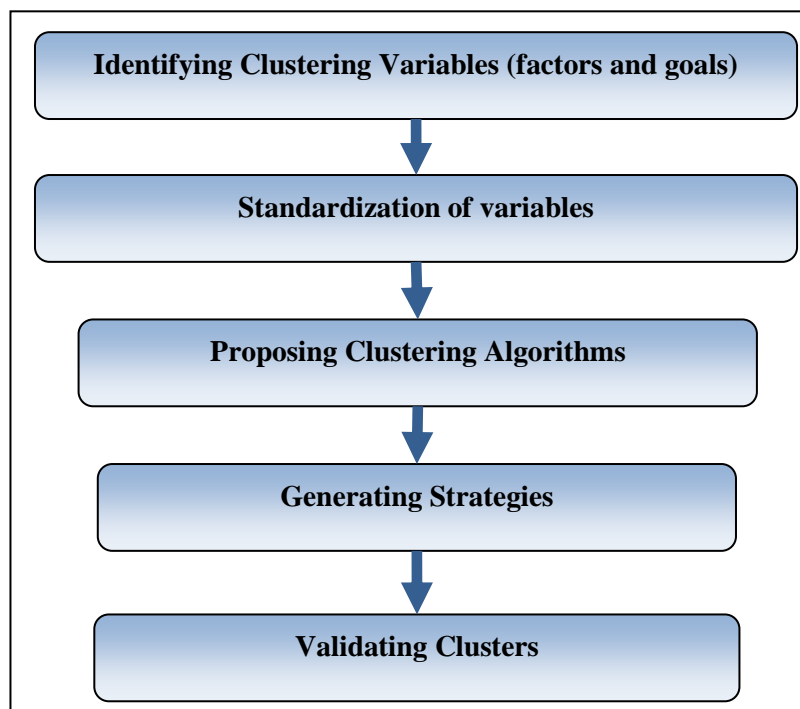
Fig. 2. Clustering approach for generating strategies

In fact, first each factor is considered as a cluster, and then the clusters are merged until the degrees of internal similarity among factors in clusters are maximized and the intrasimilarity among clusters is

minimized. Crucial aspect in clustering is the similarity measure. The formulation of clustering problem leads to a sophisticated optimization problem, with the objective functions depending on the choice of the

similarity measure. It is very important to notice that a good choice of similarity measure can yield an improvement in clustering performance. The similarity between two components is computed with one of several similarity measures based on two corresponding feature vectors; e.g., cosine measure, Jaccard measure and Euclidean distance measure (Baeza-Yates and Ribeiro-Neto, 1999). The distance matrixes applied to measure the factors and goals similarity.The distance matrix computes the distance of the two vectors and is used to separate nonhomogenous factors and goals. The following notations are used to cluster goals and factors.

Notations:

E_{ij}: Value of ith factor in j^{th} goal
W_j: Weight of jth goal
P_{ij}: Weight of ith factor in j^{th} goal
M_i: Mean value of ith factor
d_{ij}: Distance of mean value of ith factor from E_{ij}
θ_i : Threshold
FGM: Factor-goal matrix
$WFGM$: Weight of factor-goal matrix
ψ_i: A set of goals being impacted by i^{th} factor
C: Cluster index
q: Total number of goals, $q \geq 2$

$\overline{d}_c$: Average distance value of factors in class C

We can now state the steps of factor-goal clustering algorithm.

Algorithm: Factor-Goal Clustering Algorithm.
Step 1: Generate factor-goal matrix (FGM) by considering the factor's impact (E_{ij}) on goals based on information acquired from experts.

Step 2: Generate weighted factor-goal matrix (WFGM) by setting:

$$p_{ij} = E_{ij} \times W_j, \qquad \forall i, j. \tag{1}$$

Step 3: Calculate factor-goal distance matrix by:

$$M_i = \frac{\sum_{j \in \psi_i} p_{ij}}{n(\psi_i)} \qquad \forall i \tag{2}$$

Where $n(\psi_i)$ is the cardinality of ψ_i set.

$$d_{ij} = |p_{ij} - M_i|, \qquad \forall i,j. \tag{3}$$

Step 4: Generate binary factor-goal matrix by :

$$I_{ij} = \begin{cases} 1 & d_{ij} \leq \theta_i \\ 0 & Otherwise \end{cases} \tag{4}$$

where θ_i is :

$$\theta_i = \frac{\sum_j d_{ij}}{q} + \sum_j \left(\frac{d_{ij} - \dfrac{\sum_j d_{ij}}{q}}{q-1} \right)^{\frac{1}{2}} \tag{5}$$

Step 5: Constitute primary clusters. At this stage, the clusters would be formed as many as the number of factors. Then, by considering factor-goal (binary) matrix, the objectives in each row with a value of one would be assigned to one cluster.

Step 6: Let C=1 and j=1. If the distance d_{ij} compared to average distance value of factors in class C (that is, $\overline{d}_c = \sum_{j \in J_c} \sum_{i \in \varsigma_j} (d_{ij} / n(\varsigma_j).n(J_c))$, where J_c is a set of goals belong to cluster c and ς_j is a set of influential factor belong to the goal j), is greater than the confidence levelα (as is determined by experts), and the j_{th} goal belongs to another cluster then eliminate goal j from cluster C.

Step 7: Let j=j+1. If $j \leq q$ then go to Step 6.

Step 8: Let C=C+1. If $C \leq q$ then go to Step 6, else stop.

