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PRIORITIZATION OF BALANCED SCORECARD MEASUREMENT INDICATORS AS A PROCESS MANAGEMENT APPROACH VIA FUZZY AHP: CASE STUDY IN AUTOMOTIVE INDUSTRY

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Preliminary notes
This article seeks to evaluate organization's performance and minimize uncertainties and variations by presenting a methodology using fuzzy AHP in four dimensions of balanced scorecard. The purpose of this study is to prioritize the performance measurement indicators in organization that is producing automobiles for domestic and foreign market of Turkey. The case study along with the methodology used in this research can be a guideline for professionals and researchers for evaluating the processes and performance measurement indicators both in manufacturing and service organizations. The methodology of this study provides flexibility, agility, efficiency and effectiveness for preferences of the decision makers.

Keywords: *balanced scorecard, fuzzy, automotive*

Određivanje prioriteta među pokazateljima mjerenja učinkovitosti na tablici uravnoteženih rezultata kao pristupa upravljanju procesima primjenom fuzzy AHP: analiza slučaja u automobilskoj industriji

Prethodno priopćenje
Ovaj članak nastoji ocijeniti učinkovitost organizacije i smanjiti nesigurnost i varijacije predstavljajući metodologiju pomoću fuzzy AHP u četiri dimenzije tablice uravnoteženih rezultata. Svrha je ovog istraživanja odrediti prioritete pokazatelja mjerenja uspješnosti u organizaciji koja proizvodi automobile za domaće i inozemno tržište Turske. Studija slučaja uz metodologiju u ovom istraživanju može poslužiti kao smjernica profesionalcima i istraživačima u procjeni procesa i pokazatelja mjerenja uspješnosti, kako u proizvodnim tako i uslužnim organizacijama. Metodologija ovog istraživanja pruža fleksibilnost, agilnost, učinkovitost i djelotvornost kao prioritetne vrijednosti kod donošenja odluka.

Ključne riječi*: tablica uravnoteženih rezultata, fuzzy, automobilski*

1 Introduction

Managing a company in today's complex and competing business environment is really a difficult task to be performed, and for this reason, top management of a company needs managerial tools and indicators that measure the environment and performance conditions from different perspectives [1 ÷ 8]. Thus, in order to survive in today's rapidly changing environment, companies must identify their existing positions [9], clarify their goals, and operate more effectively and efficiently [10]. Goals produce what the strategy is trying to achieve and measure how success or failure directly affects objectives, targets indicate the level of performance or the rate of improvement needed, and initiatives get the result of key action programs required to achieve targets [11 ÷ 13]. In this manner the balanced scorecard criteria select and evaluate the performance measurements [14]. The basic purpose of any measurement system is to provide feedback relative to goals, and increase chances of achieving these goals effectively and efficiently [15 ÷ 17]. In competing business environment, true value is gained by measurement when it is used as a basis for timely decisions. Generalizing the organizational goals is the basic solution to overcome the problems such as rivalry, uncertainty, variability, intensive job tendency, and etc. Determination of basic organizational targets, vision, mission and quality policy, strategies that are used for reaching the goals as well as definition of job goals for each department, should be primarily taken into account [18 ÷ 20]. Definition of organizational targets and measurement of the performances of processes along with predetermined targets, objective and knowledge-oriented evaluation would provide opportunities for organizations to make comparisons and to take due precautions. Basically, goals are important for unifying efforts, for this reason, organizations have to set their goals in order to focus their energies and resources on common values. However, it is generally difficult to set common meaningful goals for entire organization. Since goals tend to be so broad, organizational elements and individuals frequently fail to understand the connection between their efforts and the goals. In this study, goal setting becomes meaningful [24, 25]. Industrial organization's business processes and their relations will be considered. The performance management criteria and their indicators will also be illustrated. Then, these performance indicators will be divided into categories that are taken into balanced scorecard principles. In that point, by using fuzzy logic, these indicators will be graded due to survey results that have been gathered from fifty professionals in the automotive industry in order to understand the decision making units (DMUs) in the system. After gathering the data, AHP method will be executed to the fuzzy scorecard indicators [16, 20 ÷ 23, 28 ÷ 30]. The rankings will be gathered, and afterwards which indicator gives the best and the worst results will try to be identified. As a corollary, the future events that the organization should restructure will be configured for the organization.

