International Journal of Business, Human and Social Sciences
ISSN: 2517-9411
Vol:11, No:9, 2017

Fuzzy Analytic Hierarchy Process for Determination of Supply Chain Performance Evaluation Criteria

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***Abstract*—**Fuzzy AHP (Analytic Hierarchy Process) method is decision-making way at the end of integrating the current AHP method with fuzzy structure. In this study, the processes of production planning, inventory management and purchasing department of a system were analysed and were requested to decide the performance criteria of each area. At this point, the current work processes were analysed by various decision-makers and comparing each criteria by giving points according to 1-9 scale were completed. The criteria were listed in order to their weights by using Fuzzy AHP approach and top three performance criteria of each department were determined. After that, the performance criteria of supply chain consisting of three departments were asked to determine. The processes of each department were compared by decision-makers at the point of building the supply chain performance system and getting the performance criteria. According to the results, the criteria of performance system of supply chain by using Fuzzy AHP were determined for which will be used in the supply chain performance system in the future.

***Keywords*—**AHP, fuzzy, performance evaluation, supply chain.

I. Introduction

COMPANIES should have a permanent and dynamic connection with their customers in order to understand and respond their demands on right time, place, and price [1], [2]. Because within rising competitive environment, cost of finding new customers is quite higher than cost of keeping current customers. Similarly, cost of changing supplier is quite higher than cost of maintaining relationships with current supplier. At this point, companies have to enhance all process from current suppliers to current customers. It was seen that efficiency is not maximized when parties within the supply chain try to reach target independent of each other. So, in order to evaluate supply chain some performance criteria are needed [3]. In determination of performance criteria, AHP method was preferred which is used in decision process effectively. This method enabled us make analysis and interpretations within a wide framework after to be developed with its fuzzy structure.

In this study, respectively Performance Evaluation System and its Importance, Performance Evaluation Methods, AHP and Fuzzy AHP method topics are examined. For application dimension of the study, planning, stock management and purchasing departments' business processes of Arkpres Seat Belt Ind. and Tra. IC are examined and job definitions with high continuity are revealed. In this stage firstly, production planning, stock management and purchasing employees and independent evaluators (six people for each department) are wanted to evaluate which job definitions may become indicator criteria for their own department's performance evaluation system. In this sense evaluators are demanded to give points to each one between the ranges of 1-9 by comparing everyone with each other. In the conclusion of interpretations, data is generated, analysed through using Fuzzy AHP method and performance index are ordered according to their order of importance. After that, evaluators are demanded to evaluate which departmental business process can be considered within the Supply Chain Performance System. At this point, evaluators evaluated departmental business processes within the common supply chain structure and compared importance of criteria one-to-one. Attained results were analysed through using developed Fuzzy AHP Method and common supply chain performance evaluation index for three departments were gained. Both application results are generated for determination of performance criteria. These results consisted infrastructure of advanced performance evaluation system to be generated in the future as well as they can be considered as current performance evaluation criteria for related entrepreneurship.

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II. Performance Evaluation System

Performance evaluation is one of the most important functions of human resources. Performance evaluation has two main functions [4], [5]. First one is getting information about business performance that information is necessary in the stage of managerial decisions. Decisions concerning wage rises, bonuses, education, promotion, and other managerial activities are generally based on information attained through performance evaluation process. The other function of performance evaluation is to provide feedback to employee about how they approached to standards indicated in job definition and business analysis. It is considered commonly that this feedback shall become quite beneficial when it is given in a positive manner and supported with occupational education. Evaluation criteria shows that employee will be evaluated according to what and in this sense, shows what is expected from employees. In establishment of performance evaluation system, primarily criteria to be evaluated should be determined. Evaluation criteria should be criteria that responding strategically requests of entrepreneurship/

institution and servicing to aim of reaching targets of company. Herein, by making business analysis determination method and weight of criteria should be decided.

III. Fuzzy AHP Method

Fuzzy logic has different usage are in literature such as developing as washing machine, vacuum cleaner, braking system ex. In fuzzy logic approach, on the contrary of Aristotelian view, it is not only taken care white and black colors but also grey tones as well. Fuzzy logic approach is similar with human conception system. From this point of view, triangular fuzzy numbers are taken in consideration with the triangle in reel numbers. In this way, fuzzy numbers are an extension of real numbers. Triangle structure creates the fuzzy numbers as lower to upper that every number has three elements. First of them expresses lower value, second one indicates the middle value (optimal), and the last one is related with the upper value[6]. AHP is one of the popular multiple-criteria-decision making method but it is not useful for the decision on uncertain times. AHP and fuzzy approach has been combined and Fuzzy AHP is show up. Decision-makers allows the discrete analysis more confidential than making the definite assessment [7]. At this point, the structure of triangular fuzzy number system is used for establishing the fuzzy numbers [8]. A fuzzy number is presented as $\tilde{A}$ and $\mu\tilde{A}(x)$: R-> [0,1] is shown as (1):

$$ma = \begin{cases} (x-l)/(m-l, & l \le x \le m \\ (u-x)/(u-m), & m \le x \le u \\ 0, & otherwise \end{cases} \quad (1)$$

From (1), l and u mean the lower and upper bounds of the fuzzy number $\tilde{A}$,and m is the modal value for $\tilde{A}$. The TFN can be denoted $\tilde{A}$ = (l, m, u). The operational laws of TFN $\tilde{A}1$ = (l_1, m1, u1) and $\tilde{A}2$ = (l_2, m_2, u_2) are displayed in (2)-(6). Addition of the fuzzy number:

$$\tilde{A}_1 + \tilde{A}_2 = (l_1 + l_2,\ m_1 + m_2,\ u_1 + u_2) \quad (2)$$

Multiplication of the fuzzy number:

$$\tilde{A}_1 x \tilde{A}_2 = (l_1 l_2,\ m_1 m_2,\ u_1 u_2) \quad l_1, l_2, m_1, m_2, u_1, u_2 > 0 \quad (3)$$

Subtraction of the fuzzy number:

$$\tilde{A}_1 - \tilde{A}_2 = (l_1 - u_2,\ m_1 - m_2,\ u_1 - l_2) \quad (4)$$

Division of the fuzzy number:

$$\tilde{A}_1 / \tilde{A}_2 = (l_1 / u_2,\ m_1 / m_2,\ u_1 / l_2) \quad l_1, l_2 > 0,\ m_1, m_2 > 0,\ u_1, u_2 > 0 \quad (5)$$

Reciprocal of the fuzzy number:

$$\tilde{A}_1 - 1 = (l_1, m_1, u_1) - 1 = (1/u_1,\ 1/m_1,\ 1/l_1) \quad l_1,\ l_2 > 0,\ m_1, m_2 > 0,\ u_1, u_2 > 0 \quad (6)$$

where, each membership function (scale of fuzzy number) is characterized by three parameters [9].