5. Strategy Generation

In traditional strategic planning, the organization's strategy experts create strategies for implementation by utilizing different techniques. The points which would not be considered precisely in these methods are the diverse conditions of the organization based on factors, criteria and the interactions among them. Here, after determining the goal-factor clusters, we pursue developing a strategy, relevant to the goals at that cluster according to the present condition of the clusters.
This allows us to survey the present condition of the organization in more detail by considering various conditions.
On the other hand, since the convergent factors and long term goals fall in a cluster, it is more facile to generate strategies, while in the ordinary SWOT method the decision maker decides according to a general condition and then generates strategies. In fact, our emphasis is to state strategies for individual clusters instead of organization strategy as a whole. This way, the generation of strategies could be more specific and accurate, considering various aspects of clusters. The main advantages of our proposed approach can be stated as follows:

1. Facilitating strategy generation for giant organizations with a large number of factors and goals.
2. Considering the whole factors and interactions among all goals and factors in an integrated form.
3. Generating strategy according to the cluster's different position in the SWOT space.
4. Aligning homogenous goals by clustering and generating strategies for each cluster.
5. Preventing unnecessary costs because of generating relevant strategies for the clusters.
6. Prompting organization development by concentrating on clusters of goals instead of individual goals.
7. Saving resources by implementing homogeneous strategies.

6. Case Study

The Mahmoudabad Training Center (MTC) is an educational institution for training personnel of petroleum industry and also staffs from other organizations needing special on the job and recruitment trainings. The center is located in north of Iran and was founded in 1985. It includes some full time lecturers and staffs, and also makes use of national and international educational and professional part-time visitors for training and supporting services. The institution is accredited by ISO 9000/2008 of DNV Company. Increasing customer satisfaction, developing organization's size and scope of activities, developing human resources, reducing number of staff quitting job, increasing market share, and improving supply chain service utilization are the challenges facing the institution. Thus, the center has set long term (3 years) goals for the organization as shown in Table 1.

Tab. 1. Organization long term goals.

Code	Organization's long-term goals (3 years)	Expected expansion percentage	Rank (from 10)
G1	Increasing customer satisfaction	%20	8
G2	Developing organization size and scope of activities	%15	5
G3	Developing human resources (by stressing on education)	%15	7
G4	Reducing number of staff quitting job	%50	8
G5	Increasing market share	%10	7
G6	Improving supply chain service utilization	%15	5

Due to the nature of activities, MTC is considered to be a service organization. Members of strategy team evaluated the organization based on organizational service indices which are introduced in the data gathering section to analyze organization's environment comprehensively. A total of 64 sub-factors were obtained by recognizing 5 indices including human resource, equipment, market, supply chain and rules. By investigating human resource sub-index, 14 sub-factors were identified as partly reported in Table 1. We prepared a factor sheet (FS) consisting of three sections. Each employee at each level of the organization filled in the FS at three steps. In the first step, employee replied to two questions for each factor consisting of the importance rate of the factor (IRF) and the present factor value (PFV). IRF was introduced as the quantity showing the amount of factor's influence and its significance on organization's development in comparison to other factors. PFV points to a value that shows the position of each factor with respect to the best attainable position. For example, the organization's employees believe that the personnel experience should greatly be promoted, as a result of IRF attaining the high value of 8 out of 10, while the PFV turns to be 5 out of 10 because the employees think that the personnel's experience is not sufficient. According to the explanation of the strategy team to the organization's employee, FS was filled on

two viewpoints: (1) priority viewpoint for filling IRF, and (2) ranking viewpoint for filling PFV. Factor's final score (FFS) was the value which indicates the role of individual factor in the organization's development path. FFS was calculated by:

$$FFS_i = \frac{IRF_i}{\sum\limits_{i=1}^{I} IRF_i} \times PFV, \qquad \forall i = 1,...,I. \quad (6)$$

At the second step, impact of each factor on an individual goal (E_{ij}) is evaluated by pertinent employees. Then, personnel proposed the E_{ij} by considering the role of the individual factor in achieving the goals. The quantitative rates of impact of sub-factors on goals were defined to be one for the least and ten for the most. So, assignment of a number close to 10 meant that the sub-factor had a substantial impact on the corresponding goal. For determining this value, the employee considered the process from two points of view, priority and ranking. It means that for assigning a weight, first the employee looked at the effect of sub-factor on goals at the best circumstances, and second considered the importance rate of sub-factor as compared to the other sub-factors in achieving the goals. At the third step, the employee filled in the GG matrix which shows the impact of an individual goal on other goals.

Finally, the employee might propose some factors which are not listed. The organization was divided into three levels including decision makers or managers, supervisors and staffs. Then, over sixty percent of organization's employees at each level filled in the questionnaire. A part of the sub-factors, IRF, PFV and FFS as instances are summarized in Table 2.

By considering the impact rate of each factor on individual goal (IWFG), the correlation among goals and factors were determined. Then, a clustering algorithm was applied to make the proper clusters containing goals and factors. The weight of impact on every goal for a fraction of factors is listed in Table 3.

Tab. 2. IRF, PFV and FFS values

Sub-Factor	IRF	PFV	FFS	Sub-Factor	IRF	PFV	FFS
Education	8	5	0.203	Demand	7	5	**0.178**
Specialty	8	6	0.243	Customer's attitude	6	5	**0.152**
Courtesy	7	6	0.213	Reputation	7	6	**0.213**
Appearance	7	5	0.177	Financial ability	7	6	**0.213**
Performance	8	4	0.162	Timely	8	7	**0.284**
Experience	8	5	0.203	Support services	7	5	**0.177**
Attitude	7	4	0.142	Social rules	6	4	**0.121**
Motivation	9	5	0.228	Tax	5	4	**0.101**
Public relation	8	6	0.243	Discipline	8	5	**0.203**
Functionality	7	4	0.142	Competitors	7	5	**0.177**
Comfort	7	5	0.177	Aesthetics	5	4	**0.101**
Organization's brand	8	6	0.243	Economic parameters	6	4	**0.122**
Timeliness	9	7	0.319	Multi function	8	5	**0.203**
Organizational rule	9	6	0.274				

Tab. 3. Factor-goal matrix.