2 Case study

The case study is composed of BSC and process management applications in an organization that is producing automobiles for domestic and foreign market of Turkey. Here, focal point is to establish the structure of BSC and process management hierarchy. First of all, the departments and their relations should be determined according to the organizational capabilities. The departments are Senior Management, Technical Directorship, Marketing & Sales Directorship, Purchasing Directorship, Manufacturing Directorship, and Accounting & Finance Directorship. Senior Management primarily decides what to produce, what the strategies and business plans are, how all these can be maintained and improved, how organization can be established, what the responsibilities are and how the authorization is shared out. Technical Directorship has three main departments, which are R&D, Quality, and Production Engineering. R&D has the role of the leadership of new research and development projects, publishes the technical drawings, prepares the risk plans like FMEA and etc., and determines the tolerances. Quality department maintains ISO standards, faces the incoming control by sampling, monitors the process and control applications due to predetermined control plans and instructions, and traces the corrective and preventive actions in the direction of continuous improvement. Production Engineering makes the apparatus, fixtures, tools for the usage of assembly line and prepares operation plans to create wisdom for workers. Marketing & Sales Directorship manages the whole sales cycle, traces the customer satisfactions, compares the results, evaluates the customer complaints, and prepares the feedbacks especially to R&D, Quality, and production departments. Purchasing Directorship determines the suppliers due to their available criteria such as quality, service, price, delivery, and etc. In addition to this, Purchasing Directorship plans and performs the supplier audits and evaluates their short and long term performances. Manufacturing Directorship makes inventory plans by comparing the available stocks and the suppliers' basic conditions such as lead time, transportation facility, and etc. Furthermore, Manufacturing Directorship stocks the incoming materials and gives the incoming materials to the assembly when there is a need in the assembly line. Also, Manufacturing Directorship produces the finished products for the customers in the predetermined conditions due to operation plans. Accounting & Finance Directorship records and calculates the assets and liabilities or costs and benefits. Moreover, personnel conditions and information are accumulated and the resources are evaluated in this department. By using the knowledge, processes can be generalized and managed. First of all the organization is divided into processes. In this case study, organization is divided into nine categories or processes that are Human Resources Management, Quality System Management, Marketing & Sales, After Sales Services, Materials Management, Production, Finance, New Product Project Management, and Management Responsibility. The contents of these processes are explained in the following subsections. As a whole, organization's process structure can be established as in Fig. 1, which shows Process Block Diagram. Generally, the processes can be thought within three dimensions, which are customer-oriented processes (COP), supported processes and managerial processes.

