



**TÜRKİYE CUMHURİYETİ
ADANA ALPARSLAN TÜRKER SCIENCE AND TECHNOLOGY
UNIVERSITY**

**GRADUATE SCHOOL
INDUSTRIAL ENGINEERING DEPARTMENT**

**AN INTEGRATED ANALYTIC HIERARCHY PROCESS-BALANCED
SCORECARD MODEL FOR EVALUATING KEY PERFORMANCE
INDICATORS: A CASE STUDY**

MELEK YAĞMUR YILMAZ

M.Sc.



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**THESIS ADVISOR
ASSOC. PROF. DR. AYŞE TUĞBA DOSDOĞRU**

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CERTIFICATION OF APPROVAL

(AN INTEGRATED ANALYTIC HIERARCHY PROCESS-BALANCED SCORECARD MODEL FOR EVALUATING KEY PERFORMANCE INDICATORS: A CASE STUDY)

This **M.Sc.** thesis, completed under the conditions determined by the relevant regulations, by **Melek Yağmur Yılmaz** with student number 19500701008 in **Adana Alparslan Türkeş Science and Technology University Institute of Graduate School Industrial Engineering Department**, has been evaluated by the following academic committee, and approved in accordance with the relevant articles of the "Adana Alparslan Türkeş Science and Technology University Graduate Education Regulations".

Prof. Dr. Ahmet Beycioğlu

Institute of Graduate School Manager

Prof. Dr. Neşe Yalçın

Head of the Department

Assoc. Prof. Dr. Ayşe Tuğba Dosdoğru

Academic Advisor

Thesis Advisory Committee Members

Assoc. Prof. Dr. Ayşe Tuğba Dosdoğru

Adana Alparslan Türkeş Science and Technology University

Assoc. Prof. Dr. Mustafa Göçken

Adana Alparslan Türkeş Science and
Technology University

Assoc. Prof. Dr. Behiye Gülsün Nakıboğlu

Çukurova University

Thesis Defence Date

14/04/2023

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In this thesis study, which was prepared following the thesis writing rules of Adana Alparslan Türkeş Science and Technology University Institute of Graduate School, I declare that I provide all the information, documents, evaluations and results in accordance with scientific ethics and moral codes without resorting to any means or assistance that would be contrary to scientific ethics and traditions. I also declare that I refer to all of the articles I used in this study with appropriate references and accept all moral and legal consequences if a situation is found contrary to my statement regarding my work.

14/04/2023

[Signature]

Melek YAĞMUR YILMAZ

ÖZET

ANAHTAR PERFORMANS GÖSTERGELERİNİ DEĞERLENDİRMEK İÇİN ENTEĞRE BİR ANALİTİK HİYERARŞİ SÜRECİ-KURUMSAL KARNE MODELİ: BİR UYGULAMA

Melek YAĞMUR YILMAZ

Yüksek Lisans, Endüstri Mühendisliği Anabilim Dalı

Danışman: Doç. Dr. Ayşe Tuğba DOSDOĞRU

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İşletmelerin pazardaki yerlerini koruyabilmeleri ve gelişerek büyümelerinin sağlanması için performanslarını takip etmeleri gerekmektedir. Anahtar performans göstergesi; bir işletmenin, ekibin, bireyin veya projenin performansını ölçmeye yarar. Bu çalışma anahtar performans göstergelerini değerlendirme çalışmalarında kullanabilecekleri bir model önerisi oluşturmayı amaçlamaktadır. Uygulamada kurumsal karne modelinde yer alan 4 boyut esas alınarak (finansal, müşteri, iç süreçler, öğrenme ve gelişme), şirketin anahtar performans göstergeleri gruplandırılmıştır. Boyutlar içerisindeki anahtar performans göstergelerinin ağırlıkları Analitik Hiyerarşi Süreci (AHP) yöntemi kullanılarak hesaplanmıştır. Oluşturulan model yalıtım sektöründe faaliyet gösteren bir şirketin 2020-2021 ve 2022 yıllarını kapsamaktadır. Çalışma sonucunda, yöneticilerin görüşleri alınarak belirlenen anahtar performans gösterge ölçütlerinin ağırlıkları ile yalıtım sektöründe faaliyet gösteren şirketlerin kullanılabilecekleri bir kurumsal karne modeli oluşturulmuştur.

Anahtar Kelimeler: Analitik Hiyerarşi Süreci, Anahtar Performans Göstergesi, Kurumsal Karne.

ABSTRACT

AN INTEGRATED ANALYTIC HIERARCHY PROCESS-BALANCED SCORECARD MODEL FOR EVALUATING KEY PERFORMANCE INDICATORS: A CASE STUDY

Melek YAĞMUR YILMAZ

M.Sc., Department of Industrial Engineering

Supervisor: Assoc. Prof. Dr. Ayşe Tuğba DOSDOĞRU

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Businesses need to monitor their performance to maintain their position in the market and to develop and grow. A key performance indicator (KPI) serves to measure the performance of a business, team, individual, or project. This study aims to create a model proposal that can be used in the evaluation of KPI for a business. In the application, the KPI of the company is grouped by the 4 dimensions (financial, customer, internal processes, learning and growth) within the Balanced Scorecard (BSC) model. The weights of the KPI within the dimensions are calculated using the Analytical Hierarchy Process (AHP) method. The model created covers the years 2020-2021 and 2022 of a company operating in the insulation sector. As a result of the study, a BSC model is created that can be used by companies operating in the insulation sector with the weights of the KPI criteria determined by taking the opinions of the managers.

Keywords: Analytic Hierarchy Process, Balanced Scorecard, Key Performance Indicator.

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LIST OF ABBREVIATIONS

AHP	: Analytic Hierarchy Process
ANP	: Analytical Network Process
BSC	: Balanced Scorecard
OEE	: Overall Equipment Effectiveness
KPI	: Key Performance Indicator
KRI	: Key Result Indicator
PI	: Performance Indicator
RI	: Result Indicator
ROI	: Return on Investment
IT	: Information Technology

LIST OF SYMBOLS

F1	: Net Saleable Output Rate
F2	: Energy Consumption Rate
F3	: Total Cost
F4	: Recycle Rate
F5	: Return on Investment
F6	: Stock Turnover Rate
C1	: Quality Rate
C2	: Claim Production Rate
C3	: Claim Logistics Rate
I1	: OEE Ratio
I2	: Utilization Ratio
I3	: Availability Ratio
I4	: Performance Rate
I5	: Overtime Ratio
L1	: Absenteeism Ratio
L2	: Holiday Pay Ratio
L3	: Personnel Turnover Ratio

1. INTRODUCTION

Today, businesses need to use an effective system to measure, evaluate and manage their performance to protect their market shares and gain competitive advantage. The requirement to use multi-dimensional performance evaluation criteria plays a crucial role in this constantly evolving and changing competitive environment.

