

CONSTRUCTION OF BALANCED SCORECARD USING ANALYTIC HIERARCHY PROCESS

Yrd. Doç. Dr. Nesrin ALPTEKİN¹

Abstract

The purpose of this paper is to demonstrate the usage of Analytic Hierarchy Process in choosing performance criteria of the balanced scorecard considering firms' differentiation strategies. The balanced scorecard is a strategic planning and management system which is aligning firms' activities and strategies, and is aimed to continually improve strategic performance. Analytic Hierarchy Process is a multi-criteria decision method including qualitative factors in addition to quantitative factors in a decision process. In this paper, it is mentioned that how can be choosing performance criteria constructing the balanced scorecard as the firms' strategic performance measurement tool by using Analytic Hierarchy Process and it is explained by an illustrative example.

Key Words: *Analytic Hierarchy Process, Balanced Scorecard, Strategic Management*

ANALİTİK HİYERARŞİ SÜRECİ KULLANILARAK KURUMSAL KARNENİN OLUŞTURULMASI

Özet

Bu çalışmanın amacı firmaların değişen stratejilerine göre kurumsal karnenin performans ölçütlerinin seçiminde Analitik Hiyerarşi Süreci'nin kullanımını göstermektir. Kurumsal karne firmaların faaliyetleriyle stratejilerini uyumlu hale getiren ve stratejik performansı sürekli olarak geliştirmeyi amaçlayan bir stratejik planlama ve yönetim sistemidir. Nicel faktörlerin yanı sıra nitel faktörlerin de karar sürecine dahil edildiği Analitik Hiyerarşi Süreci çok kriterli bir karar verme metodudur. Bu çalışmada, firmaların

¹ Anadolu Üniversitesi, İktisadi ve İdari Bilimler Fakültesi, İşletme Bölümü, nesrinesen@anadolu.edu.tr

bir stratejik performans ölçüm aracı olarak kurumsal karne oluşturmada performans ölçütlerinin nasıl seçileceği Analitik Hiyerarşi Süreci kullanılarak ele alınmış ve bir örnek yardımıyla açıklanmıştır.

***Anahtar Kelimeler:** Analitik Hiyerarşi Süreci, Kurumsal Karne, Stratejik Yönetim*

1. Introduction

In today's highly competitive business environment, availability of the right information at the right time for both decision making and performance evaluation has become a critical need for firms. Firms are shaped by their performance measures. Traditional performance measures are financial and they tend to be short-term oriented. The financial indicators are only a part of the whole system of a firm. A popular performance measurement scheme suggested by Kaplan and Norton (1992), is the balanced scorecard that incorporates non-financial metrics in an organization's performance reporting and rewarding systems.

Balanced scorecard does not only denote that the strategic management based on financial indicators, but also it includes three different dimensions which integrated with financial indicators. The beauty of the balanced scorecard is that it seeks for a balance between financial and non-financial measures². Financial indicators generally catch up the past results of the firm and they are called trace indicators by the balanced scorecard approach. When the managers make their decisions just based on these indicators, cause and result relations are ignored, and financial indicators based decisions hinder to forecasting of the future. Therefore, fateful pioneering indicators like, customer satisfaction, capabilities of employees and their creativity power must be considered. In the balanced scorecard approach, there are financial, internal business process, customers and, learning and growth perspectives.

Financial dimension of the balanced scorecard includes long term objectives of the firm and it tries to provide expectations like profitability and growth of firm's partners. Customer dimension is a measure of that how firm's products and services meet the customers' needs. Internal business process dimension is related with firm's internal operations. Firm's techniques and methods of developing product and service distribution take place in this dimension. Learning and growth dimension of the balanced scorecard includes employee training and corporate cultural attitudes related to both individual and corporate self-improvement and knowledge sharing³.

² M. H. Sohn, T. You, Seok-Lyong Lee and H. Lee, "Corporate Strategies, environmental forces, and performance measures: a weighting decision support system using the k-nearest neighbor technique", **Expert Systems with Applications**, 25, (2003), pp.279-292.

³ R. Kaplan and D. Norton, "Using the Balanced Scorecard as a Strategic Management System", **Harvard Business Review**, Jan.-Feb., (1996), pp.75-85.