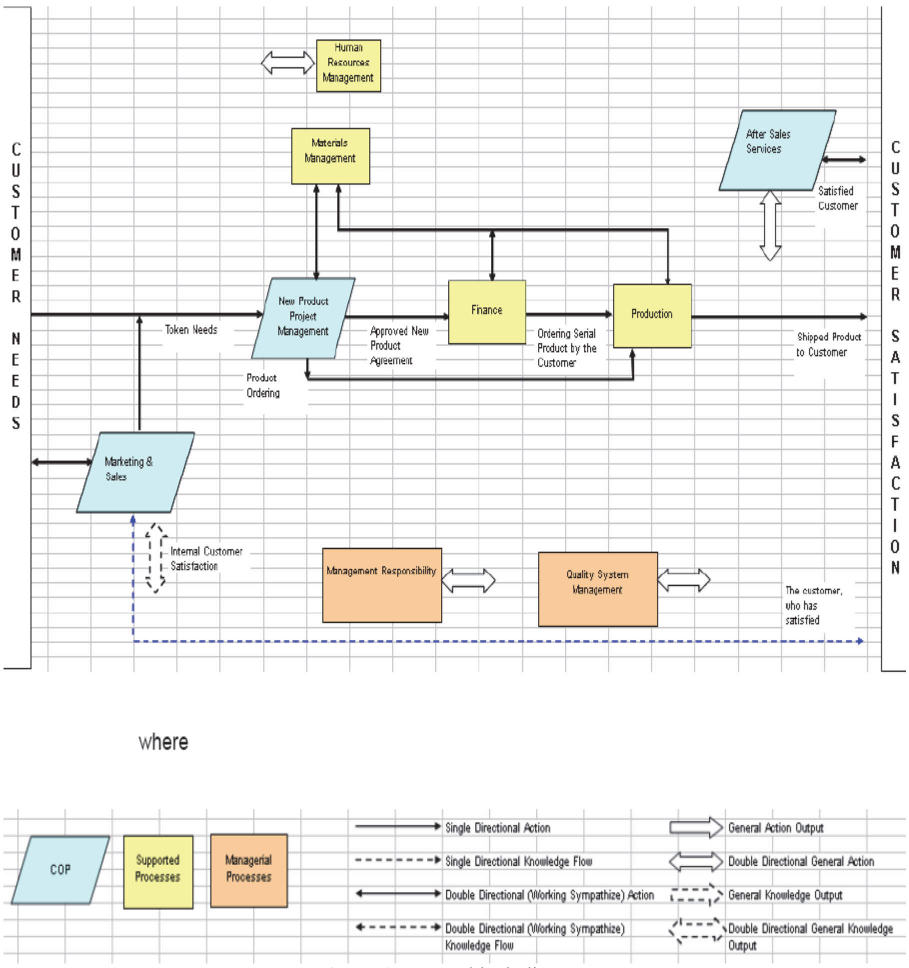

Figure 1 Process block diagram

A lot of performance indicators that are applied by various companies can be taken into account. There must be an aim to get the remarks. Goals produce what the strategy is trying to achieve and measure how success or failure directly affects objectives, targets indicate the level of performance or the rate of improvement needed, and initiatives get the result of key action programs required to achieve targets. In this manner; the BSC criteria select and evaluate the performance measurements. For instance, financial measures should be cost benefit or customer measures should align with the market segments. For this study, eight performance measurement indicators, which seem to be appropriate for all processes, are selected to analyze. The selected eight performance measurement indicators are listed below:

- Decreasing of inventory waiting time (IWT)
- Increasing profit/cost of sale product (P/S)
- Increasing of customer continuity (CSC)
- Decreasing of scrap/sales percentage (S/S)
- Decreasing of change in customer complaints (CCC)
- Increasing of total performance of suppliers (TPS)
- Increasing of capacity (CAP)
- Increasing of R&D investment per employee (R&D).

Fig. 2 illustrates Hierarchical structure of criteria.

