

# Prioritizing Strategies and Ranking Execution Methods by Integrated Approach of SWOT Analysis and Fuzzy Quality Function Deployment

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## ABSTRACT

This paper is proposing a comprehensive framework in order to Evaluation and prioritizing strategies and ranking execution methods in organizations. Our peripheral environment is changing rapidly in all areas and globalization of organizations made them complex because they attempt to get more market share, along the other effective factors. Therefore, importance of using threats and opportunities has been cleared and has required organizations to codify plans and executive methods to face with developments correctly. Contrary to expectations, some executive methods are not properly fulfilling the organization's strategic priorities. So in this paper, we codify strategic plans for opportunities and threats for a company by SWOT tool. After screening strategies by fuzzy screening method, we prioritize executive methods of the company by QFD matrix to accomplish its strategic plans. With this method, executive methods and operational plans can cover as well as its strategic priorities.

**KEYWORDS:** SWOT analysis, Quality Function Development (QFD), fuzzy screening.

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## 1. INTRODUCTION

Organizations change constantly. An organization with strategic management is one that either has identified its goals or changes by an operational plan. During the last decade, organization experienced many changes in their peripheral environment and has responded problems such as financial supports, rapid technological developments, and obsolete planning (Lerner, Alexandra, L., 1999). These problems have required strategic planning. One of the steps for organizations to remove these problems is strategic planning (Lerner, Alexandra, L., 1999). Thus, strategic planning has become a favorable planning method for inconsistent environments (Maleki, 2001). Also, strategic planning is an approach to create competitive advantages. Therefore, strategic planning plays a key role in success of organizations (Saxe, J.M.; Burgel, B.J.; Collins-Bride, G.M.; Stringari-Murray, S.; Dennehy, P.; Holzemer, W., 2002). Thus, organizations need strategic planning for competition. This paper does this by SWOT analysis. Strategic evaluation criteria examines their operational obstacles and QFD clear data and selects prioritizes suitable strategies.

This paper describes a framework in which strategic evaluation criteria were used to screen organization's strategies. In fact, the framework of this research is a combination of SWOT analysis, quality performance development, strategic evaluation criteria, and fuzzy screening. There are similar combinations in the last studies, which used traditional QFD (Lee, S.F.; Lo, K.K., 2003). However, we use fuzzy QFD to diminish ambiguity of data, which has increased ability and efficiency of this model.

We intend with develop this paper, show versatile and combination use of this analytical tools with the appropriate overlaps between organizational strategies and operational plans. First, the strengths, weaknesses and the opportunities and threats were identified. Based on that, we develop strategies using the SWOT matrix. The strategies were filtered using Fuzzy QFD screening approach. Next strategies were weighted and prioritized using matrix Fuzzy QFD. The suggested procedures for the implementation of strategies and ultimately, they prioritize these executive methods using Fuzzy QFD matrix.

## 2. REVIEW OF LITERATURE

### 2.1. SWOT analysis

SWOT analysis was firstly suggested by two graduates from Harvard Business School, George Albert Smith and Roland Christenson (Carolina, Duarte; Lawrence, P.; Etkin, Marilyn M. Helms; Michael, S. Anderson, 2006). Strategies can be designed by SWOT. By SWOT one can analyze internal and external environments and can make strategic decisions to balance an organization's strengths with its environmental opportunities (Piress & Rabinson). In fact, SWOT is a strategic tool to coincide internal pros and cons of an

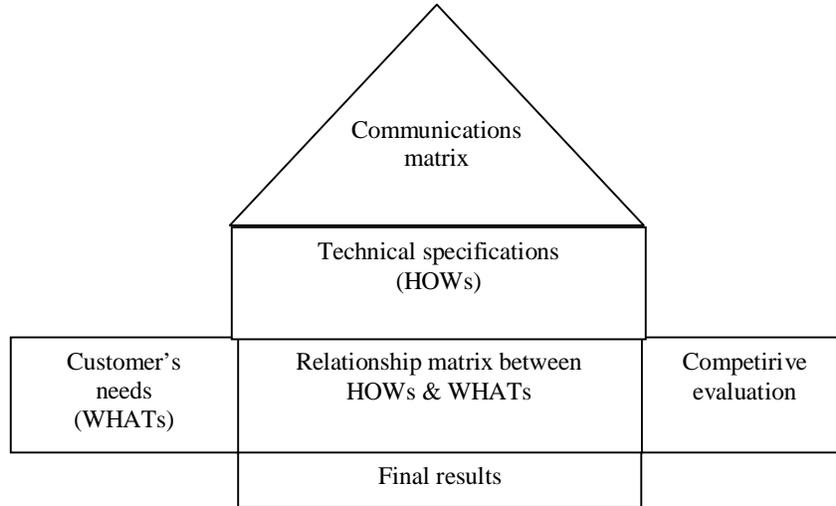
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organization with external opportunities and threats. Four strategies are concluded by comparison of these factors: SO, WO, ST, and WT.