One of the most contemporary and advanced multidimensional performance evaluation models is the BSC model. Today's managers are trying to progress in a competitive environment in which determining the right goals and understanding how to reach these goals play an important role (Gökmen, 2009). The BSC model includes a set of financial and non-financial criteria that will transform the firm's strategic goals into action and a structure that enables the firm's defined key success elements to be revealed (Yuregir & Nakıboğlu, 2007). With this structure, companies can measure performance in many aspects, as well as create a roadmap for making necessary improvements in key success elements that represent their past and future performances.

In addition to their financial controls, businesses need to use their resources more efficiently. This is possible by identifying KPI for a business and supporting it with effective methodologies. There are many methods of performance measurement and evaluation. A KPI serves to measure the performance of a business, team, individual, or project. With the BSC model, this measurement is made more systematic and objective.

In this study, a multidimensional examination of the KPI of a business operating in the insulation sector is provided using the BSC method. The importance levels of these performance criteria are determined by the AHP. Using BSC, ensured that the evaluation process is aligned with the strategies and objectives of the business. The AHP method is used to overcome the uncertainties encountered in the evaluation of KPI with the BSC method and to make the most appropriate evaluation by calculating the importance of the weights of the criteria relative to each other. Besides, such a study has not been found in the insulation sector, and it is hoped that it will shed light on future studies on the subject in this sector.

The rest of the thesis is structured as follows. Section 2 discusses the most relevant studies from literature. The BSC model, KPI, and AHP are explained in general terms, and information about the growth processes is given in section 3. In section 4, how the KPI and BSC model is created for a company operating in the insulation sector and how their importance levels are determined with AHP are explained in detail. Finally, concluding remarks of the results are given in section 5.



2. LITERATURE REVIEW

The BSC model has been a subject of extensive study among researchers, including the examination of its performance measurement, evaluation, and guidelines for proper implementation in performance measurement and management. Below are brief explanations of some of the research studies conducted in the literature to enhance the value of the BSC model and expand its boundaries and areas of application.

Samir et al. (2018) proposed a KPI study in cyber-physical production systems. KPIs are values that show the success factors of the production system. KPI stands for KPI and is a way to track the critical success factors that align with the goals set by the ISA95 Standard. It serves as a measure of progress and a means of comparing progress against set goals. By monitoring KPIs, one can determine if the company is meeting its objectives.

Tuncer (2006) selected increasing profitability, growing, increasing efficiency, reducing costs, and reducing the cash conversion cycle below its current time as the sub-criteria of the financial dimension. The sub-criteria of the customer dimension are determined as customer loyalty, customer satisfaction rate, and product variety becoming complete. The internal processes dimension is divided into several sub-criteria such as inventory utilization rate, efforts to develop new products and services, minimizing operational problems, and energy expense/sales ratio. The learning and growth dimension is the education of the employees, the satisfaction of the employees, and the turnover rate, enabling the employees to develop themselves and career opportunities in the study.

Erciyes (2018) determined financial dimension sub-criterion as net profit margin ratio, the operating profit rate of change, the rate of change in cash flow, receivable turnover rate, return on assets rate, and return on equity. The sub-criteria of the customer dimension; is the market share ratio and the rate of change in sales. The sub-criteria of the internal processes dimension are R&D expenses/sales ratio, inventory turnover ratio, gross profit margin ratio, and general administrative expenses/sales ratio. Learning and growth dimension sub-criteria are market book/book value ratio, rate of change in intangible assets, and personal turnover rate.

Çelikdin (2014) specified the sub-criteria of the customer dimension as turnover, internal volume, income per employee, savings made by outsourcing, the ratio of total profit to turnover, reduction of operating expenses, turnover of assets, inventory turnover, and economic added value. The sub-criteria of the customer dimension are new customer acquisition rate, product quality, on-time delivery rate, technical support satisfaction, customer continuity, response time to customer complaints, and market share. The sub-criteria of the internal processes dimension are production waste rate, raw material waste rate, number of nonconformities, energy cost per ton, reprocessing rate, and actual/planned improvement rate. The sub-criteria of the learning and growth dimension given as training hours per employee, personnel turnover rate, and in-house training rate are the ratio of employee satisfaction to the previous period.

In the study of Kaba's (2014), firstly, information about the concepts of performance management and performance measurement is given, then the BSC method, which is one of the modern performance measurement and evaluation methods, is explained and its application as an event study in a business is given. At the end of the study, it was concluded that the BSC method is an important management tool in guiding companies that want to monitor their own performance and direct their strategies. It demonstrates that BSC makes goals clear, helping employees see the long-term impact of their business strategy and understanding their own involvement.

Yazıcıoğlu et al. (2022) emphasized the significance of using the AHP and Vikor method to analyze the financial performances of companies in the construction index through the AHP method. They analyzed the significant contributions of the sector to employment and economic growth for the financial performance of the companies in the sector values. This study aims to analyze the financial performances of companies in the construction sector in the period of 2016-2020 using AHP. According to the findings obtained from the study, the company with the best financial performance, the company with the highest current ratio, the best financial leverage, the short-term debt ratio, and the companies with the highest return on assets and return on equity are determined.

To determine the criteria to be used in blue-collar performance evaluation, AHP is used in the study Saraç et al. (2022). The criteria to be used to evaluate the performance of blue-collar personnel varies. Therefore, it is difficult to determine which criteria to be used. Also, the data collection burden may be too high, making it impossible to use the method in practice. In the study, first, worker performances are calculated with the AHP using the criteria determined by the experts, and then the criteria that could represent all the criteria and had the least total data collection load are determined by using the proposed multi-purpose mathematical model. The proposed method is applied in a plastic injection factory. As a result, 30 of the 40 criteria are selected by the experts, and the difficulty of obtaining the data is reduced by 26% with only a 4% deviation from the performance score obtained when all criteria are selected.

In the study of Doguc's (2022), a selection is made for 4 personnel who applied for the position due to a vacancy in a position in a company. The candidates are evaluated using the AHP method, which is one of the multi-criteria decision-making techniques. While making the evaluation, 5 criteria that the company attaches importance to for this position are also taken into consideration. The candidates are ranked according to their results, and it is determined which candidate is more suitable for the company's requests.

The Şimşek (2022) aims to examine the financial performance of the ten largest deposit banks in terms of asset size operating in the Turkish banking sector. This study utilized 11 financial variables to evaluate the financial performance of banks. Using AHP, weight coefficients for the performance criteria are determined from the collected data. The financial success of the banks during the analyzed periods was then examined by combining these weight scores.

KPI, which is a performance appraisal method, focuses on the performance that is critical and vital to the ongoing and future success of organizations. When the literature is reviewed, it is seen that KPIs are defined in different ways.