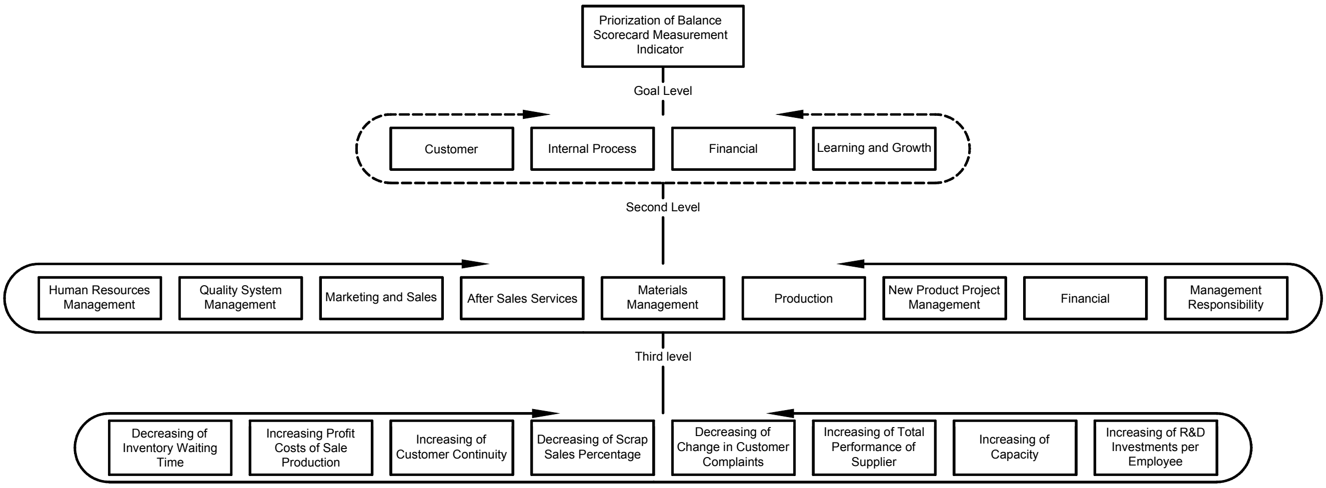

Figure 2 Hierarchical structure of criteria

3 Methodology

First of all, survey is prepared in order to get the data for fuzzy AHP. This survey is based on the criteria of BSC, the processes in the organization and their performance measurement indicators are determined. These indicators are graded due to survey results that have been gathered from fifty professionals (manager, director or general manager, and etc.) in the automotive industry in order to understand the decision making units (DMUs) in the organization system. After gathering the data, matrices for each level are constituted. With this method, a complex system can be converted into a hierarchical system of elements. In each level of the hierarchy, pair-wise comparisons of the elements are made by using a nominal scale. As it is shown in Tab. 1, the nominal scale in the survey was converted into triangular fuzzy scale [3].

Table 1 Triangular fuzzy scale table

Linguistic Scale	Triangular Fuzzy Scale	Triangular Fuzzy Reciprocal Scale
Just equal	(1, 1, 1)	(1, 1, 1)
Equally important	(1/2, 1, 3/2)	(2/3, 1, 2)
Weakly more important	(1, 3/2, 2)	(1/2, 2/3, 1)
Strongly more important	(3/2, 2, 5/2)	(2/5, ½, 2/3)
Very strongly more important	(2, 5/2, 3)	(1/3, 2/5, ½)
Absolutely more important	(5/2, 3, 7/2)	(2/7, 1/3, 2/5)

Since trapezoidal fuzzy AHP solution is used in this study, standardized trapezoidal fuzzy number (STFN) should be used. Let U be the universe of discourse, $U = [0,u]$. A STFN can be defined as $A^* = (a^1, a^m, a^n, a^u)$ where $0 \le a^1 \le a^m \le a^n \le a^u \le u$ shown in Fig. 3.

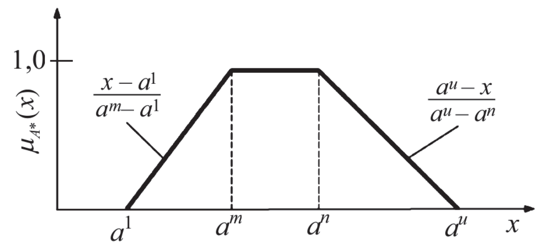

Figure 3 MF of the STFN

Table 2 Triangular fuzzy scale table

Linguistic Scale	Trapezoidal Fuzzy Scale	Trapezoidal Fuzzy Reciprocal Scale
Just equal	(1, 1, 1, 1)	(1, 1, 1, 1)
Equally important	(1/2, 1, 1, 3/2)	(2/3, 1, 1, 2)
Weakly more important	(1, 3/2, 3/2, 2)	(1/2, 2/3, 2/3, 1)
Strongly more important	(3/2, 2, 2, 5/2)	(2/5, ½, ½, 2/3)
Very strongly more important	(2, 5/2, 5/2, 3)	(1/3, 2/5, 2/5, ½)
Absolutely more important	(5/2, 3, 3, 7/2)	(2/7, 1/3, 1/3, 2/5)

$\mu_{A^*}(x)$ denotes a membership function (MF) indicating the degree of preference. It must be noticed that a triangular fuzzy number can be converted into simplified STFNs when $a^m = a^n$. Tab. 2 shows Trapezoidal Fuzzy Scale.

Individual preferences are converted into group preferences by applying an appropriate operator. The calculation of STFN scale is performed by applying the fuzzy weighted trapezoidal averaging operator, which is defined as follows:

$$a_{ij}^* = a_{ij_1}^* \otimes c_1 \oplus a_{ij_2}^* \otimes c_2 \oplus ... \oplus a_{ij_m}^* \otimes c_m , \qquad (1)$$

where a_{ij}^* is the aggregated fuzzy scale of F_i compared to F_j, for i, j = 1, 2, …, n; $a_{ij1}^*, a_{ij2}^*, ..., a_{ijm}^*$, are the corresponding STFN scales of F_i compared to F_j measured by experts $E_1, E_2, \dots, E_m$, respectively. $\otimes$ is the fuzzy multiplication operator and $\oplus$ is the fuzzy addition operator. $c_1, c_2, \dots, c_m$ are contribution functions (CFs) allocated to experts, $E_1, E_2, \dots, E_m$ and $c_1 + c_2 + \dots + c_m = 1$. In this study, all experts' CFs are accepted as equal.