Goals		G1	G2	G3	G4	G5	G6
Goal weight		**0.235294**	**0.147059**	**0.176471**	**0.117647**	**0.147059**	**0.17647**
Factor	**Sub-Factor**						
Human Resource							
	Education (F_{11})	8	6	10	5	9	5
	Specialty (F_{12})	9	7	9	6	10	7
	Courtesy (F_{13})	8	3	5	5	5	4
	Appearance (F_{14})	9	5	2	6	7	5
	Performance (F_{15})	10	8	8	7	8	6
	Experience (F_{16})	7	9	8	9	8	7
	Attitude (F_{17})	8	7	7	5	7	6
	Motivation (F_{18})	9	9	9	6	9	8
	Public relation (F_{19})	10	8	7	8	8	7
	Timeliness ($F_{1(10)}$)	10	8	9	9	10	8
Equipment							
	Functionality (F_{21})	9	8	3	7	8	7
	Comfort (F_{22})	8	6	4	8	7	6
	Aesthetic (F_{23})	10	5	2	1	6	4
	Multifunction (F_{24})	7	9	6	2	7	8
Market							
	Organization brand (F_{31})	7	7	8	9	7	8
	Competitors (F_{32})	2	9	4	8	9	5
	Economic parameters (F_{33})	6	8	5	7	8	6
	Demand (F_{34})	5	10	5	6	8	4
	Customer attitude (F_{35})	8	8	3	2	7	3
Supply chain							
	Reputation (F_{41})	9	7	2	4	8	8
	Financial ability (F_{42})	8	6	3	3	9	9
	Timely (F_{43})	10	9	5	5	9	10
	Support services (F_{44})	7	7	4	3	8	9
Rules							
	Social rules (F_{51})	7	8	7	5	4	5
	Tax (F_{52})	9	9	2	2	5	3
	Discipline (F_{53})	8	7	8	8	8	7
	Organizational rules (F_{54})	9	8	8	9	9	8

The proposed clustering algorithm was coded in JAVA, and the computations were carried out using an Intel Pentium 4, 1.7 GHz computer, 256 MB RAM. The obtained binary factor-goal matrix is reported in Table 4. Four clusters were generated, where two clusters each involved two goals and two other goals fell into two other isolated clusters.

Each cluster consisting of related goals and all factors with their rates of impact on an individual goal. Consequently, increasing customer satisfaction and reducing number of staff quitting job fell in cluster 1, developing organization size and scope of activity and improving supply chain service utilization in cluster 2, while developing human resources and increasing market share corresponded to clusters 3 and 4, respectively. The factors appeared in each cluster were divided in two categories based on the IWFG value:(1) influential factors that affect cluster's goal and (2) un-influential factors (outliers) which could be ignored. To

identify the type of each factor in every cluster, a threshold value θ_c was defined.

If the IWFG value of a factor was more than θ_c, then the factor was considered to be an influential factor; otherwise, it was considered to be in category of un-influential factors. The value of θ_c was also obtained by:

$$\theta_c = \mu_c - 2 \times (\sum_{i=1}^{I} \sum_{j \in j_c} \sqrt{\mu_c - IWFG_{ij}}) / I \times n(j_c), \ \forall c, \tag{7}$$

Where,

$$\mu_c = \frac{\sum_{i=1}^{I} \sum_{j \in j_c} IWFG_{ij}}{I \times n(j_c)} \quad , \quad \forall c. \tag{8}$$

Tab. 4. Binary factor-goal matrix.

Goals		G1	G2	G3	G4	G5	G6
Factor	**Sub-Factor**						
Human Resource	Education (F_{11})	1	0	1	0	1	1
	Specialty (F_{12})	1	1	1	0	1	1
	Courtesy (F_{13})	1	0	0	0	1	0
	Appearance (F_{14})	1	0	0	1	1	0
	Performance (F_{15})	1	1	1	0	1	0
	Experience(F_{16})	0	1	1	1	0	0
	Attitude(F_{17})	1	0	1	0	1	0
	Motivation(F_{18})	1	1	1	0	1	1
	Public relation(F_{19})	1	1	0	0	1	0
	Timeliness($F_{1(10)}$)	1	0	1	1	1	0
Equipment	Functionality (F_{21})	1	1	0	1	1	0
	Comfort (F_{22})	1	0	0	1	0	0
	Aesthetic (F_{23})	1	0	0	0	0	0
	Multifunction (F_{24})	1	1	0	0	1	1
Market	Organization brand (F_{31})	0	0	1	1	0	1
	Competitors (F_{32})	0	1	0	1	1	0
	Economic parameters (F_{33})	0	1	0	1	1	0
	Demand(F_{34})	0	1	0	0	1	0
	Customer attitude(F_{35})	1	1	0	0	1	0
Supply chain	Reputation(F_{41})	1	1	0	0	0	1
	Financial ability (F_{42})	1	0	0	0	1	1
	Timely (F_{43})	1	1	0	0	1	1
	Support service (F_{44})	1	1	0	0	1	1
Rules	Social rules (F_{51})	0	1	0	0	0	1
	Tax (F_{52})	1	1	0	0	1	0
	Discipline (F_{53})	1	1	1	1	1	0
	Organization Rule (F_{54})	1	0	0	1	1	0

In contrast to traditional methods, here we recognized four positions in the SWOT space for each cluster. This would help us present more efficient strategies. To recognize the position of each cluster, some points should be emphasized.

First, only the influential factors were used for the calculations. Then, the state of each influential factor was identified. Four states as strength, weakness, threat, and opportunity were considered.

Finally, the position of cluster was determined by the attained FFS value of each factor from each state. By considering the influential factors, the position of each cluster was determined. This was done by utilizing the FFS obtained from decision makers, and the state of sub-factors.

They were added pair wise with strengths and opportunities having positive sign and weaknesses and threats having minus sign. The position of clusters is shown in Figure 3.