In recent years, the balanced scorecard has grown into a tool used as a basis for developing a strategic management system. It also allows firms to set visibly their strategies and it is a strategic control system which enables feedback.

Usage purposes of the balanced scorecard are;

- Clarifying and focusing of the strategies,
- Distributing the strategies into firm,
- Gathering information to develop the strategies,
- Associating the strategies with long-term goals,
- Periodically evaluating performance and strategies,
- Associating individual goals with departmental goals.

Since the development of the balanced scorecard by Kaplan and Norton, firms have implemented the balanced scorecard with mixed results. Main difficulty of the firms about implementing of the balanced scorecard lies with the process of choosing the proper metrics and using them appropriately⁴.

Kaplan and Norton pointed out that success in using the balanced scorecard is highly related on the ability of the chosen metrics to encourage action and appropriate change for the firm. In successive usage of the balanced scorecard by the firms, tying the metrics to strategy is very important. By now, different methods of employing the balanced scorecard are used to clarify and update strategy, to align organization an individual goals, and to learn about and improve strategy. These methods originate from diversity in choosing metrics. In implementing and using the balanced scorecard, the most important problem is that how should a firm choose the metrics to use in each of the four dimensions?

Determining which metrics to use in a balanced scorecard requires selecting the set of metrics for each of the four areas. This can be done by the Analytic Hierarchy Process. Analytic hierarchy process (hereafter, AHP) uses a hierarchical approach to organize data for proper decision making. This method is easy to implement, simple to understand and able to provide requirements of metric choice and scorecard construction. It is based on the well-defined mathematical structure of consistent matrices and their associated right eigenvector's ability to generate true or approximate weights⁵.

To do so, the AHP uses a fundamental scale of absolute numbers that has been proven in practice and validated by physical and decision problem experiments. The fundamental scale has been shown to be a scale that captures individual preferences with respect to quantitative and qualitative attributes just as well or better than other scales. It converts individual preferences into ratio scale weights that can be combined into a linear additive weight $w(a)$ for each alternative a .

⁴ B. Douglas Clinton, Sally A. Webber and John M. Hassell "Implementing Balanced Scorecard Using Analytic Hierarchy Process", **Management Accounting Quarterly**, 3, No. 3, pp. 1-11.

⁵ B. Douglas Clinton, Sally A. Webber and John M. Hassell ; pp. 1-11.

The AHP focuses on making a series of simple paired comparisons. These comparisons are used to compute the relative importance of items in a hierarchy. The AHP can help managers or decision makers understand which metrics are more important than the others and derive weights of relative importance for both perspectives and metrics.

At the beginning of the AHP using, metrics are chosen and after that process, it is revealed their relative importance to a firm's managers and employees. Once the metrics are chosen, a balanced scorecard hierarchy is established. This hierarchy should be revised during the strategic planning process.

2. Balanced Scorecard and Metrics

The balanced scorecard is a strategic planning and management system (not only a measurement system) that is used extensively in business and industry, government, and nonprofit organizations worldwide to align business activities to the vision and strategy of the organization, improve internal and external communications, and monitor organization performance against strategic goals. It provides feedback around both the internal business processes and external outcomes in order to continuously improve strategic performance and results.

This new approach to strategic management was first detailed in a series of articles and books by Kaplan and Norton. Kaplan and Norton describe the innovation of the balanced scorecard as follows:

"The balanced scorecard retains traditional financial measures. But financial measures tell the story of past events, an adequate story for industrial age firms for which investments in long-term capabilities and customer relationships were not critical for success. These financial measures are inadequate, however, for guiding and evaluating the journey that information age firms must make to create future value through investment in customers, suppliers, employees, processes, technology, and innovation."

The beauty of the balanced scorecard is that it seeks for a balance between financial and non-financial measures. The balanced scorecard defines the firm's long-term strategy in terms of specific, measurable goals in different areas of management (financial, customer, internal business, innovation and learning). Because the goals are long-term, management must be willing to change their focus from short-term, usually financial, objectives. The balanced scorecard allows managers to look at the business from the four perspectives as illustrated in Figure 1.