**2.2. Quality Function Development (QFD)**

QFD is a qualitative tool to achieve customers’ needs, by which one can design services and products according to the needs of customers. QFD expression is a translation from its Japanese one: “him shitsu” (quality), “kinou” (function), and “ten kai” (development). QFD emerged in Japan in 60 and 70 decades. It is a systematic and analytical method to acquire customers’ requests (Seyedjavadein; Shahhoseini, 2007). The central element of QFD is called “quality house”. Quality house related customer’s requests with technical specifications (Poel, I., 2007). Structure of quality house is shown in fig. 1 (Hung Liu, Chin, 2009).



Customers should be identified, their requests should be gathered, and their weights should be determined to execute quality house successfully (Hung Liu, Chin; Hung Wu, Hsin, 2008).

**2.3. Fuzzy screening**

Yager suggested fuzzy screening system to select a small subset from a large number of sets in order to analyze them more. Screening includes participation of several experts in a decision-making process. Moreover, their decisions are suggested by several criteria. Thus, fuzzy screening method is a multi-criteria decision-making model with several experts (ME-MCDM) with minimum information (Carolina, Duarte; Lawrence, P.; Etkin, Marilyn M. Helms; Michael, S. Anderson, 2006).

Screening is a two-step process. In its first step, each expert is requested to weigh different criteria and evaluate each option in the frame of linguistic scales (table 1). In this evaluation, each expert expresses how one option meets different criteria. In its second step, evaluations are mixed to obtain a unique evaluation for each option (Yager, R.R., 1993). In this way, Importance of each criterion is determined by experts with linguistic variables. Then be determined how much each option will satisfy each of the criteria. Finally, select the options that most of the other options can satisfy the criteria.

TABLE 1: LINGUISTIC COMPARISONS TO EVALUATE STRATEGIES

Outstanding (OU)		S <sub>7</sub>		
Very high (VH)		S <sub>6</sub>		
High(H)		S <sub>5</sub>		
Medium (M)		S <sub>4</sub>		
Low (L)		S <sub>3</sub>		
Very Low (VL)		S <sub>2</sub>		
None (N)		S <sub>1</sub>		
VL	L	M	H	VH
(0,1,2)	(2,3,4)	(4,5,6)	(6,7,8)	(8,9,10)

**2.4. Mixing QFD with fuzzy screening**

At first, criteria determined by experts are screened by fuzzy screening method and by linguistic variables. Then, the strategies and executive methods to accomplish strategies are prioritized by completion of QFD, in which strategies are “WHATs” and executive methods are “HOWs”.

**3. case study**

This research studies pros and cons (internal environment) and opportunities and threats (external environment) of an organization. This research tries to extract production strategies of an organization by SWOT, and to prioritize methods to achieve them by fuzzy QFD. In this research, at first an expert team was formed by 5 experts from higher managers of an organization. Then, four steps of this analysis were executed, as follows.

**3.1. Recognition of pros and cons, opportunities, and threats**

After holding justification session to identify pros and cons, opportunities, and threats, each team member analyzed internal and external organization’s environment individually. In the second session, each member describes his items and shares his opinions. In the third session, the brain storming session, an opinion is selected by consensus. The final results are:

- Strengths
  1. (S7) Company can finance as necessary
  2. (S9) Desirable quality control
  3. (S10) Effective quality and brand as a competitive advantage of company
- Weaknesses
  1. (W2) Company is far from its suppliers
  2. (W3) Company has not enough dominance on its suppliers
  3. (W6) Cost of raw material is high
  4. (W8) Ability of organization’s stand against price pressure of external competitors
  5. (W17) Lower profit margin for products
- Opportunities
  1. (O7) High consumption
  2. (O9) High consumption culture of society
  3. (O10) Increment of prices
  4. (O11) Improvement of product quality
  5. (O18) Increment of staff skills and ability for higher production
- Threats
  1. (T1) Lower raw materials and higher prices
  2. (T3) International deprivation threats including importing machinery and raw materials and exporting final products
  3. (T7) Increment of finished price because of Purposeful Subside Law and free prices for energy carriers