The present state of each cluster is indicated by current state (CS), and the position reached by the organization after implementing strategies is presented as dated state (DS). Based on the position of the clusters in the SWOT space and goals and factors of each cluster, 11 strategies were presented. Proposed strategies with the corresponding clusters are summarized in Table 5.
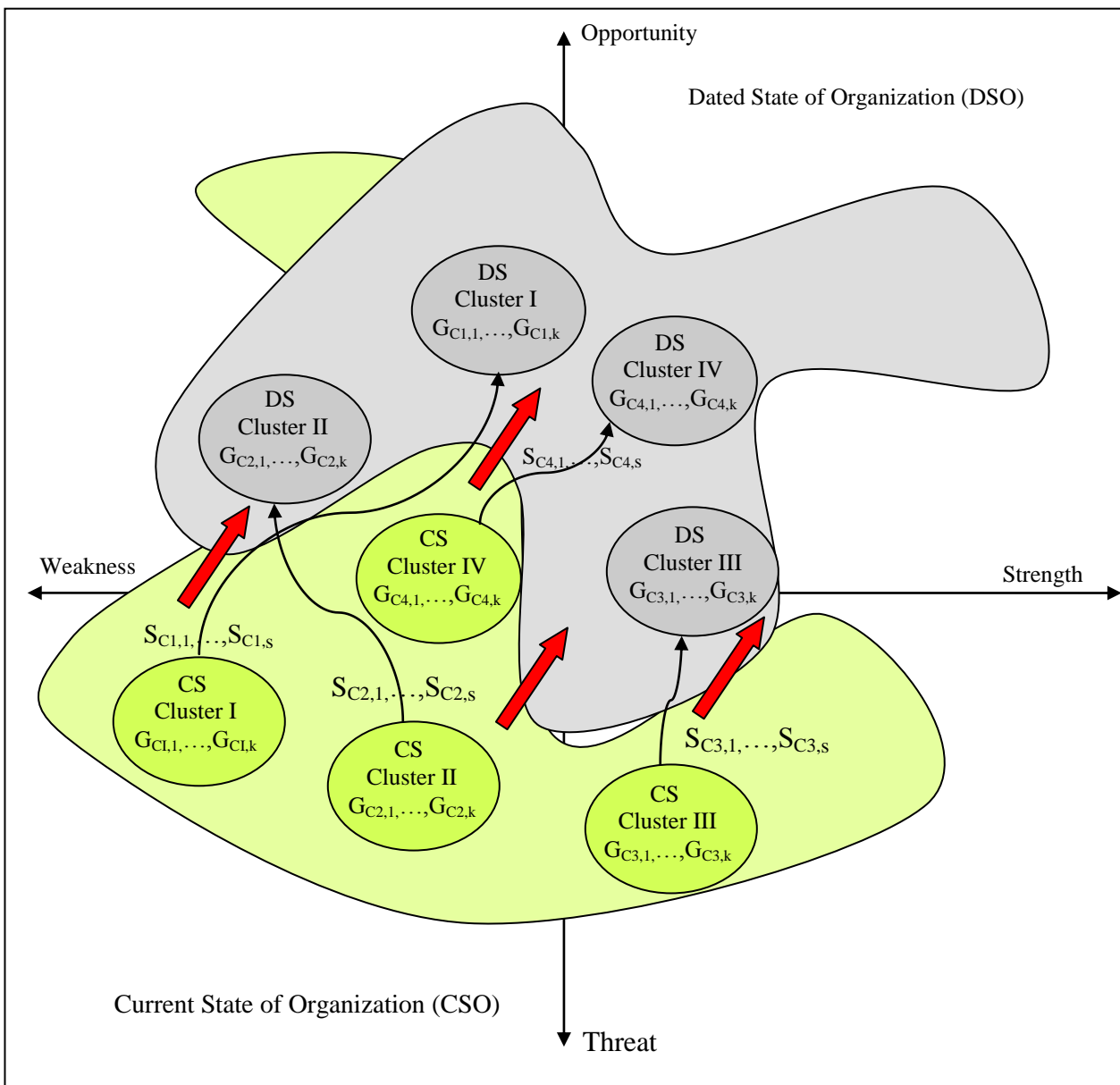

Fig. 3. Cluster position in the SWOT space

Tab. 5. Proposed strategies with corresponding clusters

Cluster	Goal	Influential factors	Presented strategy
I	G1,G4	F_{12}, F_{13}, F_{15}, F_{16},F_{17},F_{18}, F_{19}, F_{21}, F_{31},F_{44}, F_{53},$F_{1(10)}$, F_{54}	Developing a motivation system for the staff having experience more than 10 years Investing on modern equipment with easy and modified application Designing and promoting human resource developing plans by stressing on performance and public relation Enhancing advertising policies with stress on organization brand
II	G2,G6	F_{12}, F_{14}, F_{16}, F_{17}, F_{19}, F_{21}, F_{34}, F_{41}, F_{43}, F_{53}, F_{32}, F_{23}, F_{24}, F_{54}	Investing on utilizing equipment with more flexibility Setting and issuing more open organization rules particularly in the field of organization development and supply chain management Merging or utilizing the companies with relevant supply chain, stressing on support services and timeliness
III	G5	F_{11}, F_{12}, F_{13}, F_{14}, F_{15}, F_{16}, F_{21}, F_{22}, F_{31}, F_{34}, F_{35}, F_{43}, F_{53}, F_{32}, F_{33}, F_{54}, $F_{1(10)}$	Developing dynamic systems for analyzing market Designing and expanding a system for SCM selection
IV	G3	F_{11}, F_{12}, F_{14}, F_{15}, F_{16}, F_{17}, F_{18}, F_{21}, F_{31}, F_{34}, F_{35}, F_{41}, F_{53}, F_{32}, F_{23}, F_{54}, $F_{1(10)}$	Designing and developing human resource plan with emphasis on training and specialty Setting and issuing organizational rules stressing on discipline

7. Discussion

Here, we make a comparison of the proposed method with ordinary SWOT method. Furthermore, by defining route branch value and clustering strategy-goal and strategy-factor matrix we illustrate the validity of the proposed method.