Aguilera et al.(2021), proposed a method supporting a process for generating performance indicators for production areas in companies. It is supported by another decision-making method, namely the ANP. It is grouped with five titles with the BSC model. Long-term goals,

strategic business units, critical success factors, production decision areas, and human resource management. The proposed method allows managers to define performance indicators for the production area that align with the company's long-term strategic goals. This is done using a decision-making model that captures the complex relationships that exist between the various strategic objectives of a company's strategy map. Managers have found the proposed method easy to understand and follow, and useful for defining performance metrics (Aguilera et al. (2021).

Sharma and Bhagwat (2007) used the BSC model and the AHP method in their study and aimed to determine the importance of the used performance dimensions with the support of AHP by applying performance evaluation in supply chain management. In the study, financial, customer, internal processes, innovation, and growth dimensions are used for the BSC model. Afterward, the weights of the dimensions for strategic, tactical, and operational criteria were determined by AHP analysis. According to the findings obtained in the study, while the strategic performance criterion is determined as the most important criterion among the criterion weights, it is determined that the operational performance and tactical performance criteria had less importance, respectively (Sharma and Bhagwat 2007).

Yüksel and Dağdeviren (2010), aimed to integrate the BSC model and the ANP method, also known as the improved version of the AHP model. While the BSC model used in the study consists of 4 classical dimensions, the selected performance criteria are determined specifically for the model. These criteria and BSC dimensions are weighted by the ANP method and ranked according to their importance. As a result of the study, it is concluded that the financial dimension is the most important dimension and the most important indicator of this dimension is the return on assets criterion.

Lee et al. (2008) aimed to establish an approach based on fuzzy AHP and BSC to evaluate the IT department in a Taiwanese business. Evaluating the IT department is critical to understanding how the departments contribute to organizational and strategic goals. Evaluation methods based only on financial criteria are not sufficient, as the IT department performs tasks that cannot be measured by financial measures. The BSC model used in the study consists of 4

main criteria (i.e. financial, customer, internal business process, and learning and growth). The fuzzy AHP method is used to eliminate the uncertainty. As a result, it provides guidance to the IT department in the Taiwan business on strategies to improve department performance. It has been seen that the created information system is a good tool to solve other multi-criteria decision making problems (Lee et al. 2008).

Kohneh (2013), emphasized that productive results can be obtained when the AHP is integrated with the BSC to measure the performance of five different population directorates in Iran. It is aimed to eliminate the uncertainty in the input numbers and to convert them to exact values. In the study, for the analysis of the five regions, organizational researchers use education, quality, customer satisfaction, performance measurement, expenditures and annual budget as the main components.

Wadugodapitiya (2010), aims to develop a multidimensional performance measurement model for building construction project performance evaluation by integrating BSC and AHP tools. A new expanded BSC formation is aimed, which consists of four perspectives: Customer, financial, internal business processes, learning and growth. AHP is used to analyze the 4 BSC perspectives and KPI data determined.

In their study, Bentes et al. (2012), aimed to use a multi-perspective framework the BSC, and the AHP, as a decision-making tool for the evaluation of performance indicators of units in a Brazilian telecom company. The results of the questionnaires answered by the managers employed in the units are evaluated by the AHP method. Non-financial data are also taken into consideration from the BSC perspective. Thus, the importance of non-financial data has also been revealed.

An applied research in a telecommunication company is aimed in the study by Haddadi and Yaghoobi (2014). First, the company objectives are determined according to the four perspectives of the BSC framework. Then, the company's performance indicators are determined according to their importance by AHP. AHP is implemented by making bilateral comparisons by the company's senior employees. This study showed not only the characteristics

of the company, but also the characteristics of the telecommunications industry, the country environment, and the time-based moment. As a result of the work, the existence and survival of the company depend on the financial situation. However, the ability to offer new services, improve existing services, increase customer satisfaction, and maintain them is due to a good financial situation (Haddadi and Yaghoobi, 2014).

In addition to those outlined previously, various domestic and international studies have employed an integrated approach utilizing KPI, AHP, and BSC methodologies across various sectors and organizations. Some examples of these studies include Reisinger et al. (2003), Tezel (2009), Tsai et al. (2009), Abdolshah et al. (2002), Celikdin (2013), Asil et al. (2013), and Özyörük et al. (2014).

As seen in the literature above, the use of BSC and AHP methods to evaluate the performance of companies plays a key role in improving the future performance of the company. Therefore, this study aims to evaluate the key performance of an insulation company and increase its future performance by integrating AHP and BSC.

3. MATERIALS AND METHODS

In this section, the methods used in the measurement and evaluation of the performance data of a company operating in the insulation sector are explained. The objective of this thesis is to assess the company's KPI data between 2020 and 2022 through the utilization of the AHP-based BSC methodology.

The concept of KPI, which is a performance indicator, is used to monitor and review the achievement of a business with quantitative and qualitative data that can be counted and measured. Detailed information about KPI 3.3. given in the section.

The AHP method is used to overcome the uncertainties encountered in the evaluation of KPI data with the BSC method and to make the most appropriate evaluation by calculating the relative importance weights of the criteria relative to each other. AHP implementation steps has also been given in section 3.2.

KPI data, whose importance weights are determined by the AHP method, are supported by the BSC method for multidimensional evaluation. BSC is a system that can show the past and future performance, values, and strategies of the business.

BSC methodology is designed to identify the key KPIs that are critical to the success of a business strategy. This method is also used to set the right goals and understand how to reach them. Details about this method are given in section 3.1.

3.1. Balanced Scorecard

With the growth of the information age, a customer-oriented organizational understanding has emerged. Changes in the sector have shown that the success of the business cannot be measured only by financial values and numerical indicators. The search for renewal of the current understanding of performance has been directed (Papatya, 2006). Today's managers are trying to progress in a competitive environment by setting the right goals and understanding how to reach these goals play an important role (Gökmen, 2009). Managers who can expect the

changing perspectives of customers in the new market environment move away their strategy, organizational plans, and policies from traditional approaches and towards modern, multidimensional performance measures (Pirtini, 2016). They abandoned the idea of producing products and started to adopt a customer-oriented management approach. Customer-oriented performance approach also ensures that the customers are satisfied and valued. It maintains the loyalty of existing customers and produces products and services demanded by target customer groups (Kaplan, 2015).

The BSC was developed by Kaplan and Norton in 1992 as a performance measurement model. The BSC is a management system that enables businesses to implement their vision and strategic plans and turn them into action. The BSC is a strategic management approach that benefits quality assurance, total quality management, customer-oriented production, organizational change management, supply chain, process management and competition management. BSC aims to reflect the relationship between a company's short and long-term goals, financial and non-financial, internal and external, performance, and result indicators into the company strategy in a balanced way within the cause-effect hierarchy.

The BSC is a strategic performance management approach which aims to give the necessary importance to non-financial values of businesses (Pirtini, 2016). BSC financial indicators start with vision and strategy. Vision and strategy form the basis of performance measurement tools (Gökmen, 2009).