Customer perspective enables firms to align their core customer outcome measures to targeted customers and market segments. It also enables them to identify and measure, explicitly, the value propositions they will deliver to targeted customers and market segment. Many firms today have a mission focused on the customer and how a firm is performing from its customers' perspective has become a priority for top management. The balanced scorecard demands that managers translate their general mission statement on customer service into specific measures that reflect the factors that really matter to customers.

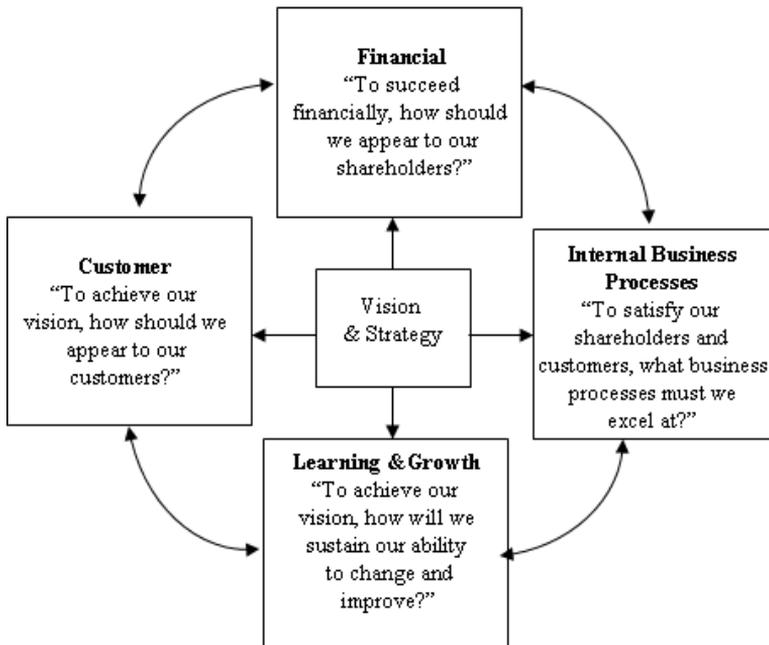
The learning and growth perspective defines the intangible assets needed to enable organizational activities and customer relationships to be performed at ever-higher levels of

performance. It also includes employee training and corporate cultural attitudes related to both individual and corporate self-improvement.

Kaplan and Norton emphasize that 'learning' is more than 'training'; it also includes things like mentors and tutors within the organization, as well as that ease of communication among workers that allows them to readily get help on a problem when it is needed.

Internal business process perspective covers statements about the scope, equipment and efficiency of the business activities. Metrics based on this perspective allow the managers to know how well their business is running, and whether its products and services conform to customer requirements. These metrics have to be carefully designed by those who know these processes most intimately; with our unique missions these are not something that can be developed by outside consultants.

Fig. 1 Translating Vision and Strategy: Four Perspectives



Source: Kaplan and Norton (1996), pp.76

Kaplan and Norton do not disregard the traditional need for financial data. Timely and accurate funding data will always be a priority, and managers will do whatever necessary to provide it. In fact, often there is more than enough handling and processing of financial data. There is perhaps a need to include additional financial-related data, such as risk assessment and cost-benefit data, in financial perspective.

3. Analytic Hierarchy Process (AHP)

The Analytic hierarchy process was developed by Thomas L. Saaty in 1970's. It is a multi-criteria decision method that allows subjective as well as objective factors to be considered in the evaluation process and it uses hierarchical structures to solve complicated, unstructured decision problems, especially in situations where there are important qualitative aspects that must be considered in conjunction with various measurable quantitative factors. The AHP methodology compares criteria, or alternatives with respect to a criterion, in a pair wise mode. The major characteristic of AHP is that breaking a complex system into a set of pairwise comparisons. These comparisons are used to compute the relative importance of items in a hierarchy.

AHP is fairly easy to use and is flexible enough to permit the decision maker to consider multiple viewpoints and multiple attributes that may be qualitative and quantitative in nature.