7.1. Comparisons

To show the capability of the proposed method, we report the results of two comparisons between ordinary SWOT method and proposed method, obtained in the implementation of generated strategies. An important issue to be considered in the implementation phase is the utilization of strengths and opportunities against weaknesses and threats, within the development path of the organization. When an organization is partitioned into different clusters, the organization is being considered more precisely and in details. We considered each cluster as an individual organization having its own goals, factors, strategies and development path.

Usually, strategists design a development path (with individual path and steps of development during strategy implementation) for current state of the organization, while in our proposed method the development paths are as many as clusters.

In fact, the current state of each cluster within the SWOT space was obtained by analyzing the relevant factors.

The comparison of FFS values between ordinary method and proposed method is reported in table 6. Then, strategic team found the dated state (DS) of each cluster by considering the expansion percentage expected by the organization decision makers. By utilizing this information, the development path was designed for each cluster. For instance, as:

Tab. 6. Obtained FFS value for ordinary and proposed method

Sub-factor	Ordinary method			Proposed method								
				IRF Cluster				PFV	FFS Cluster			
	IRF	PFV	FFS	C1	C2	C3	C4		C1	C2	C3	C4
Education	8	5	0.203	0	0	8	10	5	0	0	0.264	0.362
Specialty	8	6	0.243	8	9	9	9	6	0.48	0.465	0.357	0.391
Courtesy	7	6	0.213	7	0	8	0	6	0.42	0	0.317	0
Appearance	7	5	0.177	0	7	8	7	5	0	0.301	0.264	0.253
Performance	8	4	0.162	9	0	10	10	4	0.36	0	0.264	0.289
Experience	8	5	0.203	8	8	10	9	5	0.4	0.344	0.331	0.326
Attitude	7	4	0.142	9	8	0	8	4	0.36	0.275	0	0.231
Motivation	9	5	0.228	10	0	0	10	5	0.5	0	0	0.362