**3.2. Formation of SWOT matrix**

After recognizing important factors, the SWOT matrix is formed as follows:

TABLE 2: SWOT MATRIX

Important factors	Codified strategies
	ST
T: Payment of facilities by banks and deprivation S: Ability of financing	1. Investment for raw materials 2. Concentration on internal sale 3. Diversity of products by analysis of customer needs 4. Proximity to final consumer
T: Increment of finished price S: Quality control S: Ability of financing	5. Control of resources, especially energy carriers by modern knowledge
	WO
O: Improving quality of threads O: Increment of consumption culture W: Lower profit margin	6. Go toward high quality production with higher prices and recognition of related markets with lower competitors and higher value added
O: Increment of prices O: Increment of consumption level W: Lower profit margin	7. Concluding long-term contracts with fixed prices 8. Interaction with banks to import raw materials with long-term facilities such as usance 9. Contract duration regarding confidence margin for delivery of raw materials
	SO
S: Quality control O: Increment of staff skills O: Accessibility to modern knowledge	10. Increment of production of high quality products (increment of profit margin) 11. New investments to increase value added
	WT
W: Low profit margin T: International deprivation problems	12. Cooperation with well-known brands (such as Hakupian,...)

### 3.3. Screening strategies

Because of scarcity of resources in organizations, many strategies cannot be focused simultaneously. Therefore, some of them will be selected (N. Manteghi; A. Zohrabi, 2011). In this method, few criteria are introduced by experts to evaluate and screen strategies. These criteria are:

- Strategic implementation cost (C1)
- Time for strategic implementation (C2)
- Focus on product development (C3)
- Focus on customers and beneficiaries (C4)

The importance levels and sufficiency of these criteria must firstly be determined by experts by set S (table 1). In this step, experts were requested to determine the importance levels by set S (table 3).

TABLE 3: IMPORTANCE LEVEL OF CRITERIA FROM THE VIEW OF EXPERT (I<sub>kj</sub>)

	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>
E <sub>1</sub>	H	H	H	L
E <sub>2</sub>	H	VH	H	L
E <sub>3</sub>	VH	VH	VH	L
E <sub>4</sub>	M	OU	H	M
E <sub>5</sub>	M	VH	H	L

Then, each expert was requested to determine sufficiency of these criteria (C1, C2, C3, C4) regarding to the initial strategies of SWOT. This evaluation is shown for strategy 5 (control of resources, especially energy carriers, by modern knowledge) (table 4).

TABLE 4: SUFFICIENCY LEVELS FOR STRATEGY 5 FROM THE VIEW OF EXPERTS (π<sub>IJK</sub>)

S <sub>5</sub>	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>
E <sub>1</sub>	H	VH	H	M
E <sub>2</sub>	M	OU	H	M
E <sub>3</sub>	H	VH	H	L
E <sub>4</sub>	H	H	H	L
E <sub>5</sub>	M	VH	H	L

The next step is evaluation of each expert from each strategy. To do this, importance negative sizes of elements of S set must be determined by eq. (1).

$$\text{Neg}(S_i) = S_{7-i+1} \tag{1}$$

Regarding to eq. 1, negative sizes of elements of S set are as table 5.

TABLE 5: IMPORTANCE NEGATIVE SIZES OF ELEMENTS OF S SET

Neg(OU)=N	Neg(VH)=VL	Neg(H)=L	Neg(M)=M	Neg(L)=H
Neg(VL)=VH	Neg(N)=OU			

Then, mark of each option (strategy) is determined by each expert (U<sub>ik</sub>) by eq. 2:

$$U_{ik} = \min \{ \text{Neg}(I_{kj}) \vee \pi_{ikj} \} \quad i=1,2,3,\dots,m_k=1, \dots, r \tag{2}$$

in which,

- U<sub>ik</sub> : mark of person k for option i
- I<sub>kj</sub> : importance degree of criterion j by expert k
- π<sub>ikj</sub> : sufficiency level of criterion j for option i by person k

Now, we calculate mark of persons for strategy 5. To do this, at first, importance negative sizes of criteria are identified (table 6).