Using AHP in solving a decision problem involves four fundamental principles; decomposition, pairwise comparison, synthesis of priorities and aggregating the relative weights of decision elements. These principles also compose steps of AHP. Decomposition principle is perhaps the most important aspect of AHP. The decision analyst should break down the decision problem into a hierarchy of interrelated decision elements. A hierarchy is structured from the top level (objectives), through intermediate levels which contains attributes. Details of these attributes increase at the lower levels of the hierarchy. The last levels of the hierarchy contain decision alternatives of selection choices⁶.

Paired comparison judgments in the AHP are applied to pairs of homogeneous elements. Thomas Saaty, the developer of AHP, recommends a one-to-nine ratio scale when deciding between the two alternatives. The fundamental scale of values to represent the intensities of judgments is shown in Table 1.

When compared with itself, each element has equal importance. Diagonal elements of the comparisons matrix always equal one, and lower triangle elements of the matrix are the reciprocal of upper triangle elements.

⁶ F. Zahedi, "The Analytic Hierarchy Process- A Survey of the Method and its Applications", **Interfaces**, 16, No.4, pp.96-108.

Table 1. The Fundamental Scale

Intensity of Importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Weak importance of one over another	Experience and judgment slightly favor one activity over another
5	Essential or strong importance	Experience and judgment strongly favor one activity over another
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance is demonstrated in practice
9	Absolute importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values	When compromise is needed between adjacent scale values

Source: Saaty, (1980), pp.54

Synthesis of priorities covers the computing of relative weights of elements at each level. In this stage, the eigen-value method is used to estimate the relative weights of the decision elements.

In order to produce a vector of composite weights which serve as ratings of decision alternatives in achieving the most general objective of the problem, relative weights of decision elements are aggregated. These composite weights may also be called decision alternatives scores and they form the basis for selecting an alternative.

AHP is founded on the following set of axioms for deriving a scale from fundamental measurements and for hierarchical composition.

Axiom 1: (Reciprocal Comparison). If element A is x times as important than element B, than element B is $1/x$ times as important then elements A.

Axiom 2: (Homogeneity). Only comparable elements are compared. Homogeneity is essential for comparing similar things, as errors in judgment become large when comparing widely disparate elements.

Axiom 3: (Independence). The relative importance of elements at any level does not depend on what elements are included at a lower level.

Axiom 4: (Expectation). The hierarchy must be complete and include all the criteria and alternatives in the subject being studied. No criteria and alternatives are left out and no excess criteria and alternatives are included.

AHP methodology steps are as follows:

1. The main goal or objective is identified, and the issue is clearly defined.
2. After construction of the objective, the criteria used to satisfy the overall goal are identified. Then for specifying of a suitable solution, the sub-criteria under each criterion must be identified. The hierarchical structure is made.
3. Elements of the problem are paired with respect to their common relative impact on a property and then compared. Therefore pair wise comparisons are constructed.
4. Eigenvalue method is used to estimate the weights of the decision elements. Consistency of judgments is checked.
5. Moving downward through the hierarchy, hierarchical structure is used to combine the weight vectors and arrive at global and local relative priorities of each element.

Pair wise comparisons among n elements in each level lead to an approximation of each $a_{ij} = w_i/w_j$ which is the ratio of the weight of element i to element j . The estimated weight vector w is found by solving the following eigenvector problem: $Aw = \lambda_{max}w$, where the matrix A consists of a_{ij} 's, and λ_{max} is the principal eigenvalue of A . If there is no inconsistency between a pair of elements, then a_{ij} is equal to $1/a_{ji}$ for any i and j . The result is that $\lambda_{max} = n$ and we have, $Aw = nw$, where n is the number of elements in each row. Written out more fully this matrix equation looks as follows:

$$\begin{bmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & \dots & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & \frac{w_2}{w_2} & \dots & \frac{w_2}{w_n} \\ \frac{w_3}{w_1} & \frac{w_3}{w_2} & \dots & \frac{w_3}{w_n} \\ \vdots & \vdots & \ddots & \vdots \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \dots & \frac{w_n}{w_n} \end{bmatrix} \cdot \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix} = n \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix}$$

or

$$\begin{bmatrix} 1 & a_{12} & \dots & a_{1n} \\ a_{21} & 1 & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & 1 \end{bmatrix} \cdot \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix} = \lambda_{max} \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix}$$

To calculate the w vector (also called the eigenvector) each column of A is first normalized and then averaged over its rows. This vector is used to find the relative importance of each element. Observe that since small changes in a_{ij} imply a small change in λ_{\max} , the deviation of the latter from n (the number of elements in a row) is a measure of consistency. The consistency ratio (CR) is given by $(\lambda_{\max} - n)/(n-1)$, which is the variance of the error incurred in estimating the matrix A . If the value of CR is less or equal to 0.10, the pairwise comparisons are considered to be acceptable. Otherwise, the problem and the judgments must be reinvestigated and revise in order to resolve the inconsistencies⁷.