| Sub-factor	Ordinary method			Proposed method								
	IRF	PFV	FFS	IRF Cluster				PFV	FFS Cluster			
				C1	C2	C3	C4		C1	C2	C3	C4
Public relation	8	6	0.243	8	10	0	0	6	0.48	0.517	0	0
Functionality	7	4	0.142	7	8	9	7	4	0.28	0.275	0.238	0.202
Comfort	7	5	0.177	0	0	8	0	5	0	0	0.264	0
Organization's brand	8	6	0.243	9	0	10	7	6	0.54	0	0.397	0.304
Timeliness	9	7	0.319	9	0	9	9	7	0.63	0	0.417	0.456
Organizational rule	9	6	0.274	8	8	8	8	6	0.48	0.413	0.317	0.347
Demand	7	5	0.177	0	9	9	8	5	0	0.387	0.298	0.289
Customer's attitude	6	5	0.154	0	0	9	7	5	0	0	0.298	0.253
Reputation	7	6	0.213	0	9	0	6	6	0	0.465	0	0.260
Financial ability	7	6	0.213	0	0	0	0	6	0	0	0	0
Timely	8	7	0.284	0	9	10	0	7	0	0.543	0.463	0
Support services	7	5	0.177	8	0	0	0	5	0.4	0	0	0
Social rules	6	4	0.121	0	0	0	0	4	0	0	0	0
Tax	5	4	0.101	0	0	0	0	4	0	0	0	0
Discipline	8	5	0.203	10	8	9	9	5	0.5	0.344	0.298	0.326
Competitors	7	5	0.177	0	9	9	8	5	0	0.387	0.298	0.289
Aesthetics	5	4	0.101	0	7	0	6	4	0	0.241	0	0.173
Economic parameters	6	4	0.121	0	0	8	0	4	0	0	0.211	0
Multi-function	8	5	0.203	0	7	0	0	5	0	0.301	0	0
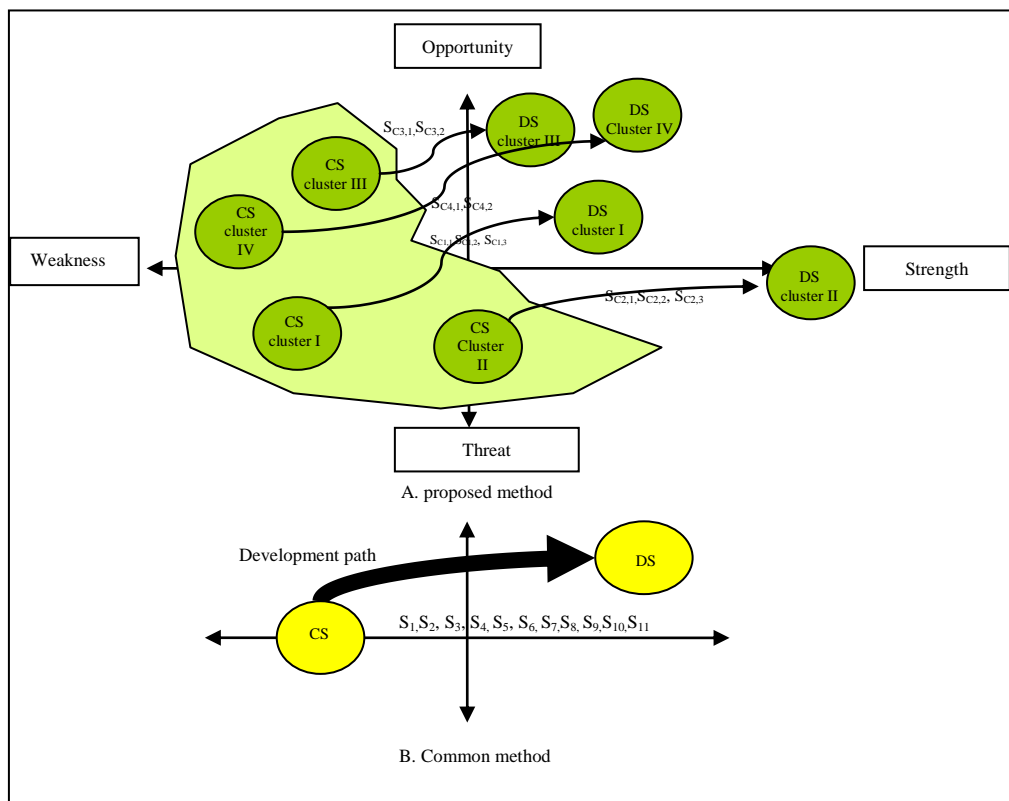
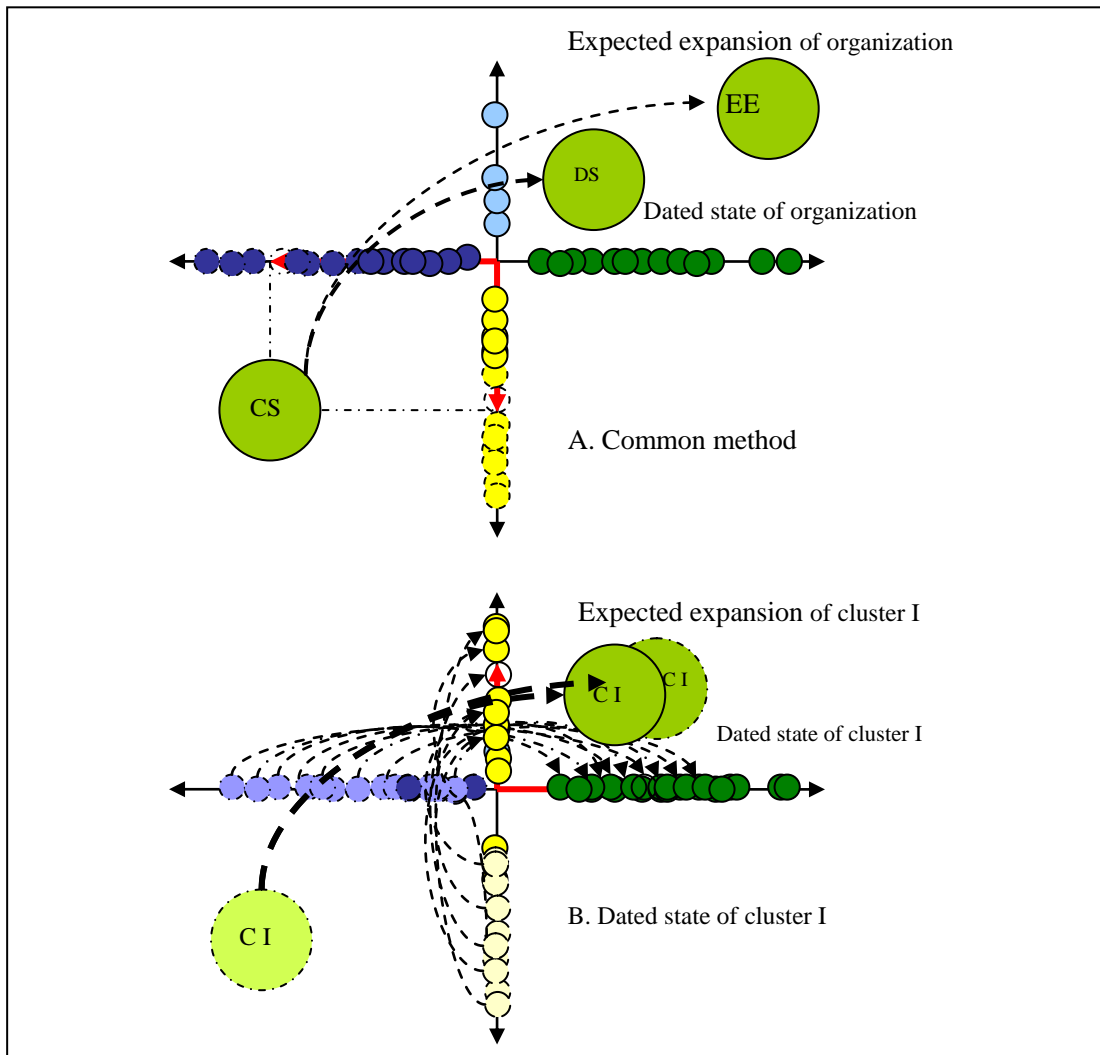**Fig. 4. A schematic comparison between common and proposed method**

Fig. 5. Differentiations between the dated state of the organization and expected expansion

shown in Table 5, cluster I consists of G1 and G4 with expansion percentages 20 and 50, respectively, and FFS value for each factor, placed in the WT zone. We gathered the influential factors having impact on G1 and G4 (according to equations (7) and (8)). The FFS value and state of each factor show the place of factor on the SWOT vectors.

We achieved the dated FFS based on goals' expected expansion percentages. The FFS factor values (which were dedicated to cluster I) including specialty (F_{12}), courtesy (F_{13}), performance (F_{15}), experience (F_{16}), attitude (F_{17}), motivation (F_{18}), public relation (F_{19}), timeliness ($F_{1,10}$), organizational brand (F_{31}), support services (F_{44}), discipline (F_{53}), and organization rule (F_{54}) were obtained as 0.243, 0.213, 0.162, 0.203, 0.152, 0.228, 0.243, 0.319, 0.243, 0.177, 0.203, 0.274 respectively, while the dated FFS values corresponding to the G1 and G2 expansion percentages were 0.4131, 0.3621, 0.2754, 0.3451, 0.2584, 0.3876, 0.4131, 0.5423, 0.4131, 0.3009, 0.3451 and 0.4658 respectively. $S_{C1,1}$, $S_{C1,2}$ and $S_{C1,3}$ force the current state

of cluster I into dated state from OW to SO zone, respectively.

In contrast to cluster I, cluster II moved into the SO zone from the WT zone directly. However, each cluster is developed by its development path. By applying ordinary SWOT method not only we may lose some opportunities, but also we have one development path and a set of strategies, restricting the organization during its development path. The comparative results of the two methods are shown schematically in Figure 4.