TABLE 6: IMPORTANCE NEGATIVE SIZES OF CRITERIA, NEG (I<sub>kj</sub>)

	Criteria			
K	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>
E1	L	VL	L	M
E2	M	N	L	M
E3	L	VL	L	H
E4	L	L	L	H
E5	M	VH	L	H

Then, mark of each expert (U<sub>ik</sub>) is obtained regarding Neg (I<sub>kj</sub>) and π<sub>ik</sub> (table 7).

TABLE 7: MARK OF EACH STRATEGY BY EACH EXPERT, NEG (IKJ) V πIK

Strategy 5 (S5)	K	Criteria				min
		C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	
Quality control of consumption items, especially energy carriers by modern knowledge	E1	H	VH	H	M	M
	E2	M	OU	H	M	M
	E3	H	H	H	H	H
	E4	H	H	H	H	H
	E5	M	VH	H	H	H

Now, the average of evaluations are determined by expert according to Eq. 3.

$$U_i = (\sum U_{ik})/k ; i=1, 2, 3, \dots, 12 ; k=1, \dots, 5 \tag{3}$$

Thus, total evaluation for strategy 5 is  $U_5 = (5.5, 6.75, 8)$

Since each energy is selected if its importance degree is equal or greater than M, then this strategy is selected. By this method, all the other strategies are evaluated and the most desirable strategies are selected. These are 6 strategies:

1. Backward development to invest for raw materials
2. Production of different products regarding to analysis of customer needs
3. Decrement of consumed resources, especially energy carriers, by modern knowledge
4. Proximity to final consumer
5. Maximum optimal usage of current facilities
6. Higher price and quality, and identification of related markets with lower competitors and higher value added

**3.4. Formation of quality house matrix**

To prioritize strategies and executive methods to access them, the following steps must be done:

**Step 1: Recognition of qualitative requirements**

Development of quality performance is started by listing the goals. These are WHATs items. According to what mentioned above, 6 screened strategies are considered as qualitative requirements.

**Step 2: Technical and engineering requirements**

After holding brainstorming session between the experts and refining them, technical and engineering requirements (HOWs items) are as follows:

1. (H1) Pre-purchase of raw materials annually
2. (H2) Establishment of a R&D Department
3. (H3) Using control systems for energy consumption
4. (H4) Establishment of sell agencies to supply markets directly
5. (H5) Creating suitable production capacities for more productivity
6. (H6) Decrement of product waste
7. (H7) Establishment of Industrial Design Department to develop performance indices of existing products

**Step 3: Determination of relationship between customers' needs and technical definitions (HOWs)**

In this step, customer's needs (m) are compared with technical specifications (n) and their relationships. Each technical specification may affect many customer needs, and vice versa. After getting linguistic variables of each experts about affect of technical specification on customer needs (table 8), the average of their views are calculated by eq. 5 and is inserted in cell 2 of quality house.

$$\text{Rating} = \{r_{ij}, \text{ where } i= 1,2,\dots,K \text{ and } j= 1,2,\dots,m\} \quad r_{ij} = 1/n \times (r_{ij} + \dots + r_{in}) \tag{5}$$

Importance degree = absolute weight × improvement ratio × correction factor

$$D = I \times B \times C \tag{6}$$

**Step 4: Prioritizing requests and qualitative requirements**

Undoubtedly, importance degrees of all strategies are not equal, and some of them are more importance by view of customers. Therefore, importance level of each strategy must be identified. Thus, in the quality house, weight of each option is calculated by eq. 7.

$$\text{Importance}_{\text{what}} = \{r_{ij}, \text{ where } i= 1,2,\dots,K \text{ and } j= 1,2,\dots,m\} \quad w_{ij} = 1/n \times (r_{ij} \times w_j + \dots + r_{in} \times w_n) \tag{7}$$

TABLE 8: RELATIONSHIP BETWEEN CUSTOMERS NEEDS AND TECHNICAL DEFINITIONS (HOWS)