Businesses which adopt BSC as a performance management philosophy should pay attention to some points. These points can be given as follows (Coşkun, 2006):

- They need to provide balance between services and customer demands.
- They must provide adaptability and flexibility to the market.
- They should perform the service offered to the customer more quickly and completely.
- It is necessary to foresee and eliminate the losses that may occur during the supply.
- Internal customers need to pay attention to improving their performance.

In addition, BSC aims to present performance indicators related to the vision and strategic goals of businesses in a balanced way. In addition, BSC, which has a customer-oriented management approach, is a measurement tool which shows the extent to which the strategic goals of the businesses can be achieved.

BSC is a system that can visually display the performance, values, and strategies of the business to both employees and managers. It serves to determine what the business should measure or what should be emphasized in detail while measuring. BSC's strategy serves as a tool which determines what is important for the success of businesses. It also indicates at which point each employee will contribute to the basic strategy of the business.

In consideration of the literature, BSC transforms the vision and strategies of businesses into understandable performance measures. Thus, it forms the main lines of the strategic measurement and management system required for the business. Thus, the BSC integrates the employee's behavior with the goals and strategies of the business. Employee and business objectives are aligned (Kershaw, 2001). The goals and strategies of the business in BSC management are given in Figure 3.1. (Kaplan, 2015)

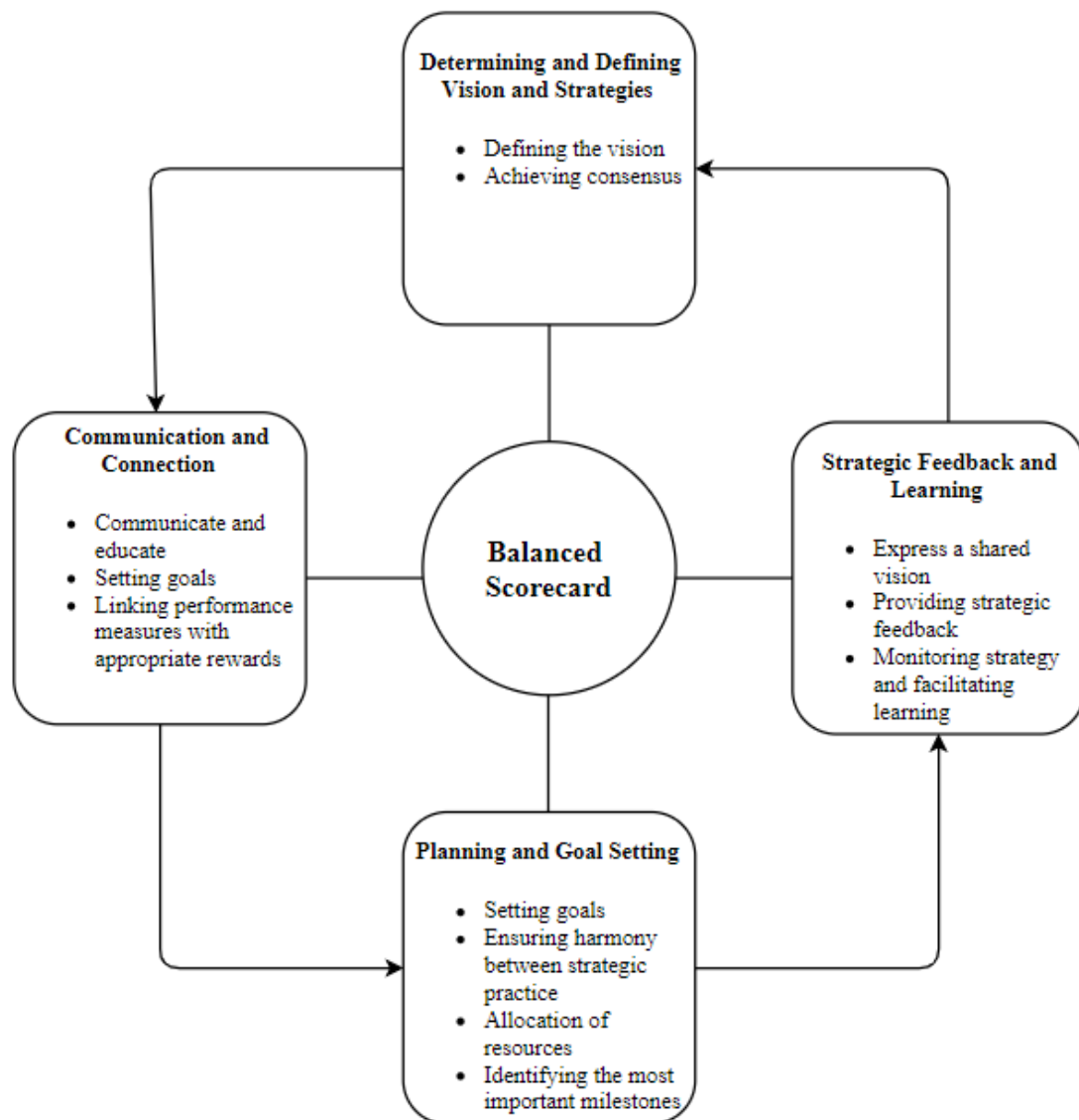


Figure 3. 1. Managing BSC Perspectives (Kaplan, 2015)

The BSC integrates financial measures of former performance with factors to ensure future performance (Gökmen, 2009).

3.1.1. Balanced Scorecard Dimensions

There are 4 dimensions of the BSC created by using the financial and non-financial criteria of the businesses. The BSC is a management tool designed to use both financial and non-financial assets effectively (Gökmen, 2009). These dimensions are determined by considering the goals

and measures of the BSC and the vision and strategy of the business. BSC determines the results businesses want to achieve and the factors on how to achieve these results. In addition, business managers act to direct the talents, knowledge, and tendencies of the employees to achieve long-term goals (Kaplan, 2015).

The purpose of sizing is to define the strategy of the businesses and to ensure that the relations between the employees and the businesses are in harmony with each other and line with a common purpose (Kaplan, 2015). BSC should not be used as a monitoring system, but as an information and learning system. Used in this manner, it does not require employees and departments to follow the pre-determined plan for traditional measurement systems.

The BSC is a method which evaluates performance according to four main dimensions and sub-dimensions. The sub-criteria covered by Kaplan and Norton are as follows (Kaplan, 2015):

Sub-criteria of financial dimension are net profit margin ratio, new customers and markets, revenue growth and composition, operating profit change rate, new products, new customers and markets, new applications, rate of change in cash flow, receivable turnover rate, cost reduction, active profitability ratio, return on equity ratio, cost reduction in unit price, reduction of expenses.

The sub-criteria of the customer dimension; customer satisfaction, customer acquisition, market share rate, rate of change in sales, marketing spend/sales, product and service attributes.