In order to convert STFN scales into crisp values that represent the group preferences, defuzzification is needed. If STFN scale $a_{ij}^* = (a_{ij}^1, a_{ij}^m, a_{ij}^n, a_{ij}^u)$, crisp value a_{ij} can be obtained as follows:

$$a_{ij} = \frac{a_{ij}^1 + 2(a_{ij}^m + a_{ij}^n) + a_{ij}^u}{6}, \qquad (2)$$

where $a_{ii} = 1$, $a_{ji} = 1/a_{ij}$. Comparison matrix is formed by using crisp values as follows:

$$\mathscr{A} = a_{ij} = \begin{array}{c} \\ F_1 \\ F_2 \\ \vdots \\ F_n \end{array} \begin{array}{c} \begin{array}{cccc} F_1 & F_2 & \cdots & F_n \end{array} \\ \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{12} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/a_{1n} & 1/a_{2n} & \cdots & 1 \end{bmatrix} \end{array}, i, j = 1, 2, ..., n. \qquad (3)$$

In order to find the priority weights of each element, the eigenvector of the comparison matrix should be calculated as follows:

$$w_i = \frac{1}{n} \sum_{j=1}^{n} \frac{a_{ij}}{\sum_{k=1}^{n} a_{kj}}, \; i, j = 1, 2, ..., n, \qquad (4)$$

where w_i is the section weight of F_i. Assume that for every F_i at different levels of AHP hierarchy, there are t numbers of upper sections, and the i^{th} upper section's weight is $w_{\text{section}}^{(i)}$ which contains F_i in the hierarchy. The final weight w_i' of F_i can be derived as follows:

$$w_i' = w_i x \sum_{i=1}^{t} w_{\text{section}}^{(i)}. \qquad (5)$$

At the end, the highest weight emphasizes the most important performance measurement indicator.

4 Results

In this section, examples for each of the steps given above are demonstrated for goal level of AHP. Tab. 3 shows gathered data from fifty professionals for goal level. Examples given below are just the representative calculations based on the answers of the first expert among fifty experts. Actual results are based on fifty questionnaires.

For example, based on the data given in Step 1, the first expert compared FD with CD as equally important (2), which corresponds to (0,5; 1; 1; 1,5) values in the trapezoidal fuzzy number scale. Table 4 shows answers of Expert 1 compared to FD-CD, FD-BP, FD-LG, CD-BP, CD-LG, BP-LG and corresponding values in trapezoidal fuzzy number scale.

Table 3 Goal Level Table

GOAL LEVEL

attributes	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
FD	2	2	0,5	2	5	2	5	5	5	4	1	1	5	1	3	6	3	4	6	3	1	4	5	6	5	CD
FD	4	1	3	5	3	0,5	3	3	6	1	0,3	2	3	1	1	5	1	4	5	1	0,3	5	2	5	4	BP
FD	5	5	6	3	1	3	4	4	4	2	0,25	3	4	4	4	6	2	1	6	2	2	2	2	3	2	LG
CD	4	2	2	2	2	4	1	0,5	1	0,3	0,5	1	1	0,5	5	3	5	3	1	1	0,5	1	0,5	2	0,5	BP
CD	5	4	2	0,5	0,3	0,25	1	1	2	3	0,2	1	5	0,3	3	1	4	5	2	4	1	3	1	4	0,2	LG
BP	1	0,5	4	0,5	2	2	0,25	0,25	0,3	0,5	2	1	2	3	1	2	0,3	2	0,3	4	4	1	4	0,5	0,25	LG