4. AHP and Constructing Balanced Scorecard

In the constructing of balanced scorecard using AHP task, the first level of the hierarchy contains the four balanced scorecard perspectives. The second level of the hierarchy contains the metrics that are used to measure performance for each of the four categories⁸.

The AHP can be used two steps to complement a balanced scorecard:

- At the beginning of the process, to help choose metrics,
- After the metrics are chosen, to help understand their relative importance to a firm's managers and employees.

Determining which metrics to use in a balanced scorecard requires selecting the set of metrics for each of the four perspectives: customer, financial, internal business process, and innovation and learning. In metrics choosing process, participants should be encouraged to brainstorm and use their experiences and expertise to identify all possible metrics in four perspectives. After identifying the set of all possible metrics, the next step is to reduce to list to a smaller number of metrics. If possible, all participants should discuss which metrics are most important⁹.

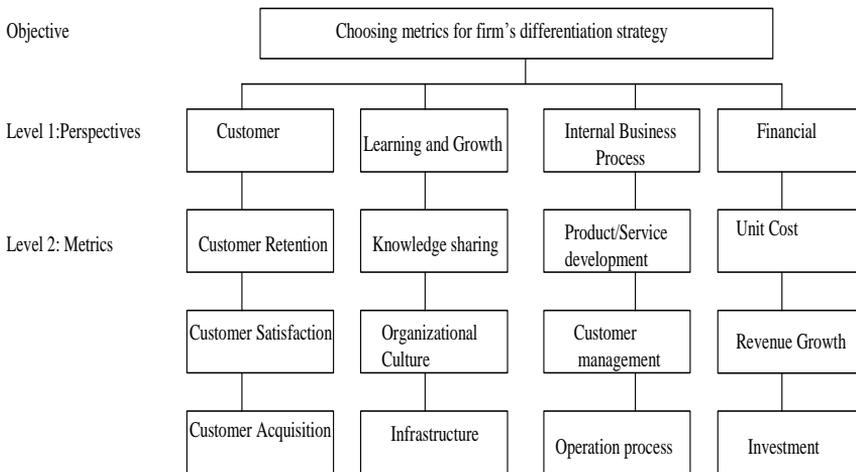
Once the balanced scorecard metrics are chosen, a balanced scorecard hierarchy is established. The first level of the hierarchy contains the four balanced scorecard categories. In the second level of the hierarchy, there should be the metrics that are used to measure performance for each of the four categories. In Figure 2, a hypothetical structure of a balanced scorecard using the AHP is illustrated. In first level, four perspectives of BSC are listed. Metrics of perspectives are given in second level.

⁷T. L. Saaty. *The Analytic Hierarchy Process*. (McGraw-Hill: New York, 1980), pp.12.

⁸B. Douglas Clinton, Sally A. Webber and John M. Hassell ; pp.1-11.

⁹B. Douglas Clinton, Sally A. Webber and John M. Hassell ; pp. 1-11.

Fig.2 Balanced Scorecard Hierarchy



AHP is used to compute decision weights of relative importance for each perspective in step one. The first decision is to select which of the two perspectives is considered to be more important in the BSC. The degree of the importance is measured in the nine-point scale (fundamental scale) which is shown in Table 1. For example, customer perspective is three times more important than the financial perspective. An illustration of the paired comparison process for level one is presented in Table 2. According to Table 2, the most important perspective is innovation and learning (%46), followed by customer (%31), with internal business process (%12) and financial (%11). Consistency ratio of pairwise comparisons matrix is 0.076 means that these comparisons are acceptable.