TABLE I
Membership Function of Linguistic Scale (Example)

Fuzzy Number	Linguistic	Scale of fuzzy number
9	Perfect	(8,9,10)
8	Absolute	(7,8,9)
7	Very good	(6,7,8)
6	Fairly good	(5,6,7)
5	Good	(4,5,6)
4	Preferable	(3,4,5)
3	Not bad	(2,3,4)
2	Weak advantage	(1,2,3)
1	Equal	(1,1,1)

AHP application including fuzzy logic is expressed in two steps given below:

Step 1: Create pairs of comparison matrices between all elements in the dimensions of the hierarchy system. Assign the linguistic terms to pairwise comparison by asking which of the two dimensions is more important, as the following matrix $\tilde{A}$ [7]. The comparison matrix is given (7):

$$\tilde{A} = \begin{bmatrix} 1 & \tilde{a}_{12} & \cdots & \tilde{a}_{1n} \\ \tilde{a}_{21} & 1 & \cdots & \tilde{a}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{a}_{n1} & \tilde{a}_{n2} & \cdots & 1 \end{bmatrix} = \begin{bmatrix} 1 & \tilde{a}_{12} & \cdots & \tilde{a}_{1n} \\ 1/\tilde{a}_{12} & 1 & \cdots & \tilde{a}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/\tilde{a}_{1n} & 1/\tilde{a}_{2n} & \cdots & 1 \end{bmatrix} \quad (7)$$

$$\tilde{a}_{ij} = \begin{cases} \tilde{9}^{-1}, \tilde{8}^{-1} \cdots \tilde{3}^{-1}, \tilde{2}^{-1}, \tilde{1}^{-1}, \tilde{1}, \tilde{2}, \tilde{3} \cdots \tilde{8}, \tilde{9}, & i \ne j \\ 1 & i = j \end{cases} \quad (8)$$

Step 2: The technique of using geometric mean technique to define the fuzzy geometric mean and fuzzy weights of each criterion is presented as (9) [6]:

$$\tilde{r}_i = \left(\tilde{a}_{i1} \otimes \cdots \otimes \tilde{a}_{ij} \otimes \cdots \otimes \tilde{a}_{in}\right)^{1/n} \quad \tilde{w}_i = \tilde{r}_i \otimes \left[\tilde{r}_1 \otimes \cdots \otimes \tilde{r}_i \otimes \cdots \otimes \tilde{r}_n\right]^{-1} \quad (9)$$

where, $\tilde{a}_{ij}$ is the fuzzy comparison value of dimension i according to criterion j, and $\tilde{r}_i$ is the geometric mean of the fuzzy comparison value of criterion i according to each criterion, thus $\tilde{w}_i = (lw_i, mw_i, uw_i)$ is the fuzzy weight of the ith criterion, can be indicated by a TFN. The lw_i, mw_i and uw_i represent the lower, middle, and upper values of the fuzzy weight of the ith dimension [9]. Based on these values, importance levels were determined using the fuzzy AHP method [10], [11].

IV. Determination of Criteria of Performance System Within Supply Chain Structure

Existence of different departments and fields within the supply chain structures of companies causes emergence of complex systems. Herein, design and establishment of general performance evaluation system of current supply chain structure become helpful to reveal healthy both departmental and individual performance system. Through our current application, generating supply chain evaluation system is aimed at and herein, job definitions processes of production planning, stock management and purchasing department which are under supply chain roof are examined. At the end of related interpretations, it is considered to determinate departmental basis performance evaluation criteria for supply chain departments. In this sense, business processes for each department are presented in a table and corresponding employees of an automotive sub-industry firm are wanted to evaluate comparatively these business processes.

TABLE II
Production Planning, Stock Management and Purchasing Business Processes

Numbers	Definition of Responsibilities
	Production Planning
1	Daily production planning
2	Monthly production planning
3	Completing unfinished products to end products
4	Revision of production planning on sudden times
5	Making requirement list as to production quantities
6	Work and time study analysis
7	Development studies of the workstation
8	Preparing reports related with the production management
	Stock (Inventory) Management
1	Keeping updated inventory datas
2	Storing the materials and products on efficient racks
3	Controlling of stock availability as to received materials requirement list from production planning and determination of the purchasing list
4	Determination of the damaged parts while unloading the shipments
5	Making analysis for damaged parts and drawbacks to suppliers (if any drawbakcs)
6	Determination of internal rate of waste (Number of damaged parts from materials acceptance to warehouse to production)
7	Preparing the reports related with the stock management
	Purchasing
1	Making orders on time as to materials requirement list received from stock management
2	Receiving shipments with the ordered quantities on time
3	Preparing the purchasing agreements with the related suppliers
4	Making researches on alternative suppliers
5	Organizations for supplier audits
6	Building filling system for the related suppliers
7	Planning logistic operations for the related shipments
8	Preparing the reports related with the purchasing deparment

Concerned evaluators evaluated business processes for each department by giving points between 1 and 9 (equal importance degree-outstandingly). Production planning, stock management and purchasing business processes are given in Table II. After performed analysis, the most important three business process criteria per each department were determined and these criteria are considered as founder components of performance evaluation system to be generated in the future. On the other hand, evaluators (six evaluators) also made evaluations about determination of criteria revealing common performance structure of three departments and generated infrastructure of performance evaluation system of supply chain structure including these three departments. Herein, evaluators evaluated criteria they supposed as important within three departments comparatively through 1-9 range grading and determined three of them which are the most important.

V. Application of Fuzzy AHP Method

In our applied study by using Fuzzy AHP method, determination of both departmental basis performance evaluation criteria and general supply chain performance evaluation criteria are aimed. Here in studies conducted are separated into two parts on the basis of department and group:

A. Determination of Departmental Performance Evaluation Criteria

In the stage of determination of departmental performance evaluation criteria, production planning, stock management and purchasing departments' business processes of Arkpres Seat Belt Ind. were examined and concerning department employees were wanted to evaluate importance degrees of business processes. In the conclusion of comparative situation assessment done, production planning, stock management and purchasing departments' performance evaluation criteria were determined and ordered according to order of importance degree. (Within the scope of situation assessment done, evaluators evaluated criteria comparatively one-to-one and replied on the basis of linguistic concepts from 1 to 9. These concepts are converted to fuzzy number scale by considering Fig. 1.)