The sub-criteria of the internal processes dimension; sales percentage of new products, percentage of sales of patented products, production possibilities, R&D expenses/sales ratio, inventory turnover ratio, capacity utilization ratio, gross profit margin ratio, general administrative expenses/sales ratio.

The sub-criteria of the learning and growth dimension; the measurement of employee satisfaction, the relationship between book value and market book value, the rate of change of intangible assets, the staff turnover rate, Individual Compliance and Enterprise Compliance.

All BSC criteria are designed to achieve the strategy determined in an integrated manner. Thus, we can say that there is a unity of purpose in a correctly prepared BSC for the business. An example of a BSC prepared according to the strategic objectives of the company is given in Figure 3.2.

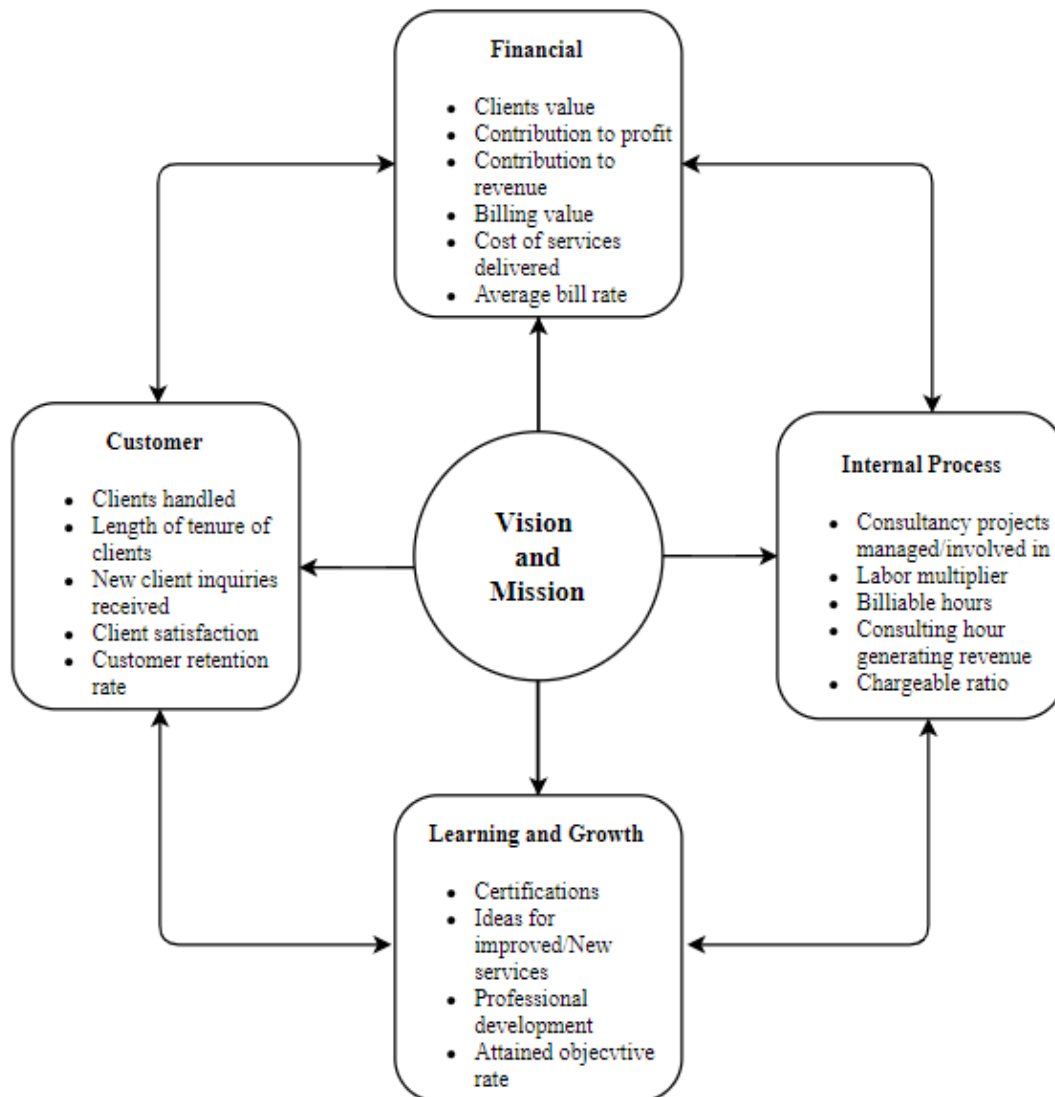


Figure 3. 2. An example of BSC (Kaplan, 2015)

3.1.1.1. Financial Dimension

Financial measures are up-to-date and appropriate in traditional performance measurement methods. Today, however, traditional approaches are not sufficient for companies to create value by investing in their customers, suppliers, employees, internal processes, technology, and

innovations (Kaplan, 2015). In addition to financial criteria, other dimensions which can lead the business to the strategic point of its objectives should also be considered.

According to BSC, the necessary connections between the four dimensions must be established correctly to increase the income of the businesses, increase efficiency, use the resources more effectively and minimize the risks. In other words, the profit ratio of two different businesses in the same industry will be different. Expecting the profitability ratio to be identical across various units within the same business is not realistic.

Integrating the financial objectives of different units and the overarching business objectives is crucial in the financial aspect of BSC, as financial measures are fundamental to other components of BSC.

3.1.1.2. Customer Dimension

In the customer dimension, which is the second basic dimension of the BSC, there are critical decisions regarding the customer and market segment that businesses choose to compete with. With advanced technology, businesses need to meet the expectations of their existing customers and earn leads to continue their life activities.

In the past, many businesses produced products with an increased focus on internal performance and technological innovations (Kaplan, 2015). Businesses which do not understand customer demands have fallen behind their competitors because they cannot offer their preferred product and service. Businesses that could not progress in this way, like their competitors, thought of making progress by prioritizing customer requests. The first aim of its strategic goals was “to become the number one manufacturer for our customers”.

Potential customers of a business are not perceived to possess identical traits. Thus, they hold varying perspectives and values concerning the products and services they encounter or request. Detailed market studies should be conducted while progressing towards policy objectives.

The examination of literature revealed that businesses commonly adopt two different sets of measures within the customer dimension. The first series is the basic measure group used more

by businesses. The basic dimensions of the customer dimension are given in Figure 3.3 (Kaplan, 2015).