experts	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
FD	2	6	6	4	4	3	4	5	3	1	4	3	6	2	5	4	1	6	5	5	3	3	5	0,3	3	CD
FD	1	5	5	1	2	1	4	6	1	0,5	2	2	6	2	4	0,5	5	1	2	5	0,3	0,3	2	2	0,5	BP
FD	3	4	6	0,25	2	2	1	3	5	0,2	1	3	4	1	4	1	3	4	4	3	1	1	1	0,5	2	LG
CD	2	3	1	2	0,5	5	0,5	5	4	4	0,3	3	5	0,3	0,5	0,5	4	3	0,5	4	0,2	0,5	4	0,2	0,3	BP
CD	5	5	0,25	3	3	0,3	2	1	6	3	4	4	2	3	1	0,3	0,3	0,3	1	1	5	3	0,3	0,3	0,5	LG
BP	4	4	3	1	5	1	0,25	2	2	6	5	1	1	4	2	2	1	0,5	0,3	2	5	5	0,5	3	2	LG

Table 4 Expert1 answers for pair-wise comparisons corresponding values in trapezoidal fuzzy number scale

FD	0,50	1,00	1,50	CD
FD	1,50	2,00	2,50	BP
FD	2,00	2,50	3,00	LG
CD	1,50	2,00	2,50	BP
CD	2,00	2,50	3,00	LG
BP	1,00	1,00	1,00	LG

Calculate the group STFNs from individual STFNs.

$$a_{11}^{*} = (1{,}39; 1{,}81; 1{,}81; 2{,}25). \qquad (6)$$

Converting the STFN scales into crisp values that represent the group preferences, defuzzification is performed. If STFN scale $a_{11}^{*} = (a_{11}^{1}, a_{11}^{m}, a_{11}^{n}, a_{11}^{u})$, crisp value a_{11} can be obtained as follows:

$$a_{11} = \frac{a_{11}^{1} + 2(a_{11}^{m} + a_{11}^{n}) + a_{11}^{u}}{6} = \frac{1{,}39 + 2(1{,}81 + 1{,}81) + 2{,}25}{6} = 1{,}816. \qquad (7)$$

Comparison matrix is formed by using crisp values as in Tab. 5.

Priority weights of each element, the eigenvector of the comparison matrix, which is given in Tab. 5, should be calculated according to Eq. (4). Eigenvector of the comparison matrix is given in Tab. 6.

Table 5 Comparison matrix

	FD	CD	BP	LG
FD	1	1,82	1,43	1,46
CD	0,55	1	1,24	1,289
BP	0,7	0,802	1	1,239
LG	0,68	0,775	0,806	1

Table 6 Eigenvector of the comparison matrix

	w_i
FD	0,34168
CD	0,2379
BP	0,22286
LG	0,197517

Since there is no upper level, w_i' does not exist in the goal level. The calculation of w_{HRM}' which is at the second level, is performed as follows:

$$w_{\mathrm{HRM}}' = w_{\mathrm{HRM}} \cdot w_{\mathrm{FD}} = 0{,}148869 \cdot 0{,}341683 = 0{,}050866. \qquad (8)$$

To demonstrate the w_i' second level matrices are shown in Tab. 7.

Table 7 Second level matrices for w_i'

FD matrice

	HRM	QSM	MAS	ASS	PDP	MMP	FNP	NPM	ROM	Wi	Wi'
HRM	1	1,659	1,5464	1,4311	1,4775	1,2774	1,3135	1,274	1,2591	0,148869	0,050866
QSM	0,6	1	1,2492	1,2908	1,1526	1,2795	1,2183	1,308	1,3093	0,123909	0,042338
MAS	0,65	0,801	1	1,3971	1,4115	1,4397	1,2241	1,1065	1,1576	0,121132	0,041389
ASS	0,7	0,775	0,7158	1	1,2036	1,2885	1,2798	1,2208	1,3112	0,112349	0,038388
PDP	0,68	0,868	0,7085	0,8309	1	1,34	1,1727	1,1464	1,2883	0,107072	0,036585
MMP	0,78	0,782	0,6946	0,7761	0,7463	1	1,3068	1,215	1,3146	0,102508	0,035025
FNP	0,76	0,821	0,8169	0,7814	0,8528	0,7652	1	1,0988	1,1702	0,096940	0,033123
NPM	0,78	0,765	0,9037	0,8191	0,8723	0,823	0,9101	1	1,1824	0,097116	0,033183
ROM	0,79	0,764	0,8639	0,7626	0,7762	0,7607	0,8546	0,8457	1	0,090106	0,030788