1. Determination of Production Planning Department Performance Evaluation Criteria

Interpretations and grading were made by production planning employee and specific evaluators about comparative performance evaluation criteria. Herein, evaluation tables are presented in APPENDIXES. Within the scope of study done, each criterion evaluated by six evaluators were calculated depending (10).

$$\tilde{a}_{ij} = (\tilde{a}_{ij}^{1} \otimes \tilde{a}_{ij}^{2} \otimes \cdots \otimes \tilde{a}_{ij}^{10}) \quad (10)$$

Comparison matrix was generated in this way (as in Fig. 1). In order to determinate fuzzy weight values, operations depending (11) were done and r values were calculated.

$$\tilde{r}_i = (\tilde{a}_{i1} \otimes \cdots \otimes \tilde{a}_{ij} \otimes \cdots \otimes \tilde{a}_{in})^{1/n} \quad (11)$$

	a1	a2	a3	a4	a5	a6	a7	a8
a1	(1,1,1)	(6.76,7.78,8.49)	(3.78,4.83,5.87)	(2.67,3.78,4.83)	(1.90,2.67,3.36)	(5.87,6.90,7.78)	(5.87,6.90,7.78)	(1.12,1.34,1.51)
a2	(0.11,0.12,0.14)	(1,1,1)	(2.67,3.78,4.83)	(1.90,2.67,3.36)	(5.87,6.90,7.78)	(4.83,5.87,6.90)	(4.83,5.87,6.90)	(1.12,1.51,1.81)
a3	(0.17,0.20,0.26)	(0.20,0.26,0.37)	(1,1,1)	(3.78,4.83,5.87)	(1.34,1.90,2.38)	(5.87,6.90,7.78)	(5.87,6.90,7.78)	(5.23,6.33,7.27)
a4	(0.20,0.26,0.37)	(0.30,0.37,0.52)	(0.25,0.29,0.37)	(1,1,1)	(1.34,1.90,2.38)	(5.87,6.90,7.78)	(5.87,6.90,7.78)	(4.83,5.87,6.90)
a5	(0.30,0.37,0.52)	(0.13,0.14,0.17)	(0.26,0.33,0.47)	(0.41,0.52,0.74)	(1,1,1)	(5.87,6.90,7.78)	(6.76,7.78,8.49)	(5.07,6.09,7.11)
a6	(0.12,0.14,0.17)	(0.14,0.17,0.20)	(0.24,0.28,0.33)	(0.12,0.14,0.17)	(0.12,0.14,0.17)	(1,1,1)	(5.87,6.90,7.78)	(6.09,7.11,7.99)
a7	(0.21,0.24,0.28)	(0.14,0.17,0.20)	(0.12,0.14,0.17)	(0.12,0.14,0.17)	(0.11,0.12,0.14)	(0.12,0.14,0.17)	(1,1,1)	(5.27,6.28,7.30)
a8	(0.42,0.45,0.52)	(0.33,0.38,0.49)	(0.14,0.16,0.19)	(0.13,0.15,0.18)	(0.13,0.15,0.18)	(0.12,0.14,0.16)	(0.13,0.15,0.18)	(1,1,1)

Fig. 1 Comparison matrix table of production planning

In the stage of determination of performance importance levels of criteria, it is necessary to calculate firstly w values, and then BNP values. These calculation operations were calculated by considering (12):

$$\tilde{w}_i = \tilde{r}_i \otimes \left[\tilde{r}_1 \otimes \cdots \otimes \tilde{r}_i \otimes \cdots \otimes \tilde{r}_n\right]^{-1} \quad (12)$$

TABLE III
"R" VALUE TABLE OF PRODUCTION PLANNING CRITERIA

r1	2,904	3,537	4,067
r2	1,762	2,157	2,520
r3	1,553	1,875	2,228
r4	1,182	1,408	1,707
r5	0,986	1,157	1,403
r6	0,478	0,540	0,618
r7	0,283	0,318	0,365
r8	0,224	0,250	0,292
rtop	9,372	11,242	13,200

TABLE IV
"W" VALUE TABLE OF PRODUCTION PLANNING CRITERIA

w1	0,310	0,315	0,308
w2	0,188	0,192	0,191
w3	0,166	0,167	0,169
w4	0,126	0,125	0,129
w5	0,105	0,103	0,106
w6	0,051	0,048	0,047
w7	0,030	0,028	0,028
w8	0,024	0,022	0,022

$$BNP_{w_1} = \left[\left(U_{w_1} - L_{w_1}\right) + \left(M_{w_1} - L_{w_1}\right)\right] / 3 + L_{w_1} \quad (13)$$

TABLE V
BNP VALUE TABLE OF PRODUCTION PLANNING CRITERIA

Criterion	U	L	M	U-L	M-L	BNP
1	0,315	0,308	0,310	0,007	0,002	0,311
2	0,192	0,188	0,191	0,004	0,003	0,190
3	0,169	0,166	0,167	0,003	0,001	0,167
4	0,129	0,125	0,126	0,004	0,001	0,127
5	0,106	0,103	0,105	0,003	0,002	0,105
6	0,051	0,047	0,048	0,004	0,001	0,049
7	0,030	0,028	0,028	0,003	0,001	0,029
8	0,024	0,022	0,022	0,002	1E-04	0,023

Dependently this table, because the first three criteria (1st, 2nd and 3rd criteria) got the highest BNP value, it can be expressed that these are the most important performance evaluation criteria.

2. Determination of Stock Management Department Performance Evaluation Criteria

Interpretations and grading were made by stock management employee and specific evaluators about comparative performance evaluation criteria. At this point, evaluation tables are presented in Appendixes. Within the scope of study done, each criterion evaluated by six evaluators were calculated depending formulation and the last BNP Values are given in Table VI.

TABLE VI
BNP VALUE TABLE OF STOCK MANAGEMENT CRITERIA

Criterion	U	L	M	U-L	M-L	BNP
1	0,501	0,461	0,487	0,040	0,027	0,483
2	0,173	0,144	0,160	0,029	0,017	0,159
3	0,167	0,163	0,166	0,004	0,002	0,165
4	0,087	0,083	0,084	0,004	0,000	0,085
5	0,054	0,051	0,051	0,003	0,000	0,052
6	0,038	0,036	0,036	0,003	0,001	0,037
7	0,020	0,019	0,019	0,001	0,001	0,019

Dependently this table, because the first three criteria (1st, 3rd and 2nd criteria) got the highest BNP value, it can be expressed that these are the most important performance evaluation criteria.

3. Determination of Purchasing Management Department Performance Evaluation Criteria

Interpretations and grading were made by stock management employee and specific evaluators about comparative performance evaluation criteria. At this point, evaluation tables are presented in Appendixes. Within the scope of study done, each criterion evaluated by six evaluators were calculated depending formulation and the last BNP Value Table is given in Table VII. Dependently this table, because the first three criteria (1st, 2nd and 3rd criteria) got the highest BNP value, it can be expressed that these are the most important performance evaluation criteria.

B. Determination of Supply Chain Performance Evaluation Criteria

In the stage of determination of supply chain performance evaluation criteria, production planning, stock management and purchasing departments' business processes of Arkpres Safe Belt Ind. and Tra. IC. Corporation were examined and concerning department employees were wanted to evaluate importance degrees of business processes by interpreting business processes comprehensively in the aspect of three departments.