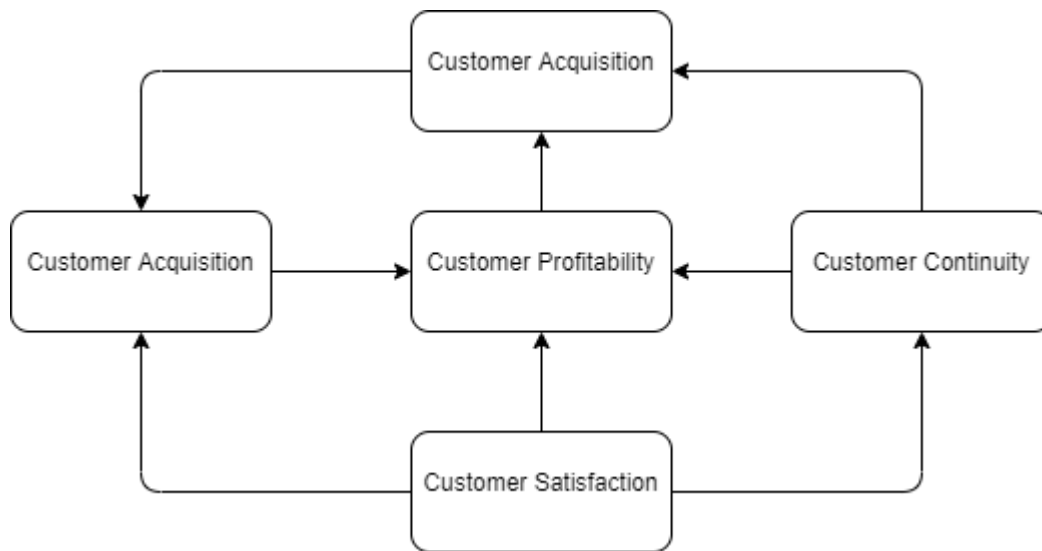


Figure 3. 3. Customer Size Basic Dimensions (Kaplan, 2015)

The market share shows the ratio of the sales made by the company in a certain market to the total business volume in that market, by measures such as the number of customers, the total amount of expenditure, or the number of unit goods sold.

Customer acquisition measures the rate at which the business acquires new business or customers in absolute or relative values.

Customer continuity follows the ratio of relationships that businesses maintain with their customers, using absolute or linked values.

Customer satisfaction determines the level of customer satisfaction provided by the value propositions offered to customers through specific performance criteria.

Customer profitability measures the net profit of a customer or customer segment after special expenses incurred for a customer are incurred.

3.1.1.3. Internal Process Dimension

In the dimension of internal processes, the business must determine what the internal processes and how it should proceed to satisfy its customers, achieve its goals related to its shareholders, and be superior to its competitors.

Along with the internal processes dimension, the growth of an organization provides an opportunity to focus on core functions and processes. (Ensari, 2005).

The objective of the business is to investigate and introduce newly developed products and services, with the aim of satisfying existing customers and catering to prospective ones. In the operations process, which constitutes the second leg of the chain, existing products and services are produced and delivered to the customer. The most important purpose of the operations process is perfected and minimizing costs while delivering the product or service to the customer. The third stage of the chain, after-sales services, covers the portion of the service offered to customers after sale and delivery. Warranty, repair, maintenance, and installation processes of the purchased product, all products or services sold in installments or with a credit card are included in the scope of after-sales services (Kaplan, 2015). The inner operational dimension of the global value chain is illustrated in Figure 3.4.

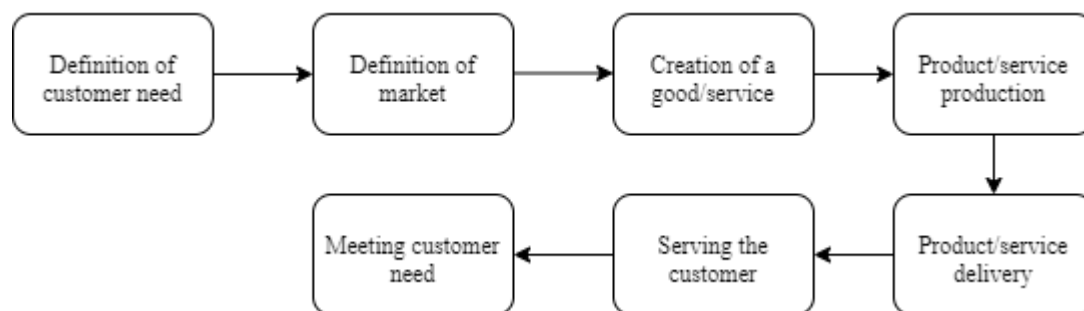


Figure 3. 4. Internal Operational Dimension-Overall Value Chain (Kaplan, 2015)

3.1.1.4. Learning and Growth Dimension

The goals in the learning and growth dimension form the infrastructure necessary for the growth of high goals set in other dimensions and then turning them into action. The goals in this

dimension are attempts to achieve excellent results in other dimensions (Kaplan, 2015). In other words, the criteria and objectives of the learning and growth dimension are supportive of the other dimensions.

For the performance of a business to be stable, it must be in constant learning and growth. Thus, the creative abilities of the employees of the business will intersect with the objectives of the institution thanks to the training they receive (Pirtini, 2016). The learning and Growth Indicator is given in Figure 3.5.

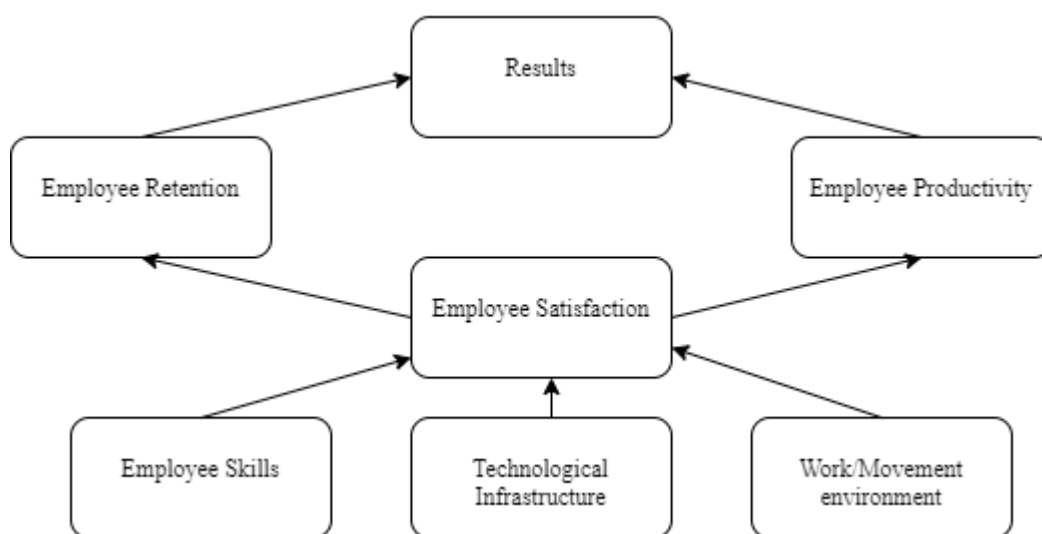


Figure 3. 5. Learning and Growth Indicator (Pirtini, 2016)

3.1.2. Formation of BSC

BSC should not be a standard system, businesses should have a structure specific to their own goals and visions. BSC, which consists of 4 basic dimensions, may vary according to the strategy of the business as a criterion. With a participatory approach, attention should be paid to the perception levels of all employees, and compliance with the business management strategy should be ensured. The support of the senior management in the formation of the BSC is very important. First, it should be defined as a pilot project in a certain part of the business and then it should be applied to all departments.