HOWS WHATS	H1					H2					H3					H4					H5					H6					H7				
	E1	E2	E3	E4	E5	E1	E2	E3	E4	E5	E1	E2	E3	E4	E5	E1	E2	E3	E4	E5	E1	E2	E3	E4	E5	E1	E2	E3	E4	E5	E1	E2	E3	E4	E5
Expert	VH	H	H	VH	H	VH	VH	VH	H	VH	L	VL	VL	L	VL	M	L	L	L	L	L	VL	VL	L	VL	H	H	H	H	H	L	L	L	L	L
ST 1	VH	H	H	VH	H	VH	VH	VH	H	VH	L	VL	VL	L	VL	M	L	L	L	L	L	VL	VL	L	VL	H	H	H	H	H	L	L	L	L	L
ST 2	M	M	L	M	M	H	H	M	M	H	VH	VH	VH	H	VH	L	L	L	L	L	M	M	M	M	M	L	L	VL	L	L	M	M	H	M	M
ST 3	H	M	H	M	M	M	M	M	M	M	L	L	L	L	L	H	VH	VH	H	VH	L	L	L	L	L	VH	VH	VH	H	VH	H	H	H	H	H
ST 4	H	H	VH	H	H	VH	VH	VH	H	VH	M	L	L	M	L	H	VH	VH	VH	VH	L	L	L	L	L	M	VL	H	H	VL	L	VL	VL	L	VL
ST 5	H	H	H	H	H	H	H	M	H	H	L	L	L	M	L	M	M	M	M	M	L	L	VL	L	L	H	H	H	H	H	VL	VL	VL	L	VL
ST 6	H	M	H	M	M	VH	VH	H	H	VH	VL	L	L	M	L	H	VH	VH	VH	VH	M	M	M	M	M	H	H	VH	H	H	H	H	VH	H	H

TABLE 9: IMPORTANCE DEGREES OF QUALITATIVE REQUIREMENTS (STRATEGIES)

WHATS	E1	E2	E3	E4	E5
ST <sub>1</sub>	VH	VH	H	H	VH
ST <sub>2</sub>	M	L	M	L	L
ST <sub>3</sub>	H	M	M	M	M
ST <sub>4</sub>	M	M	L	M	M
ST <sub>5</sub>	L	VL	L	L	VL
ST <sub>6</sub>	M	L	L	L	L

Regarding to views of experts, qualitative requirements by their importance degrees are:

1. Strategy 1: Backward development to invest for raw materials
2. Strategy 2: Decrement of consumed resources, especially energy carriers, by modern knowledge
3. Strategy 3: Proximity to final consumer
4. Strategy 4: Production of different products regarding to analysis of customer needs
5. Strategy 5: Higher price and quality, and identification of related markets with lower competitors and higher value added
6. Strategy 6: Maximum optimal usage of current facilities

**Step 5: Prioritizing technical and engineering specifications**

The QFD team identifies the most important technical definitions to estimate strategies. This is suitable for determination of distinct goals (for future designing), evaluation of progress, and decrement of individual monitoring. The absolute weights of technical definitions are obtained from eq. 4 and are inserted in the quality cell (fig. 4).

$$WEIGHT_{SHOW} = \{ W_j, \text{ where } j= 1,2,\dots,m \} \quad W_j= 1/k \otimes (r_{ij} \otimes w_j + \dots + r_{in} \otimes w_n) \quad (9)$$

By these calculations, priorities of execution methods according to the most relative weight are:

1. Execution method 1: Establishment of Industrial Design Department to develop performance indices of existing products
2. Execution method 2: Establishment of a R&D Department
3. Execution method 3: Pre-purchase of raw materials annually
4. Execution method 4: Decrement of product waste
5. Execution method 5: Establishment of sell agencies to supply markets directly
6. Execution method 6: Using control systems for energy consumption

7. Execution method 7: Creating suitable production capacities for more productivity

Step 7: Development of mutual communications matrix between technical specifications of product/service

Some of technical features are correlated and changes to one, affect the other. Thus, their correlations must be identified mutually, which is shown in the roof of quality house.