In the conclusion of comparative situation assessment done, supply chain performance criteria including all of production planning, stock management and purchasing departments were determined and criteria were ordered according to their importance degree. (Within the scope of situation assessment done, evaluators evaluated criteria comparatively one-to-one and replied on the basis of linguistic concepts from 1 to 9. These concepts are converted to fuzzy number scale by considering Fig. 2.)

TABLE VII
BNP VALUE TABLE OF PURCHASING MANAGEMENT CRITERIA

Criterion	U	L	M	U-L	M-L	BNP
1	0,425	0,412	0,424	0,012	0,012	0,420
2	0,258	0,248	0,253	0,010	0,006	0,253
3	0,129	0,127	0,127	0,002	0,000	0,128
4	0,059	0,052	0,055	0,007	0,003	0,055
5	0,060	0,057	0,058	0,003	0,000	0,058
6	0,037	0,033	0,035	0,004	0,001	0,035
7	0,035	0,030	0,031	0,004	0,001	0,032
8	0,020	0,018	0,018	0,002	0,000	0,019

1. Determination of Supply Chain Performance Evaluation Criteria for Production Planning Department

Interpretations and grading were made by production planning employee and specific evaluators about comparative performance evaluation criteria. Herein, evaluation tables are presented in Appendixes. Within the scope of study done, each criterion evaluated by six evaluators were calculated depending (14) and (15), and comparison matrix was generated from (16):

$$\tilde{a}_{ij} = (\tilde{a}_{ij}^{1} \otimes \tilde{a}_{ij}^{2} \otimes \cdots \otimes \tilde{a}_{ij}^{10}) \tag{14}$$

$$\tilde{a}_{ij} = \begin{cases} \tilde{9}^{-1}, \tilde{8}^{-1} \cdots \tilde{3}^{-1}, \tilde{2}^{-1}, \tilde{1}^{-1}, \tilde{1}, \tilde{2}, \tilde{3} \cdots \tilde{8}, \tilde{9}, & i \neq j \\ 1 & i = j \end{cases} \tag{15}$$

Comparison matrix was generated in Fig. 2. In order to determinate fuzzy weight values, operations depending (16) were done and r values were calculated.

$$\tilde{r}_i = (\tilde{a}_{i1} \otimes \cdots \otimes \tilde{a}_{ij} \otimes \cdots \otimes \tilde{a}_{in})^{1/n} \tag{16}$$

In the stage of determination of performance importance levels of criteria, it is necessary to calculate firstly w values, and then BNP values. These calculation operations were calculated by considering (17) and (18):

$$\tilde{w}_i = \tilde{r}_i \otimes \left[\tilde{r}_1 \otimes \cdots \otimes \tilde{r}_i \otimes \cdots \otimes \tilde{r}_n\right]^{-1} \tag{17}$$

$$BNP_{w_i} = \left[\left(U_{w_i} - L_{w_i}\right) + \left(M_{w_i} - L_{w_i}\right)\right] / 3 + L_{w_i} \tag{18}$$

Dependently this table, because the first three criteria (1st, 2nd and 3rd criteria) got the highest BNP value, it can be say that these are the most important performance evaluation criteria.

	a1	a2	a3	a4	a5	a6	a7	a8
a1	(1,1,1)	(6.77,7.79,8.50)	(2.67,3.78,4.84)	(2.67,3.78,4.84)	(3.78,4.84,5.88)	(5.88,6.90,7.79)	(5.88,6.90,7.79)	(2.67,3.78,4.84)
a2	(0.12,0.13,0.15)	(1,1,1)	(2.67,3.78,4.84)	(2.67,3.78,4.84)	(5.88,6.90,7.79)	(4.84,5.88,6.90)	(4.84,5.88,6.90)	(1.91,2.67,3.37)
a3	(0.21,0.26,0.37)	(0.21,0.26,0.37)	(1,1,1)	(3.78,4.84,5.88)	(1.91,2.67,3.37)	(5.88,6.90,7.79)	(5.88,6.90,7.79)	(5.88,6.90,7.79)
a4	(0.21,0.26,0.37)	(0.21,0.26,0.37)	(0.18,0.21,0.26)	(1,1,1)	(3.78,4.84,5.88)	(5.88,6.90,7.79)	(5.88,6.90,7.79)	(4.84,5.88,6.90)
a5	(0.18,0.21,0.26)	(0.13,0.14,0.17)	(0.31,0.37,0.52)	(0.18,0.21,0.26)	(1,1,1)	(5.88,6.90,7.79)	(5.88,6.90,7.79)	(4.84,5.88,6.90)
a6	(0.13,0.14,0.17)	(0.14,0.17,0.21)	(0.13,0.15,0.17)	(0.13,0.15,0.17)	(0.13,0.15,0.17)	(1,1,1)	(5.88,6.90,7.79)	(5.88,6.90,7.79)
a7	(0.13,0.14,0.17)	(0.14,0.17,0.21)	(0.13,0.15,0.17)	(0.13,0.15,0.17)	(0.13,0.15,0.17)	(0.13,0.14,0.17)	(1,1,1)	(3.78,4.84,5.88)
a8	(0.21,0.26,0.37)	(0.31,0.37,0.52)	(0.13,0.15,0.17)	(0.15,0.17,0.21)	(0.14,0.17,0.21)	(0.13,0.14,0.17)	(0.18,0.21,0.26)	(1,1,1)

Fig. 2 Comparison matrix of production planning in supply chain

TABLE VIII
"R" VALUES OF PRODUCTION PLANNING CRITERIA IN SUPPLY CHAIN SYSTEM

r1	3,376	4,202	4,920
r2	1,963	2,418	2,848
r3	1,682	2,038	2,451
r4	1,218	1,450	1,756
r5	0,820	0,947	1,127
r6	0,438	0,494	0,566
r7	0,257	0,292	0,339
r8	0,211	0,244	0,299
rtop	9,967	12,086	14,304

TABLE IX
"W" VALUES OF PRODUCTION PLANNING CRITERIA IN SUPPLY CHAIN SYSTEM

w1	0,339	0,348	0,344
w2	0,197	0,200	0,199
w3	0,169	0,169	0,171
w4	0,122	0,120	0,123
w5	0,082	0,078	0,079
w6	0,044	0,041	0,040
w7	0,026	0,024	0,024
w8	0,021	0,020	0,021

TABLE X
BNP VALUES OF PRODUCTION PLANNING CRITERIA IN SUPPLY CHAIN

Criterion	U	L	M	U-L	M-L	BNP
1	0,348	0,339	0,344	0,009	0,005	0,343
2	0,200	0,197	0,199	0,003	0,002	0,199
3	0,171	0,169	0,169	0,003	0,000	0,170
4	0,123	0,12	0,122	0,003	0,002	0,122
5	0,082	0,078	0,079	0,004	0,000	0,080
6	0,044	0,04	0,041	0,004	0,001	0,041
7	0,026	0,024	0,024	0,002	0,000	0,025
8	0,021	0,02	0,021	0,001	0,001	0,021

2. Determination of Supply Chain Performance Evaluation Criteria for Stock Management Department

Interpretations and grading were made by production planning employee and specific evaluators about comparative performance evaluation criteria. Herein, evaluation tables are presented in Appendixes. Within the scope of study done, each criterion evaluated by six evaluators were calculated depending formulation and the last BNP Value Table is given in Table XI.