As a second comparison, the difference between the dated state of the organization and expected expansion was considered as shown in Figure 4. Here, we considered the achieved position in the SWOT space between proposed method and the ordinary method. By presenting development strategies according to the common method, a 19.5% average variance was obtained after one year from the start of strategy's implementation phase. We predicted that it would be increased to 45% after 3 years.

This variance is due to the loss of some strengths and opportunities (that organization could have used during the first year). Although, organizations are expected to develop comprehensively, but they have missed many aspects that have been changed during the first year of the implementation.

For example, expectation percentages of 6.55%, 5%, 5%, 16.65%, 3.3% and 5% respectively for customer satisfaction, organization size and scope of activity, human resource, staff quitting job, market share and supply chain service utilized during a year were expected, but our team analyzers reported that 5.35%, 3.95%, 4.025%, 13.40%, 2.70% and 4.10% of goals were achieved, respectively.

Several reasons may be the cause of this variance such as failure to notice influential factors, the interaction among factors and goals, and divergence of factors within the organization. For example, setting and issuing organizational rules by stressing on discipline ($S_{C4,2}$), which was generated to achieve G3 (developing human resource), is conflicting with G4 (reducing number of staff quitting job).

So, the organization's decision makers would be unhappy if they decide to go along with one development path. In the proposed method, by clustering goals and factors and generated strategies for each of them the contradictions among goals are eliminated.

In contrast to the ordinary method, the average variance of the proposed method is about 8.65% (5.98%, 4.52%, 4.61%, 15.16%, 2.97% and 4.55% for G1 to G6, respectively). Consequently, by clustering goals and factors based on the impact rate of factors on goals, the organization was split into different clusters each of which was considered as an organization. In this approach, we did not eliminate any one of the factors within clusters. We only investigated a set of goals and factors having considerable influence on one another. Motivation, specialty, flexibility, reputation, timeliness, training, social rules, and organizational rule were recognized as the influential factors on developing organization's size and scope of activities (G2), and improving supply chain service utilized (G6) was positioned into cluster II.

At the same time, we were able to monitor the factor changes in relation to goals within clusters, and so we took advantage of all development opportunities. Also, the difference between dated state of the organization and expected expansion can be observed in Figure 5.

Tab. 7. Strategy-factor matrix.

Sub-Factor	Strategy										
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
Education	40	40	75	50	55	50	25	85	75	95	80
Specialty	65	60	70	50	50	40	35	80	65	90	75
Courtesy	50	10	50	25	10	25	45	30	40	60	40
Appearance	65	55	75	60	30	40	35	10	25	55	35
performance	90	80	95	65	55	55	50	45	40	85	79
Experience	50	60	75	50	60	40	30	35	50	50	40
Attitude	75	65	70	50	50	60	50	40	50	65	55
Motivation	95	76	80	65	70	65	60	50	60	75	65
Public relation	70	50	95	60	50	50	55	40	50	55	50
Functionality	65	75	80	55	60	50	60	35	25	45	15
Comfort	35	90	50	30	60	35	15	25	15	40	10
Organization brand	50	80	75	90	55	50	60	65	50	60	60
Demand	40	60	65	50	60	55	65	50	45	60	50
Customer attitude	35	55	60	65	65	50	60	55	50	70	55
Reputation	50	65	75	75	75	70	75	55	55	75	60
Financial ability	25	35	20	25	70	65	60	10	65	55	45
Timeliness	45	55	60	50	65	70	85	15	90	50	60
Training	50	50	30	40	60	65	75	50	15	55	50
Social rules	40	30	35	45	25	50	40	15	25	35	55
Tax	25	20	35	40	30	35	40	10	20	15	45
Discipline	55	50	60	50	35	60	55	45	35	40	85
Competitors	45	50	55	60	55	50	55	55	75	65	50
Economic parameters	30	25	50	65	30	25	30	40	45	40	35
Aesthetic	40	50	40	55	40	10	25	35	20	15	20
Flexibility	45	50	45	45	90	10	25	30	15	15	25
Timely	50	80	75	55	55	50	60	65	50	60	60
Support service	40	30	35	45	40	50	35	50	25	35	55

7.2. Validation

To investigate the interrelationship between proposed strategies, goals and factors, goal-strategy and factor-strategy matrix was formed. We asked from the decision makers of the organization to specify the impact of each strategy on factors and goals individually as factor-strategy and goal-strategy matrix, which is listed in tables 7 and 8, respectively. Using these matrices, we first calculated the route branch of each goal, and second by clustering the goals and factors in accordance with the impact of strategies on them, validate the goal-factor clusters as the basis of our methodology.

Now, we introduce the concept of the route branch and clustering algorithm that form factor-strategy and goal-strategy clusters.

Tab. 8. Strategy-goal matrix.

Strategy	Goal					
	G1	**G2**	**G3**	**G4**	**G5**	**G6**
S1	85	60	50	90	75	45
S2	70	35	40	75	50	30
S3	90	65	85	70	80	35
S4	60	55	35	60	75	40
S5	50	50	30	50	50	45
S6	55	55	35	45	45	60
S7	50	60	40	45	50	65
S8	40	65	65	20	85	50
S9	45	55	50	25	65	65
S10	85	70	90	45	75	50
S11	70	65	65	50	60	50

The impact of a strategy on an individual goal (SG_{kj}) is known as the impact of the strategy on the goal. Moreover, the impact of strategy on factors (SF_{ki}) shows how, and how much a strategy would develop an organization in achieving its goal paths. So, the route branch value (RB_j) would be obtained by:

$$RB_j = \sum_{i \in \varsigma_j} \sum_{k=1}^{K} SG_{kj} \times SF_{ki}, \qquad \forall j. \qquad (9)$$

By considering this value, we find out how the organization achieved each goal. Additionally, this value shows how the proposed strategies prioritized the goals. In fact, the proposed strategies possessing higher impacts on goals have higher route branch. The route branch value of each goal was calculated and reported in Table 9. The goal G5, increasing of market shares, has the highest route branch value, while the reduction of number of staff quitting job (G4) has the lowest route branch value. So, the proposed strategies prioritize goals as G5, G1, G2, G3, G6 and G4.