CD matrice

	HRM	QSM	MAS	ASS	PDP	MMP	FNP	NPM	ROM	Wi	Wi'
HRM	1	1,692	1,5664	1,5308	1,5017	1,2251	1,2893	1,1997	1,3756	0,148327	0,035293
QSM	0,59	1	1,344	1,3176	1,1758	1,266	1,2489	1,4305	1,2966	0,125280	0,029809
MAS	0,64	0,744	1	1,4626	1,2524	1,4606	1,1767	1,0709	1,0918	0,116588	0,027741
ASS	0,65	1,518	0,6837	1	1,1527	1,1132	1,3018	1,2933	1,511	0,119936	0,028538
PDP	0,67	0,851	0,7985	0,8675	1	1,4697	1,2481	1,1626	1,256	0,109179	0,025978
MMP	0,82	0,79	0,6847	0,8983	0,6804	1	1,1395	1,2342	1,1887	0,099720	0,023727
FNP	0,78	0,801	0,8498	0,7682	0,8012	0,8776	1	1,1409	1,015	0,095551	0,022735
NPM	0,83	0,699	0,9338	0,7732	0,8601	0,8103	0,8765	1	1,2734	0,096082	0,022862
ROM	0,73	0,771	0,916	0,6618	0,7962	0,8413	0,9853	0,7853	1	0,089337	0,021257

BP matrice

	HRM	QSM	MAS	ASS	PDP	MMP	FNP	NPM	ROM	Wi	Wi'
HRM	1	1,609	1,4362	1,6167	1,4036	1,2277	1,2687	1,1663	1,2002	0,145312	0,032384
QSM	0,62	1	1,2939	1,1858	1,1528	1,1782	1,18	1,436	1,3431	0,123857	0,027603
MAS	0,7	0,773	1	1,4763	1,3741	1,326	1,2361	1,0578	1,1453	0,120468	0,026848
ASS	0,62	0,843	0,6774	1	1,291	1,202	1,3514	1,309	1,3228	0,113540	0,025304
PDP	0,71	0,867	0,7278	0,7746	1	1,2481	1,2564	1,2402	1,3195	0,108591	0,024201
MMP	0,81	0,849	0,7542	0,832	0,8012	1	1,205	1,1987	1,222	0,103801	0,023133
FNP	0,79	0,847	0,809	0,7399	0,7959	0,8299	1	1,0716	0,9618	0,094698	0,021104
NPM	0,86	0,696	0,9454	0,764	0,8063	0,8342	0,9332	1	1,2021	0,097021	0,021622
ROM	0,83	0,745	0,8731	0,7559	0,7578	0,8184	1,0397	0,8319	1	0,092712	0,020662

Table 7 Second level matrices for $w_i^{'}$ (continuation)

LG matrice

	HRM	QSM	MAS	ASS	PDP	MMP	FNP	NPM	ROM
HRM	1	1,639	1,5967	1,5131	1,5136	1,2988	1,3196	1,3245	1,3336
QSM	0,61	1	1,2599	1,2147	1,1935	1,246	1,1976	1,4781	1,2894
MAS	0,63	0,794	1	1,4125	1,2986	1,288	1,2066	1,1318	1,2057
ASS	0,66	0,823	0,708	1	1,1773	1,1432	1,2396	1,2952	1,4968
PDP	0,66	0,838	0,7701	0,8494	1	1,4005	1,1688	1,2443	1,164
MMP	0,77	0,803	0,7764	0,8747	0,7141	1	1,3227	1,2308	1,1133
FNP	0,76	0,835	0,8288	0,8067	0,8556	0,756	1	1,0849	1,0846
NPM	0,76	0,677	0,8835	0,7721	0,8037	0,8125	0,9218	1	1,261
ROM	0,75	0,776	0,8294	0,6681	0,8591	0,8982	0,922	0,793	1

Wi	Wi'
0,152268	0,030075
0,124530	0,024597
0,118402	0,023386
0,112566	0,022234
0,107858	0,021304
0,102722	0,020289
0,096411	0,019043
0,094573	0,018680
0,090670	0,017909