TABLE XI
BNP VALUES OF STOCK MANAGEMENT CRITERIA IN SUPPLY CHAIN SYSTEM

Criterion	U	L	M	U-L	M-L	BNP
1	0,411	0,4	0,410	0,010	0,010	0,407
2	0,072	0,066	0,068	0,006	0,003	0,069
3	0,223	0,217	0,221	0,005	0,004	0,220
4	0,118	0,114	0,115	0,004	0,001	0,116
5	0,134	0,129	0,130	0,005	0,001	0,131
6	0,033	0,032	0,033	0,001	0,001	0,033
7	0,025	0,024	0,024	0,001	0,001	0,024

Dependently this table, because the first three criteria (1st, 3rd and 5th criteria) got the highest BNP value, it can be expressed that these are the most important performance evaluation criteria.

3. Determination of Supply Chain Performance Evaluation Criteria for Purchasing Department

Interpretations and grading were made by production planning employee and specific evaluators about comparative performance evaluation criteria. Herein, evaluation tables are presented in Appendixes. Within the scope of study done, each criterion evaluated by six evaluators were calculated depending formulation and the last BNP Value Table is given in Table XII.

TABLE XII
BNP VALUE TABLE OF PURCHASING DEPARTMENT CRITERIA IN SUPPLY CHAIN SYSTEM

Criterion	U	L	M	U-L	M-L	BNP
1	0,402	0,391	0,400	0,011	0,010	0,398
2	0,233	0,224	0,230	0,008	0,006	0,229
3	0,121	0,117	0,118	0,004	0,001	0,118
4	0,042	0,039	0,040	0,003	0,001	0,040
5	0,040	0,037	0,038	0,002	0,001	0,038
6	0,029	0,027	0,027	0,002	0,000	0,028
7	0,135	0,125	0,126	0,010	0,001	0,129
8	0,021	0,019	0,019	0,002	0,000	0,020

Dependently this table, because the first three criteria (1st, 2nd and 7th criteria) got the highest BNP value, it can be expressed that these are the most important performance evaluation criteria.

VI. APPLICATION ANALYSIS AND EVALUATIONS

In the conclusion of application study for determination of performance evaluation criteria, common performance main criteria of evaluation system were determined for both related operation departments (production planning, stock management, and purchasing) and supply chain structure. Herein, fuzzy AHP method was used and weight values of performance criteria were determined.

Concerning method started with comparing current criteria one-to-one done by entrepreneurship employees and independent evaluators (6 people). Evaluators compared concerning performance criteria and evaluated with linguistics statements. They matched concerning linguistics statements with numbers between 1 and 9 and generated comparison matrix. Generated matrix was converted to fuzzy AHP structure within fuzzy number scale.

TABLE XIII
PERFORMANCE CRITERIA FOR PRODUCTION PLANNING

No	Criteria	Weight	BNP	Ranking
1	Daily production planning	(0.308,0.310,0.315)	0,311	1
2	Monthly production planning	(0.188,0.191,0.192)	0,190	2
3	Completing unfinished products to end products	(0.166,0.167,0.169)	0,167	3
4	Revision of production planning on sudden times	(0.125,0.126,0.129)	0,127	4
5	Making requirement list as to production quantities	(0.103,0.105,0.106)	0,105	5
6	Work and time study analysis	(0.047,0.048,0.051)	0,049	6
7	Development studies of the workstation	(0.028,0.028,0.030)	0,029	7
8	Preparing reports related with the production management	(0.022,0.022,0.024)	0,023	8

TABLE XIV
PERFORMANCE CRITERIA FOR STOCK MANAGEMENT

No	Criteria	Weight	BNP	Ranking
1	Keeping updated inventory data	(0.461,0.487,0.501)	0,483	1
2	Storing the materials and products on efficient racks	(0.144,0.160,0.173)	0,159	3
3	Controlling of stock availability as to received materials requirement list from production planning and determination of the purchasing list	(0.163,0.166,0.167)	0,165	2
4	Determination of the damaged parts while unloading the shipments	(0.083,0.084,0.087)	0,085	4
5	Making analysis for damaged parts and drawbacks to suppliers (if any drawbacks)	(0.051,0.051,0.054)	0,052	5
6	Determination of internal rate of waste	(0.036,0.036,0.038)	0,037	6
7	Preparing the reports related with the stock management	(0.019,0.019,0.020)	0,019	7

TABLE XV
PERFORMANCE CRITERIA FOR PURCHASING DEPARTMENT

No	Criteria	Weight	BNP	Ranking
1	Making orders on time as to materials requirement list received from stock management	(0.412,0.424,0.425)	0,420	1
2	Receiving shipments with the ordered quantities on time	(0.248,0.253,0.258)	0,253	2
3	Preparing the purchasing agreements with the related suppliers	(0.127,0.127,0.129)	0,128	3
4	Making researches on alternative suppliers	(0.052,0.055,0.059)	0,055	5
5	Organizations for supplier audits	(0.057,0.058,0.060)	0,058	4
6	Building filling system for the related suppliers	(0.033,0.035,0.037)	0,035	6
7	Planning logistic operations for the related shipments	(0.030,0.031,0.035)	0,032	7
8	Preparing the reports related with the purchasing department	(0.018,0.018,0.020)	0,019	8

Application was practiced for determination of concerning business departments and supply chain structure performance evaluation criteria. In the conclusion of analysis and

evaluations made, performance evaluation criteria tables of firm's production planning-stock management and purchasing departments are given in Table XIII.

For production planning department, performance evaluation criteria were determined and 0.311 BNP value "Daily production planning flow determination" activity was determined as the most important performance evaluation criteria. On the other hand, "Monthly production planning flow determination" and "completing incomplete products to end products" activities were determined as 2nd and 3rd performance evaluation criteria according to their importance order.

For stock management department, performance evaluation criteria were determined and 0.483 BNP value "Keeping correct and updated stock data" activity was determined as the most important performance evaluation criteria. On the other hand, "Control of state of stocks according to material requirement list coming from PP and determination of list to be sent to purchasing" and "storing stock materials within right and efficient shelf system" activities were determined as 2nd and 3rd performance evaluation criteria according to their importance order.

For purchasing department, performance evaluation criteria were determined and 0.420 BNP value "Placing order on time according to material requirement list coming from stock management" activity was determined as the most important performance evaluation criteria. On the other hand, "Taking delivery sufficiently and on time according to material requirement list" and "making purchasing contracts with concerning suppliers at affordable prices" activities were determined as 2nd and 3rd performance evaluation criteria according to their importance order.