Tab. 9. Route branch value.

Goal	G1	G2	G3	G4	G5	G6
Rout branch	823350	727770	496256	419575	824095	471455

Finally, strategy-goal and strategy-factor matrices have been formed to cluster the goals and factors based on the impact of the strategies on each of them. If the elements of the new clusters are adapted to the factor-goal clusters, which are the basis of the proposed methodology, then the proposed strategies are valid; otherwise, the strategic team should propose other strategies. This shows that if the influential factors and strategies of each initial cluster do not fall in the same cluster, then the proposed strategy is not appropriate.

To cluster the factor-strategy and goal-strategy matrices, the same clustering algorithm as proposed in Section 4.2 has been applied. The new clusters have been formed and shown in Table 10. According to the new clusters, G1 and G4 with S1 to S4 fall in a cluster. Comparing strategy-goal and strategy-factor clusters with the factor-goal clusters shows that all goals and strategies in previous clusters again fall in the same clusters while some factors fall in different clusters. However, the sub-factor attitude (F_{17}) and training (F_{44}) were considered as uninfluential factors for cluster I including S1, S2, S3, S4, G1 and G4, while in the new constructed strategy-factor cluster they appear as influential factors.

Tab. 10. Strategy-goal and strategy-factor clusters.

Cluster	Strategy	goal	Factor
CI	S1	G1,G4	F_{12}, F_{13}, F_{14}, F_{15}, F_{16}, F_{17}, F_{18}, F_{19}, F_{21}, F_{31}, F_{41}, F_{44}, F_{53}
	S2	G1,G4	F_{12}, F_{14}, F_{15}, F_{16}, F_{17}, F_{18}, F_{19}, F_{21}, F_{22}, F_{31}, F_{34}, F_{35}, F_{41}, F_{43}, F_{44}, F_{53}, F_{32}, F_{23}, F_{24}
	S3	G1,G4	F_{11}, F_{12}, F_{13}, F_{14}, F_{15}, F_{16}, F_{17}, F_{18}, F_{19}, F_{21}, F_{22}, F_{31}, F_{34}, F_{35}, F_{41}, F_{43}, F_{53}, F_{32}, F_{33}
	S4	G1,G4	F_{11}, F_{12}, F_{14}, F_{15}, F_{16}, F_{17}, F_{18}, F_{19}, F_{21}, F_{31}, F_{34}, F_{35}, F_{41}, F_{43}, F_{53}, F_{32}, F_{33}, F_{23}
CII	S5	G2,G6	F_{11}, F_{12}, F_{15}, F_{16}, F_{17}, F_{18}, F_{19}, F_{21}, F_{22}, F_{31}, F_{34}, F_{35}, F_{41}, F_{42}, F_{43}, F_{44}, F_{32}, F_{24}
	S6	G2,G6	F_{11}, F_{15}, F_{17}, F_{18}, F_{19}, F_{21}, F_{31}, F_{34}, F_{35}, F_{41}, F_{42}, F_{43}, F_{44}, F_{51}, F_{53}, F_{32}
	S7	G2,G6	F_{15}, F_{17}, F_{18}, F_{19}, F_{21}, F_{31}, F_{34}, F_{35}, F_{41}, F_{42}, F_{43}, F_{44}, F_{53}, F_{32}
CIII	S8	G5	F_{11}, F_{12}, F_{18}, F_{31}, F_{34}, F_{35}, F_{41}, F_{44}, F_{32}
	S9	G5	F_{11}, F_{12}, F_{16}, F_{17}, F_{18}, F_{19}, F_{31}, F_{35}, F_{41}, F_{42}, F_{43}, F_{32}
CIV	S10	G3	F_{11}, F_{12}, F_{13}, F_{14}, F_{15}, F_{16}, F_{17}, F_{18}, F_{19}, F_{31}, F_{34}, F_{35}, F_{41}, F_{42}, F_{43}, F_{44}, F_{32}
	S11	G3	F_{11}, F_{12}, F_{15}, F_{17}, F_{18}, F_{19}, F_{31}, F_{34}, F_{35}, F_{41}, F_{43}, F_{44}, F_{51}, F_{53}, F_{32}

8. Conclusion

A clustering approach was applied to develop a new strategy formulation by clustering factors and long term goals based on impact of factors on individual goals. To find the influence of factors on goals, a comprehensive environmental analysis was performed by dividing the organization into services and manufacturing sectors and prioritizing factors. Then, the strategies were presented for each cluster individually, instead of the whole organization.

The main contributions of this paper are as follows:

1. Presentation of an efficient data gathering method by dividing organization into services and manufacturing organization, prioritizing factors, and elimination of unnecessary factors.
2. Development of a new strategy formulation process by considering all elements and aspects of organization and the interactions among them.
3. Partitioning organization into different clusters based on the impact of each factor on individual goals.
4. Considering the effect of strategies on the development paths based on clustering approach.
5. Investigating the differences of dated state of organization with the expected expansion of the organization.
6. Facilitating the strategy making process by utilizing an effective clustering approach.
7. Saving considerable resources in implementing homogeneous strategies.

We presented the capability of the proposed method by implementing its obtained strategy for the first year in Mahmoudabad Training Center (an educational institution in north of Iran for training personnel of petroleum industry), as a services organization. The comparative results between the ordinary SWOT method and the proposed method demonstrated that the proposed method had a more realistic performance. Route branch value, strategy-goal and strategy-factor clustering were utilized to validate the proposed method. The obtained results demonstrated the capability of the proposed approach in formulating strategy for an organization.

About the limitations of this method we can state that the proposed method is not suitable for the small firms with a few factors affecting the goal. In addition, improving and applying variety of clustering algorithms by simplifying the matrix and applying our approach to the related topics are worthwhile of further study.

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