In second level that identifying the relative importance of the metrics for respective scorecard perspectives, the process is same to that used for level one. Paired comparisons are made between all combinations of three metrics proposed within each BSC perspective. The number of metrics can change across perspectives. Limiting my choices to three metrics for each perspective is just for convenience in using small number of paired comparisons in my illustration. For firms already using BCS, their existing list of metrics can be used. Paired comparisons of metrics are given in Table 3.

Table 2. Pairwise Comparison Matrix of BSC Four Perspectives

Criteria	Customer	Learning and Growth	Internal Business Process	Financial	Performance Scores	Consistency Measures
Customer	1	1/2	4	3	0,31	4,3239
Learning and Growth	2	1	5	3	0,46	4,3089
Internal Business Process	1/4	1/5	1	2	0,12	4,1156
Financial	1/3	1/3	1/2	1	0,11	4,0696

(Consistency Ratio: 0,076)

Table 3. Pairwise Comparison Matrices of Metrics

	CR	CS	CA
CR	1	1/3	2
CS	3	1	1/2
CA	1/2	2	1

(CR: Customer Retention, CS: Customer Satisfaction, CA: Customer Acquisition)

	KC	OC	INF
KS	1	1/3	1
OC	3	1	1/3
INF	1	3	1

(KC: Knowledge Sharing, OC: Organizational Culture, INF: Infrastructure)

	PD	CM	OP
PD	1	3	1/3
CM	1/3	1	2
OP	3	1/2	1

(PD: Product/Service development, CM: Customer Management, OP: Operation Process)

	UC	RG	INV
UC	1	1/3	1/2
RG	3	1	1/3
INV	2	3	1

(UC: Unit Cost, RG: Revenue Growth, INV: Investment)

Table 4. Overall Performance of Balanced Scorecard

Balanced Scorecard		
<i>Objective : Choosing Metrics for Firm's Differentiation Strategy</i>		
Perspectives and Metrics	Level One*Level Two	Global Outcome
Customer		
Customer Retention	(0.30 x 0.31)	0.0930
Customer Satisfaction	(0.37 x 0.31)	0.1147
Customer Acquisition	(0.33 x 0.31)	0.1023
		Total: 0.31
Learning and Growth		
Knowledge Sharing	(0.24 x 0.46)	0.1104
Organizational Culture	(0.32 x 0.46)	0.1472
Infrastructure	(0.44 x 0.46)	0.2024
		Total: 0.46
Internal Business Process		
Product/Service Development	(0.33 x 0.12)	0.0396
Customer Management	(0.30 x 0.12)	0.0360
Operation Process	(0.37 x 0.12)	0.0444
		Total: 0.12
Financial		
Unit Cost	(0.17 x 0.11)	0.0187
Revenue Growth	(0.30 x 0.11)	0.0330
Investment	(0.53 x 0.11)	0.0583
		Total: 0.11

Finally, AHP computes overall performances of BSC perspectives and metrics. These values are listed in Table 4. According to Table 4, the most important metric is infrastructure and the least important metric is unit cost.

5. Conclusion

The BSC is a very effective multi-attribute evaluation framework for firms. It employs performance metrics from financial, customer, internal business process and, learning and growth. This set of measures is designed to capture the firm's desired business strategy. Use of the BSC should improve managerial decision making by aligning performance measures with the goals and the strategies of the firm and the firm's business units.

In this paper, AHP is used to construct the BSC by aligning performance measures with goals of firms. AHP is a multi-criteria decision method that allows qualitative judgments as well as quantitative ones in decision making process.

In illustrative example, it is showed how AHP is employed of constructing the BSC. In this example, performance metrics or perspectives' relative importance weights are calculated. Then, relative importance of each metrics in perspectives is calculated. It is found that the most important perspective is "learning and growth" and the most important metric is infrastructure.

AHP is a powerful and simple tool for BSC metrics, so it can be quickly and easily updated as firms' desired direction.