In the 2nd part of application study, general supply chain performance evaluation criteria were determined for supply chain structure. Herein, evaluators made interpretations for determination of criteria to measure general performance of three departments (production planning-stock management and purchasing) and determined performance evaluation criteria for their own departments within supply chain structure. Performance evaluation criteria tables of concerning production planning-stock management and purchasing departments are given in Table XVI.

TABLE XVI
PERFORMANCE CRITERIA FOR PRODUCTION PLANNING IN SUPPLY CHAIN

No	Criteria	Weight	BNP	Ranking
1	Daily production planning	(0.339,0.344,0.348)	0,343	1
2	Monthly production planning	(0.197,0.199,0.200)	0,199	2
3	Completing unfinished products to end products	(0.169,0.169,0.171)	0,170	3
4	Revision of production planning on sudden times	(0.120,0.122,0.123)	0,122	4
5	Making requirement list as to production quantities	(0.078,0.079,0.082)	0,080	5
6	Work and time study analysis	(0.040,0.041,0.044)	0,041	6
7	Development studies of the workstation	(0.024,0.024,0.026)	0,025	7
8	Preparing reports related with the production management	(0.020,0.021,0.021)	0,021	8

TABLE XVII
PERFORMANCE CRITERIA FOR STOCK MANAGEMENT IN SUPPLY CHAIN

No	Criteria	Weight	BNP	Ranking
1	Keeping updated inventory data	(0.400,0.410,0.411)	0,407	1
2	Storing the materials and products on efficient racks	(0,066,0,068,0.072)	0,069	5
3	Controlling of stock availability as to received materials requirement list from production planning and determination of the purchasing list	(0,217,0.221,0.223)	0,220	2
4	Determination of the damaged parts while unloading the shipments	(0,114,0.115,0.118)	0,116	4
5	Making analysis for damaged parts and drawbacks to suppliers(if any drawbacks)	(0.129,0.130,0.134)	0,131	3
6	Determination of internal rate of waste	(0.032,0.032,0.033)	0,033	6
7	Preparing the reports related with the stock management	(0.024,0.024,0.025)	0,024	7

TABLE XVIII
PERFORMANCE CRITERIA FOR PURCHASING DEPARTMENT IN SUPPLY CHAIN

No	Criteria	Weight	BNP	Ranking
1	Making orders on time as to materials requirement list received from stock management	(0.391,0.400,0.402)	0,398	1
2	Receiving shipments with the ordered quantities on time	(0.224,0.230,0.233)	0,229	2
3	Preparing the purchasing agreements with the related suppliers	(0.117,0.118,0.121)	0,118	4
4	Making researches on alternative suppliers	(0.039,0.040,0.042)	0,040	5
5	Organizations for supplier audits	(0.037,0.038,0.040)	0,038	6
6	Building filling system for the related suppliers	(0.027,0.027,0.029)	0,028	7
7	Planning logistic operations for the related shipments	(0.125,0.126,0.135)	0,129	3
8	Preparing the reports related with the purchasing department	(0.019,0.019,0.021)	0,020	8

For production planning department supply chain structure, performance evaluation criteria were determined and 0.343 BNP value "Daily production planning flow determination" activity was determined as the most important performance evaluation criteria. On the other hand, "Monthly production planning flow determination" and "completing incomplete products to end products" activities were determined as 2nd and 3rd performance evaluation criteria according to their importance order. For stock management department supply chain structure, performance evaluation criteria were determined and 0.407 BNP value "Keeping correct and updated stock data" activity was determined as the most important performance evaluation criteria. On the other hand, "Control of state of stocks according to material requirement list coming from PP and determination of list to be sent to purchasing" and "Situation analysis for damaged piece group determined in the course of delivery and to return to supplier (in the case of return to supplier)" activities were determined as 2nd and 3rd performance evaluation criteria according to their importance order. It was seen that BNP value of "Detection of damaged piece group in the course of delivery" activity is near to BNP point of 3rd criteria. In this sense, it is considered that these two criteria have proximate importance and this criterion can also be included in performance evaluation criteria structure.

TABLE XIX
EVALUATOR TABLE OF PRODUCTION PLANNING

	1	2	3	4	5	6	7	8
1	*	8	5	4	3	7	7	1
2	8*	*	4	3	7	6	6	1
3	5*	4*	*	5	2	7	7	7
4	4*	3*	5*	*	2	7	7	6
5	3*	7*	2*	2*	*	7	8	6
6	7*	6*	7*	7*	7*	*	7	7
7	7*	6*	7*	7*	8*	7*	*	6
8	1	1	7*	6*	6*	7*	6*	*
1	*	7	4	3	2	6	6	1
2	7*	*	3	2	6	5	5	1
3	4*	3*	*	4	1	6	6	6
4	3*	2*	1	*	1	6	6	5
5	2*	6*	6*	1	*	6	7	5
6	6*	5*	5*	6*	6*	*	6	6
7	6*	5*	6*	6*	7*	6*	*	5
8	5*	6*	6*	7*	6*	6*	5*	*
1	*	9	6	5	4	8	8	2
2	9*	*	5	4	8	7	7	2
3	6*	5*	*	6	3	8	8	8
4	5*	4*	3*	*	3	8	8	7
5	4*	7*	7*	3*	*	8	9	7
6	8*	7*	6	8*	8*	*	8	8
7	8*	7*	8*	8*	9*	8*	*	7
8	7*	8*	8*	9*	8*	8*	7*	*
1	*	6	3	2	1	5	5	1
2	6*	*	2	1	5	4	4	2
3	3*	2*	*	3	1	5	5	3
4	2*	1*	3*	*	1	5	5	4
5	1*	5*	1*	1*	*	5	6	5
6	5*	4*	5*	5*	5*	*	5	6
7	5	4*	5*	5*	6*	5*	*	6
8	1*	2*	3*	4*	5*	6*	6*	*
1	*	8	5	4	3	7	7	1
2	8*	*	4	3	7	6	6	1
3	5*	4*	*	5	2	7	7	7
4	4*	3*	5*	*	2	7	7	6
5	3*	7*	2*	2*	*	7	8	6
6	7*	6*	7*	7*	7*	*	7	7
7	7*	6*	7*	7*	8*	7*	*	6
8	1	1	7*	6*	6*	7*	6*	*
1	*	9	7	6	5	9	9	3
2	9*	*	6	5	9	8	8	3
3	7*	6*	*	7	4	9	9	9
4	6*	5*	7*	*	4	9	9	8
5	5*	9*	4*	4*	*	9	9	8
6	9*	8*	9*	9*	9*	*	9	9
7	9*	8*	9*	9*	9*	9*	*	8
8	3*	3*	8*	8*	8*	9*	8*	*

For purchasing department supply chain structure, performance evaluation criteria were determined and 0.398 BNP value "Placing order on time according to material requirement list coming from stock management" activity was determined as the most important performance evaluation criteria. On the other hand, "Taking delivery sufficiently and on time according to material requirement list" and "organizing logistics for concerning deliveries under favourable conditions(time-price)" activities were determined as 2nd and 3rd performance evaluation criteria according to their importance order.