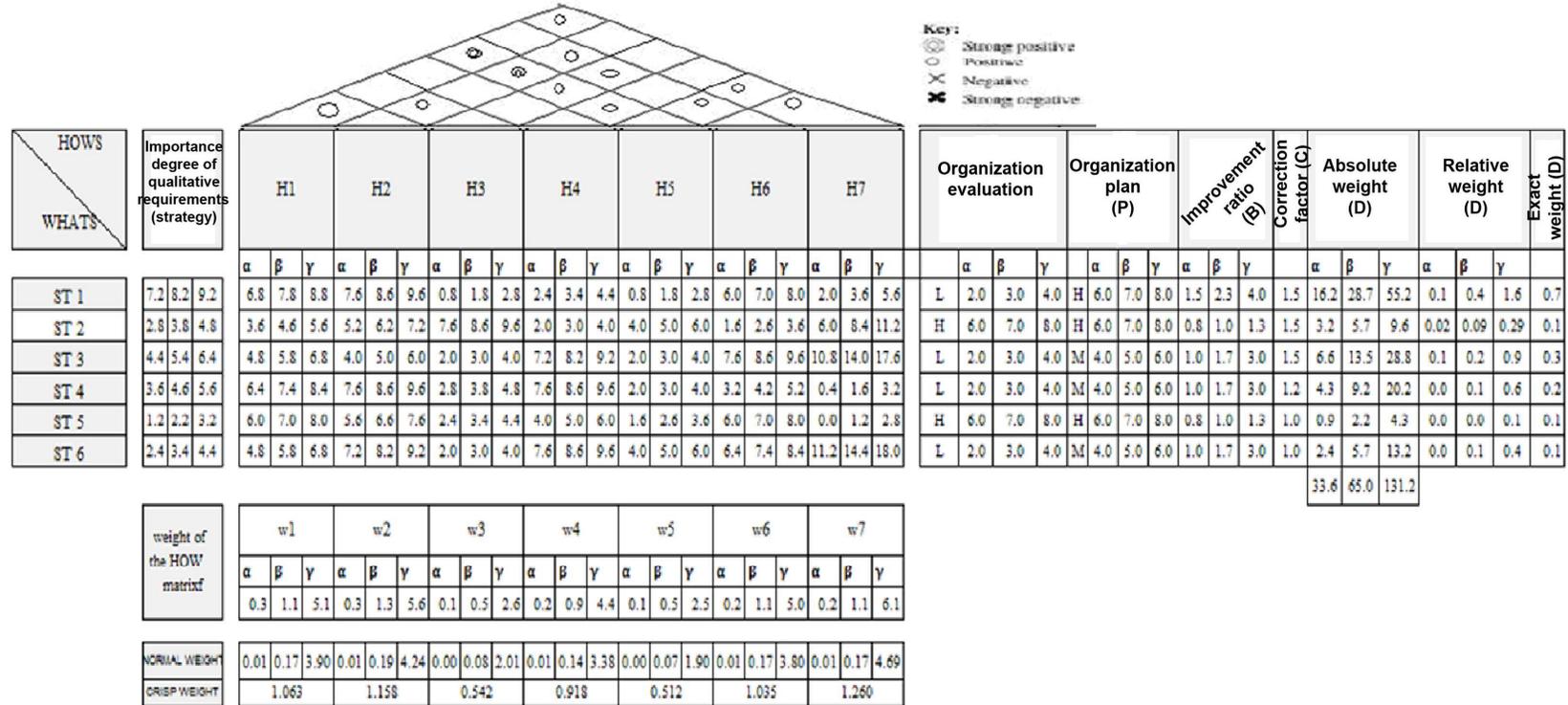


FIG. 2: QUALITY HOUSE

#### 4. conclusion

This research offers an integrated method to codify strategies of organizations. In this method, at first, initial strategies were codified by SWOT matrix. Then, fuzzy screening was used to screen the strategies. Finally, by QFD as a suitable tool to link between different elements of strategic planning, QFD quality house was used to examine relationships between WHATs (strategies obtained from SWOT) and HOWs (strategy execution methods). The results show that this innovative model can be used as a total framework to codify strategies of organizations. Thus, total strategic planning is propounded as a necessity in organizations. One of the reasons to use this method in organizations is huge and rapid technological developments. Generally, technological developments and changes in the contemporary world, mutual effects between organizations and society in the shape of communications, and broad programs are areas that make total planning inevitable for organizations.

As noted in this study, developments and changes in the environment is increasing the complexity of the decisions and actions in organizations, and organizations without proper strategy and operational plan, will be faced with many problems and limitations in the competitive environment, consequently selection procedure incorrectly can cause failure to achieve its strategic priorities.

This study offers an integrated method to complete the organizations strategic and operational planning process using the sequential use of two matrices SWOT and FQFD, In order to implement the appropriate Executive methods in the organization, coordination and evaluation of the effect of each procedure on a different strategy, and avoid wasting resources by choosing the correct paths.

Certainly, choosing the correct executive methods and comply with the organization strategic priorities, can contribute to the success the organization its commercial competitors.

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