5 Results

In this research, the data have been gathered from a detailed survey, which has been applied to fifty professionals. After gathering the data, matrices for each level are constituted in order to convert a complex system into a hierarchical system. In each level of the hierarchy, pair-wise comparisons of the elements are made by using a nominal scale. The nominal scale is converted into triangular fuzzy scale so that it is possible to convert the values into STFNs. Then, the group STFNs are calculated from the individual STFNs. After the defuzzification of these STFNs, the weights of each performance measurement indicators are calculated. As a result, these performance measurement indicators are ranked in order to understand which indicator has the highest weight and which indicator has the lowest weight. In this study, the most important performance measurement indicators are found as Decreasing of inventory waiting time (IWT), Increasing profit/cost of sale product (P/S), and increasing of customer continuity (CSC). On the other hand, the least important performance measurement indicators are found as increasing of capacity (CAP) and increasing of R&D investment per employee (R&D). The first important indicator is the Decreasing of inventory waiting time (IWT). IWT has different direct and indirect effects for many processes and outcomes of the organization. Market pioneers often develop sustainable market share advantages. Thus, waiting time of inventories would affect the reorder level directly and maximum stock and reorder quantity of the item indirectly. If the inventory waiting time is decreased, the reorder level will also be reduced, and striking reduction in the holding cost of the item(s). The second important indicator is the Increasing profit/cost of sale product (P/S), which is known, admitted, and widely accepted as one of the most basic performance measurement indicators. P/S is the most distinct indicator that shows the profitability along with the total success of the organization. If profit/sale rate is relatively high, the organization is said to be successful and promising. There are two reasons for this accomplishment: either the selling price of the product is high or the cost of the product is low. The need of success can be satisfied in both situations. The third important indicator is the increasing of customer continuity (CSC), which is a golden key of keeping the market share and stabilizing the available position of the organization. In marketing, there are two basic breakthroughs: one is to attract new customers by increasing market share or entering to new markets and the other one is to keep the available customers by stabilizing the existing market share. However, it must be taken account that if the organization cannot keep its existing market share, new customers may be meaningless and insufficient. Retaining customer continuity can be obtained by understanding customer needs, clear communication. Establishing brand personality is one of the primary ways for organizations to inspire loyalty. Nevertheless, obtaining new customer is more expensive than keeping the available customer.

6 Conclusion

It is difficult to make decision about performance indicators of organizations' processes with available knowledge related to process performance since it is ambiguous and imprecise. By using fuzzy logic at the decision phase, it is possible to minimize uncertainties and variations. Fuzzy AHP method provides solution for MCDM problems effectively and overcomes the uncertainty at the decision making process. From this standpoint, in this study, fuzzy AHP methodology is used to analyse the organization's performance due to process management based balanced scorecard approach. The performance measurement indicators are evaluated and analyzed for an organization in automotive industry. In other words, the case study is composed of BSC and process management applications in an organization that is producing automobiles for domestic and foreign market of Turkey. A frame of fuzzy AHP approach is constituted in order to evaluate the organization's performance. Four basic characteristics of balanced scorecard approach along with nine different processes, which are considered according to the working area and needs of the organization, have been used. Eight performance measurement indicators, which seem to be appropriate for all processes, are selected for analysis. According to these criteria, performance measurement indicators have been evaluated as just equal, equally important, weakly more important, strongly more important, very strongly more important and absolutely more important variables instead of numerical expressions. Easier and more accurate results are obtained for the analysis and evaluation of performance measurements. It must be taken into account that, most of the respondents of our survey have marketing and manufacturing backgrounds that affect their decisions. It is possible to conclude that respondents' backgrounds can affect the results. For this reason, selection of the indicators or the decision making process can be affected by the role of the people in the organization though it is not possible for us to determine whether this effect exists or not and to evaluate the degree of this effect. For further research, we suggest the usage of different fuzzy MCDM methods for determination of the effects of respondents' backgrounds. Finally, our case study and the approaches that are used in this research can be a guideline for professionals and researchers for evaluating the processes and performance measurement indicators in different (service or manufacturing) organizations. The methodology of this study provides flexibility, agility, efficiency and effectiveness for preferences of the decision makers. Various indicators due to the enterprises' attributions can be executed. The methodology can also be used with different evaluation indicators within new organizations' processes. For instance, different performance measurement indicators in a service organization can be used.

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