TABLE XX
EVALUATOR TABLE OF INVENTORY MANAGEMENT

	1	2	3	4	5	6	7
1	*	8	9	9	9	9	6
2	8*	*	3	4	4	4	4
3	9*	3*	*	7	8	7	5
4	9*	4*	7*	*	5	5	7
5	9*	4*	8*	5*	*	4	7
6	9*	4*	7*	5*	4*	*	8
7	9*	4*	5*	7*	7*	8*	*
1	*	9	9	9	9	9	7
2	9*	*	4	5	5	5	5
3	9*	4*	*	8	9	8	6
4	9*	5*	8*	*	6	6	8
5	9*	5*	9*	6*	*	5	8
6	9*	5*	8*	6*	5*	*	9
7	7*	5*	6*	8*	8*	9*	*
1	*	7	8	8	8	8	5
2	7*	*	2	3	3	3	3
3	8*	2*	*	6	7	6	4
4	8*	3*	6*	*	4	4	6
5	8*	3*	7*	4*	*	3	6
6	8*	3*	6*	4*	3*	*	7
7	5*	3*	4*	6*	6*	7*	*
1	*	8	9	9	9	9	6
2	8*	*	3	4	4	4	4
3	9*	3*	*	7	8	7	5
4	9*	4*	7*	*	5	5	7
5	9*	4*	8*	5*	*	4	7
6	9*	4*	7*	5*	4*	*	8
7	9*	4*	5*	7*	7*	8*	*
1	*	9	9	9	9	9	8
2	9*	*	5	6	6	6	6
3	9*	5*	*	9	9	9	7
4	9*	6*	9*	*	7	7	9
5	9*	6*	9*	7*	*	6	9
6	9*	6*	9*	7*	6*	*	9
7	8*	6*	7*	9*	9*	9*	*
1	*	6	7	7	7	7	4
2	6*	*	1	2	2	2	2
3	7*	1*	*	5	6	5	3
4	7*	2*	5*	*	3	3	5
5	7*	2*	6*	3*	*	2	5
6	7*	2*	5*	3*	2*	*	6
7	4*	2*	3*	5*	5*	6*	*

VII. CONCLUSION

In this study, performance evaluation system and its importance were examined. The criteria were recorded according to their weights with the help of Fuzzy AHP approach and top three performance criteria of each department were established. In accordance with attained results, it was determined that performance evaluation criteria for production planning department can be used effectively for establishment of supplier chain performance evaluation

system. Herein, planning production effectively and completing incomplete products to end products are considered as the most important criteria for continuity of production and keeping sale assurances of the firm.

TABLE XXI
EVALUATOR TABLE OF PURCHASING

	1	2	3	4	5	6	7	8
1	*	9	9	9	9	7	6	6
2	9*	*	9	9	9	7	6	7
3	9*	9*	*	7	8	6	7	3
4	9*	9*	7*	*	3	3	2	4
5	9*	9*	8*	3*	*	8	4	7
6	7*	7*	6*	3*	8*	*	4	4
7	6*	6*	7*	2*	4*	4*	*	7
8	6*	7*	3*	4*	7*	4*	7*	*
1	*	9	9	9	9	8	7	7
2	9*	*	9	9	9	8	7	8
3	9*	9*	*	8	9	7	8	4
4	9*	9*	8*	*	4	4	3	5
5	9*	9*	9*	4*	*	9	5	8
6	8*	8*	7*	4*	9*	*	5	5
7	7*	7*	8*	3*	5*	5*	*	8
8	7*	8*	4*	5*	8*	5*	8*	*
1	*	8	8	8	8	6	5	5
2	8*	*	8	8	8	6	5	6
3	8*	8*	*	6	7	5	6	2
4	8*	8*	6*	*	2	2	1	3
5	8*	8*	7*	2*	*	7	3	6
6	6*	6*	5*	2*	7*	*	3	3
7	5*	5*	6*	1*	3*	3*	*	6
8	5*	6*	2*	3*	6*	3*	6*	*
1	*	9	9	9	9	7	6	6
2	9*	*	9	9	9	7	6	7
3	9*	9*	*	7	8	6	7	3
4	9*	9*	7*	*	3	3	2	4
5	9*	9*	8*	3*	*	8	4	7
6	7*	7*	6*	3*	8*	*	4	4
7	6*	6*	7*	2*	4*	4*	*	7
8	6*	7*	3*	4*	7*	4*	7*	*
1	*	9	9	9	9	9	8	8
2	9*	*	9	9	9	9	8	9
3	9*	9*	*	9	9	8	9	5
4	9*	9*	9*	*	5	5	4	6
5	9*	9*	9*	5*	*	9	6	9
6	9*	9*	9*	5*	9*	*	6	6
7	8*	8*	9*	4*	6*	6*	*	9
8	8*	9*	5*	6*	9*	6*	9*	*
1	*	7	7	7	7	5	4	4
2	7*	*	7	7	7	5	4	5
3	7*	7*	*	5	6	4	5	1
4	7*	7*	5*	*	1	1	1	2
5	7*	7*	6*	1*	*	6	2	5
6	5*	5*	4*	1*	6*	*	2	2
7	4*	4*	5*	1*	2*	2*	*	5
8	4*	5*	1*	2*	5*	2*	5*	*

On the other hand, for stock management performance evaluation, being correct and updated of stock values and evaluating data coming from production planning are important for presenting requirement list to purchasing. And although shelf array criteria of stocks were detected as stock management performance criteria, in the aspect of general supply chain performance, it could not be placed in the first three orders for general supply chain performance evaluation criteria because detection of damaged piece group in the course of delivery is more crucial for all of production planning, stock management and purchasing departments.