REFERENCES

- ACZEL, J. and SAATY, T., “The Theory of Ratio Scale Estimation: Saaty’s Analytic Hierarchy Process”, **Management Science**, 1983, Vol.33, No.11, pp. 1383-1403.
- BAGCHI, P. and RAO, R. P., “Decision Making in Mergers: An Application of the Analytic Hierarchy Process”, **Managerial and Decision Economics**, 1992, Vol.13, pp.91-99.
- BANKER, D. R., CHANG, H., JANAKIRAMAN, Surya N., and KONSTANS, C. , “A balanced scorecard analysis of performance metrics”, **European Journal of Operational Research**, 2004, Vol.154, pp.423-436.
- CHOW, C.W., HADDAD K.M. and WILLIAMSON, J.E., “Applying the Balanced Scorecard to Small Firms”, **Management Accounting**, 1997, Vol. 79, No.2, pp.21-27.
- CLINTON, B. Douglas, WEBBER, Sally A. and HASSELL, John M. (2002), “Implementing Balanced Scorecard Using Analytic Hierarchy Process”, **Management Accounting Quarterly**, 2002, Vol.3, No.3, pp.1-11.
- DIGUERA, J., GRECO S. and EHRGOTT M. Edt., **Multiple Criteria Decision Analysis**, Springer, USA, 2005.
- HASTINGS, S., “A Strategy Evaluation Model for Management”, **Management Decision**, 1996, Vol. 34, No.1, pp.25-34.
- HUNJAK, T., “Mathematical Foundations of the Methods for Multicriterial Decision Making”, **Mathematical Communications**, 1997, Vol. 2, pp.161-169.
- KAPLAN, R. and NORTON D., “Using the Balanced Scorecard as a Strategic Management System”, **Harvard Business Review**, Jan.-Feb., 1996, pp.75-85.
- KAPLAN, R. and NORTON D., “**The Balanced Scorecard: Translating Strategy into Action**”, Harvard Business School Press, Boston, 1996.
- KAPLAN, R. and NORTON D., “Why Does Business Need a Balanced Scorecard?” , **Journal of Cost Management**, 1997, May-June, pp.5-10.
- KURUÜZÜM, A. and ATSAN, N., “Analitik Hiyerarşi Yöntemi ve İşletmecilik Alanındaki Uygulamaları”, **Akdeniz İ.İ.B.F Dergisi**, 2001, Vol.1, pp. 83-105.
- LIPE, M. G. and SALTERIO, S.E., “The Balanced Scorecard: Judgmental Effects of Common and Unique Performance Measures”, **Accounting Review**, Vol.75, No.3, 2000, pp. 283-298.
- MILLET, I., “Ethical Decision Making Using the Analytic Hierarchy Process”, **Journal of Business Ethics**, 17, 1998, pp.1197-1204.

-
- PARLOS, P.M. Ed., **Multi-Criteria Decision Making Methods: A Comparative Study**, First Ed. Kluwer Academic Pubs., USA, 2000.
- POMEROL, J. C. and ROMERO, S. B., **Multicriterion Decision in Management : Principles and Practice**, First Ed. Kluwer Academic Pubs., USA, 2000.
- SAATY, T. L., **The Analytic Hierarchy Process**, McGraw-Hill, New York, 1980.
- SAATY, T.L. and VARGAS, L.G., **Models, Methods, Concepts and Applications of the Analytic Hierarchy Process**, First Ed. Springer, USA, 2000.
- SEARCY, D.L., “Aligning the Balanced Scorecard and a Firm’s Strategy Using the Analytic Hierarchy Process”, **Management Accounting Quarterly**, Vol.5, No.4, 2004, pp. 1-10.
- SOHN, M. H., YOU, T., LEE, Seok-Lyong and LEE, H., “Corporate Strategies, environmental forces, and performance measures: a weighting decision support system using the k-nearest neighbor technique”, **Expert Systems with Applications**, 25, 2003, pp. 279-292.
- UZOKA, F. M., “AHP-based System for Strategic Evaluation of Financial Information”, **Information Knowledge Systems Management**, 5, 2005, pp. 49-61.
- ZAHEDI, F., “The Analytic Hierarchy Process- A Survey of the Method and its Applications”, **Interfaces**, Vol.16, No.4, 1986, pp. 96-108.
- ZOPOUNIDIS, C. and DOUMPOS, M., “Multi-criteria Decision Aid in Financial Decision Making: Methodologies and Literature Review”, **Journal of Multi-Criteria Decision Analysis**, 11, 2002, pp.167-186.