3.1.2.1. Determining and Defining Strategic Objectives

First, a business should clearly state its vision and mission and specify how it wants to achieve them. Especially in the customer dimension, managers should clarify all the objectives such as which customer will be reached, and which market tool will be used. With the definition of internal business processes, brand-new methods will emerge that must be fully implemented for the business to achieve its strategic goals (Kaplan, 2015).

The last link in the BSC relates to the last dimension, learning, and growth goals. In this section, corporate methods are reached by using information systems and information technologies to improve the competence, skills, and performance of employees. In addition, the reasons why these methods should be reached "for" are revealed (Sezerel, 2008).

3.1.2.2. Alignment of Goals Between Strategic Practices

Senior managers should set scorecard targets for three or five years. These targets should be the targets that will bring about a significant disruption, a fundamental change in the continued performance of the business until that day. In other words, the management level needs to deal with 4 basic dimensions, including customers, internal business processes, learning and growth, apart from financial inputs and outputs and set goals. To define excellent performance, the preferences of both current and potential customers should be examined. BSC is different from traditional methods, which is to reduce expenses and make profits. It is also created with elements such as saving time in order preparation, product development and product development processes. In addition to the goals we have mentioned, final goals exist with more cause-effect relationships in the BSC (Kaplan, 2015).

3.1.2.3. Obtaining a BSC

For the BSC to be used as a building block of a targeted management system, it must be fully established. The BSC is a roadmap which shows businesses how to reach their target growth rate.

The BSC is a method that enables us to visually communicate corporate performance, values and strategies to employees and managers. Please note that the BSC is a performance measurement that is specially prepared for each business. In other words, the BSC for a business

is based on the 4 basic dimensions and the basic criteria for the dimensions above, but there may be different criteria that each business considers as extra. Consequently, the factors which the size of companies takes as criteria are determined in parallel with their vision, mission and strategies. (Sezerel, 2008).

3.2. Analytical Hierarchy Process

The AHP method was originally established by Myers and Alpert in 1968 and was developed by Saaty in 1971 as a usable model (Çelikdin, 2013: 145). The AHP is used in multi-criteria, multi-factor, and multi-purpose decision-making situations under certainty and uncertainty in situations where there are many decision-makers and more than one option (Acar, 2006: 117). If there is a criterion and purpose that includes more than one quality and amount in a decision making problem, such decision making problems are called "Multi-Criteria Decision Making". (Timor, 2011). AHP is one of the most known methods among "Multi-Criteria Decision Making" methods.

AHP is a multi-criteria decision making method that determines the priorities of the criteria according to the comparison matrix of the opinions of experts in the field. In any problem process, it offers many different options for decision-making and these options help us reach the right decision. It is a method of choosing from many different options.

In AHP, we first need to recognize the problem and determine what kind of information we need for the problem. Then, it is necessary to create a hierarchical structure including a set of alternatives where the target of the decision is at the top, the criteria are in the intermediate parts, and the bottom part (Saaty, 2008). After that the comparison matrix is created. The comparison matrix is created by comparing each element at a level with other elements at the same level, and this process should be applied for each part (Saaty, 2008). Priorities and weights are determined separately for each part, and these processes continue until the weights of the alternatives are determined (Saaty, 2008). A scale between 1 and 9 is used in the comparison matrix and the consistency of the comparison results is examined (Timor, 2011).

3.2.1. AHP Implementation Steps

The AHP methods are used in multi-criteria, multi-factor, and multi-purpose decision-making situations of many decision-makers under certainty and uncertainty (Acar, 2006).

The AHP implementation process consists of four steps. The first step starts with the definition of the decision-making problem and the hierarchy problem. Afterward, $(n \times n)$ dimensional pairwise comparison matrices are created between the criteria and the matrices. In the third step, the priorities and importance distributions of the criteria and factors are determined. In the last step, the consistency of the comparison matrices is checked. When these four steps are performed in a healthily, a properly structured AHP is formed.

Step 1: Creating the Decision Hierarchy

It is necessary to create a hierarchical structure to make the best choice with AHP, which includes both rating and comparison methods (Tez sürücü, 2016). This hierarchical structure consists of different types of decision alternatives (Saaty, 2008).

Step 2: Creating the Matrices

It involves comparing the criteria in the hierarchical structure with each other in pairs. In these comparisons, the importance scale suggested by Saaty is given in Table 3.1. (Akdeniz, 2007).

Table 3. 1. Significance Scale in Matrices (Akdeniz, 2007)

Significance Scale (a_{ij})	Comment
1	The criteria i and j are equally important.
3	Criterion i is more important than j.
5	Criterion i is considerably more important than j.
7	Criterion i is much more important than j.
9	Criterion i is more important than j.
2,4,6,8	They are intermediate values that can be used in cases where the decision-maker cannot reach a definite judgment.

The priority vector found by using the pairwise comparison matrix A created for a certain level of the hierarchy gives normalized relative priority values for n criteria as (Tezsürücü, 2016).

$$w = [w_1, w_2, \dots w_n] \quad (3.1)$$

w_i is the degree of importance of the criterion relative to the other criteria indicates the weight. The sum of the values in the priority vector is equal to 1. If the decision maker is fully consistent, the value given by the decision maker evaluating the criteria will be equal to Equation 3.2.

$$a_{ij} = w_i / w_j \quad (3.2)$$

$$a_{jk} = a_{ik} \quad (i, j, k = 1, 2, 3, \dots, n) \quad (3.3)$$

For this case a_{ij} must be satisfied equality 3.3 (Saaty, 2008). In this case, the comparison matrix A can be written in the matrix form of the pairwise comparison ratios that is given in the equation in Figure 3.6.

$$A = \begin{bmatrix} 1 & a_{12} & \dots & a_{1n} \\ 1/a_{12} & 1 & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/a_{1n} & 1/a_{2n} & \dots & 1 \end{bmatrix} = \begin{bmatrix} w_1/w_1 & \dots & w_1/w_n \\ \vdots & \ddots & \vdots \\ w_n/w_1 & \dots & w_n/w_n \end{bmatrix}$$

Figure 3. 6. Matrix Form of Binary Comparison Ratios

After the decision hierarchy is created, binary decision matrices are created. After the matrices are created, the decision maker or makers are asked to make comparisons. It is checked whether these comparisons meet the consistency test.