TABLE XXII
EVALUATOR TABLE OF PRODUCTION PLANNING-SUPPLY CHAIN

	1	2	3	4	5	6	7	8
1	*	8	4	4	5	7	7	4
2	8*	*	4	4	7	6	6	3
3	4*	4*	*	5	3	7	7	7
4	4*	4*	5*	*	5	7	7	6
5	5*	7*	3*	5*	*	7	7	6
6	7*	6*	7*	7*	7*	*	7	7
7	7*	6*	7*	7*	7*	7*	*	5
8	4*	3*	7*	6*	6*	7*	5*	*
1	*	9	5	5	6	8	8	5
2	9*	*	5	5	8	7	7	4
3	5*	5*	*	6	4	8	8	8
4	5*	5*	6*	*	6	8	8	7
5	6*	8*	4*	6*	*	8	8	7
6	8*	7*	8*	8*	8*	*	8	8
7	8*	7*	8*	8*	8*	8*	*	6
8	5*	4*	8*	7*	7*	8*	6*	*
1	*	7	3	3	4	6	6	3
2	7*	*	3	3	6	5	5	2
3	3*	3*	*	4	2	6	6	6
4	3*	3*	4*	*	4	6	6	5
5	4*	6*	2*	4*	*	6	6	5
6	6*	5*	6*	6*	6*	*	6	6
7	6*	5*	6*	6*	6*	6*	*	4
8	3*	2*	6*	5*	5*	6*	4*	*
1	*	8	4	4	5	7	7	4
2	8*	*	4	4	7	6	6	3
3	4*	4*	*	5	3	7	7	7
4	4*	4*	5*	*	5	7	7	6
5	5*	7*	3*	5*	*	7	7	6
6	7*	6*	7*	7*	7*	*	7	7
7	7*	6*	7*	7*	7*	7*	*	5
8	4*	3*	7*	6*	6*	7*	5*	*
1	*	9	6	6	7	9	9	6
2	9*	*	6	6	9	8	8	5
3	6*	6*	*	7	5	9	9	9
4	6*	6*	7*	*	7	9	9	8
5	7*	9*	5*	7*	*	9	9	8
6	9*	8*	9*	9*	9*	*	9	9
7	9*	8*	9*	9*	9*	9*	*	7
8	6*	5*	9*	8*	8*	9*	7*	*
1	*	6	2	2	3	5	5	2
2	6*	*	2	2	5	4	4	1
3	2*	2*	*	3	1	5	5	5
4	2*	2*	3*	*	3	5	5	4
5	3*	5*	1*	3*	*	5	5	4
6	5*	4*	5*	5*	5*	*	5	5
7	5*	4*	5*	5*	5*	5*	*	3
8	2*	1*	5*	4*	4*	5*	3*	*

Finally, for purchasing department performance evaluation, placing order on time and taking delivery on required amount and on time are first two criteria for both purchasing department and supply chain performance evaluation system criteria. Because organizing logistics criteria is also important for regularity of applications, it is considered as 3rd important criteria for supply chain performance evaluation system by evaluators.

TABLE XXIII
EVALUATOR TABLE OF INVENTORY MANAGEMENT AND SUPPLY CHAIN

	1	2	3	4	5	6	7
1	*	8	9	6	3	7	6
2	8*	*	5*	2	5*	3	4
3	9*	5	*	8	2	8	6
4	6*	2*	8*	*	5	5	6
5	3*	5	2*	5*	*	7	8
6	7*	3*	8*	5*	7*	*	3
7	6*	4*	6*	6*	8*	3*	*
1	*	9	9	7	4	8	7
2	9*	*	6*	3	6*	4	5
3	9*	6	*	9	3	9	7
4	6	3	9*	*	6	6	7
5	4*	6	3*	6*	*	8	9
6	8*	4*	9*	6*	8*	*	4
7	7*	5*	7*	7*	9*	4*	*
1	*	7	8	5	2	6	5
2	7*	*	4*	1	4*	2	3
3	8*	4	*	7	1	7	5
4	5*	1*	7*	*	4	4	5
5	2*	4	1*	4*	*	6	7
6	6*	2*	7*	4*	6*	*	2
7	3*	3*	5*	5*	7*	2*	*
1	*	8	9	6	3	7	6
2	8*	*	5*	2	5*	3	4
3	9*	5	*	8	2	8	6
4	6*	2*	8*	*	5	5	6
5	3*	5	2*	5*	*	7	8
6	7*	3*	8*	5*	7*	*	3
7	6*	4*	6*	6*	8*	3*	*
1	*	9	9	8	5	9	8
2	9*	*	7*	4	7*	5	6
3	9*	7	*	9	4	9	8
4	8*	4*	9*	*	7	7	8
5	5*	7	4*	7*	*	9	9
6	9*	5*	9*	7*	9*	*	5
7	8*	6*	8*	8*	9*	5*	*
1	*	6	7	4	1	5	4
2	6*	*	3*	1	3*	1	2
3	7*	3	*	6	1	6	4
4	4*	1*	6*	*	3	3	4
5	1*	3	1*	3*	*	5	6
6	5*	1*	6*	3*	5*	*	1
7	4*	2*	4*	4*	6*	1*	*

TABLE XXIV
EVALUATOR TABLE OF PURCHASING-SUPPLY CHAIN

	1	2	3	4	5	6	7	8
1	*	9	9	9	9	7	4	6
2	9*	*	9	9	9	7	3	7
3	9*	9*	*	7	8	6	4	3
4	9*	9*	7*	*	3	3	7*	4
5	9*	9*	8*	3*	*	8	8*	7
6	7*	7*	6*	3*	8	*	8*	4
7	4*	3*	4*	7	8	8	*	7
8	6*	7*	3*	4*	7*	4*	7*	*
1	*	9	9	9	9	8	5	7
2	9*	*	9	9	9	8	4	8
3	9*	9*	*	8	9	7	5	4
4	9*	9*	8*	*	4	4	9*	5
5	9*	9*	9*	4*	*	9	9*	8
6	8*	8*	7*	4*	9*	*	9*	5
7	5*	4*	5*	9	9	9	*	8
8	7*	8*	4*	5*	8*	5	8*	*
1	*	8	8	8	8	6	3	5
2	8*	*	8	8	8	6	2	6
3	8*	8*	*	6	7	5	3	2
4	8*	8*	6*	*	2	2	6*	3
5	8*	8*	7*	2*	*	7	7*	6
6	6*	6*	5*	2*	7*	*	7*	3
7	3*	2*	3*	6	7	7	*	6
8	5*	6*	2*	3*	6*	3*	6*	*
1	*	9	9	9	9	7	4	6
2	9*	*	9	9	9	7	3	7
3	9*	9*	*	7	8	6	4	3
4	9*	9*	7*	*	3	3	7*	4
5	9*	9*	8*	3*	*	8	8*	7
6	7*	7*	6*	3*	8	*	8*	4
7	4*	3*	4*	7	8	8	*	7
8	6*	7*	3*	4*	7*	4*	7*	*
1	*	9	9	9	9	9	6	8
2	9*	*	9	9	9	9	5	9
3	9*	9*	*	9	9	8	6	5
4	9*	9*	9*	*	5	5	8*	6
5	9*	9*	9*	5*	*	9	9*	9
6	9*	9*	8*	5*	9*	*	9*	6
7	6*	5*	6*	8	9	9	*	9
8	8*	9*	5*	6*	9*	6*	9*	*
1	*	7	7	7	7	5	2	4
2	7*	*	7	7	7	5	1	5
3	7*	7*	*	5	6	4	2	1
4	7*	7*	5*	*	1	1	5*	2
5	7*	7*	6*	1*	*	6	6*	5
6	5*	5*	4*	1*	6*	*	6*	2
7	2*	1*	2*	5	6	6	*	5
8	4*	5*	1*	2*	5*	2*	5*	*

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