Step 3: Determining the Priorities and Importance Distributions of Criteria and Factors

For each column in the binary comparison matrix, the normal data in the matrix are obtained by taking the sums of the columns and dividing each column criterion by the corresponding column sum. Then, the average of the row sums formed for each alternative or criterion in the normalized data matrix is taken. The calculated values are priority values for criteria. The matrix formed by these values is the priority vector matrix (Ömürbek, 2016). In the priority matrix created with the priority vector, the priority values obtained from each criterion are multiplied by all the elements in the column in the binary comparison matrix of that criterion or option (Özyörük, 2005).

Step 4: Checking for Consistency in the Comparison Matrix

AHP is the mathematical relationship of the decisions made with consistency in the process to each other.

Calculation of the consistency index (CI) is given in Equation (3.4):

$$CI = (\lambda_{max} - n)/(n - 1) \quad (3.4)$$

The calculation of the consistency ratio (CR) is given in Equation (3.5):

$$CR = \text{Consistency Index} / \text{Randomness Index}. \quad (3.5)$$

After the consistency index is calculated, the result is compared with the Randomness index (RI), an index randomly derived from the inverse matrix of 1-9 scales. Saaty suggested that the Consistency Ratio (CR) for the pairwise comparison matrix should be less than 10%. A ratio of less than 0.10 indicates that the judgments of the decision-makers are consistent, and the results obtained are within acceptable limits (Saaty, 2008).

3.3. Key Performance Indicator

Today, customer expectations and technological advances are growing rapidly each year and businesses need some innovative formations within themselves. These innovations allow the business to be managed effectively and efficiently. Therefore, the concept of "performance" has become established in business life. For the company's core strategies to be effective, performance management must be well structured. Performance is defined as the capacity of existing companies to achieve their objectives of effective and efficient use of their resources. (Rainey, 2010). Accordingly, the concept of "performance indicators" is addressed by the criteria (Parmenter, 2014).

Performance measurement is a powerful tool for operating efficiencies. It plays a significant role in the creation, measurement, progression and achievement of corporate objectives. These measures guide the company's success as a company or business employee. This guidance also assists management in various matters. Businesses create new strategies according to these results. According to the results, successful strategies can continue as they are an unsuccessful strategy must be readaptation. Performance measurement tools benefits can be given as follows: (Eckerson, 2009)

- Creates a communication strategy.
- Increases motivation.
- Brings a consistent approach to the business.
- Reduces cost and unnecessary resource usage.
- Supports users.
- Provides the needed information.

Considering the contribution of performance indicators to businesses, the need for "Business Performance Management" has appeared to use it more effectively and efficiently. Business management is like the ocean surrounding an iceberg, as shown in Figure 3.7. The iceberg refers to business performance management. This management system is built on the infrastructure of "business intelligence" and "information integration". With the data obtained from these, "performance dashboards" are created by the business structure. It is ensured that these tables can be changed continuously by the content of the business. The most prominent among these tables are BSC and dashboards using precise indicators (Eckerson, 2009).



Figure 3. 7. Structure of Performance Management (Eckerson, 2009)

Depending on the performance indicator, the concept of "KPI" should also be defined. KPI; is used to monitor and review the achievement of a business's objectives that are quantitative and qualitative data that can be counted and measured. These are organized based on pre-determined

business success objectives and strategies. It is measured at certain time intervals, and we observe if it reaches the required level. (FinPa, 2009).

Along with KPI, there are a few other concepts where the word "key" is used. These indicators support KPI measurement. There are four different forms of performance measurement according to indicators (Parmenter, 2014):

- Key Results Indicators (KRI):

It provides a summary table of the status of the organization's performance.

- Results Indicators (RI):

Summarizes multiple team/group activities. It refers to reviewing teamwork.

- Performance Indicators (PI):

Refers to non-financial indicators. This is the difference between KPI. It helps the team implement the strategies of the organization.

- Key Performance Indicators (KPI):

These indicators enable the organization to focus on organizational performance that is most critical to its current and future success.

The first three of these indicators help business managers to reach appropriate KPIs, and KPIs are prepared based on the results. The types of key measures are shown in Figure 3.8 (Parmenter, 2014).

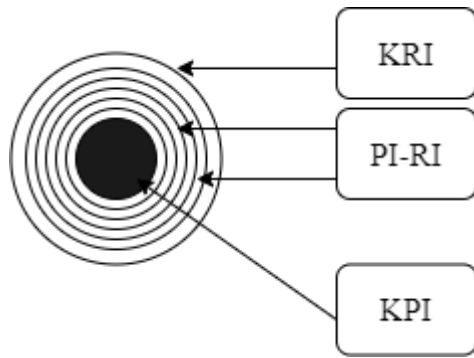


Figure 3. 8. Performance Measures Figure (Parmenter, 2014)

The loop in the figure is likened to the onion skin model. The outer shell is regarded as the place where the sun, water or food source is caught and represents the attractive part of the market. In other words, it is the general evaluation of the business. As the hull is peeled, more detailed data becomes available. Each ring represents divisions within the business. The core part is KPI which constitutes all of them. KPIs, which are created by going through certain processes, have the following basic features in their effect on decision-making (Parmenter, 2010).

- Non-financial: Using non-financial measures.
- Timely: There should be a frequency of measurement at certain intervals.
- Manager-oriented: It should be acted on by the CEO and senior management personal.
- Simple: Emphasize the need for measurement and corrective action that all personal will understand.
- Depends on the team: Responsibility should be given depending on a team or group working together.
- Significant impact: KPIs should have a significant impact on organizations.
- Eligibility: They encourage appropriate action related to the business.

Based on these features, the other features of KPIs in an expanded sense are as follows (Parmenter, 2014).

1. The business vision, mission, strategy, and objectives should be relevant and consistent.
2. It should be focused on the strategy of the business. The wrong choice of KPI can cause negative results.

3. It must be representative. It should be suitable for the business structure along with the operational performance.
4. It should be realistic. It must be compliant with operating costs and constraints.
5. It should be objective. It should be clear and focused against misinterpretation and ambiguity.
6. It should be accessible. It should be measurable with independent, observable, verifiable, and accessible data.
7. It should be measurable. It should be measurable with qualitative and quantitative data.
8. It should be used to identify trends.
9. It must be on time. It should be available within the given time frame.
10. It should be understandable. Individuals and groups should contribute to how their activities and behaviors affect business goals.
11. Must ensure participation. All participants should share how to participate within the business.
12. It should be reportable. It should prepare reports for all stakeholders and users and make these reports available.
13. It should be manageable. It should be accountable and understandable with a sense of responsibility.
14. It should be a source. It should ensure that the program is a cost-effective and sufficient resource in its use.
15. It should be evaluable. It should allow for regular evaluations.

According to Bauer, KPIs are grouped by considering their characteristics as indicated in the mentioned dimension chart in Figure 3.9.

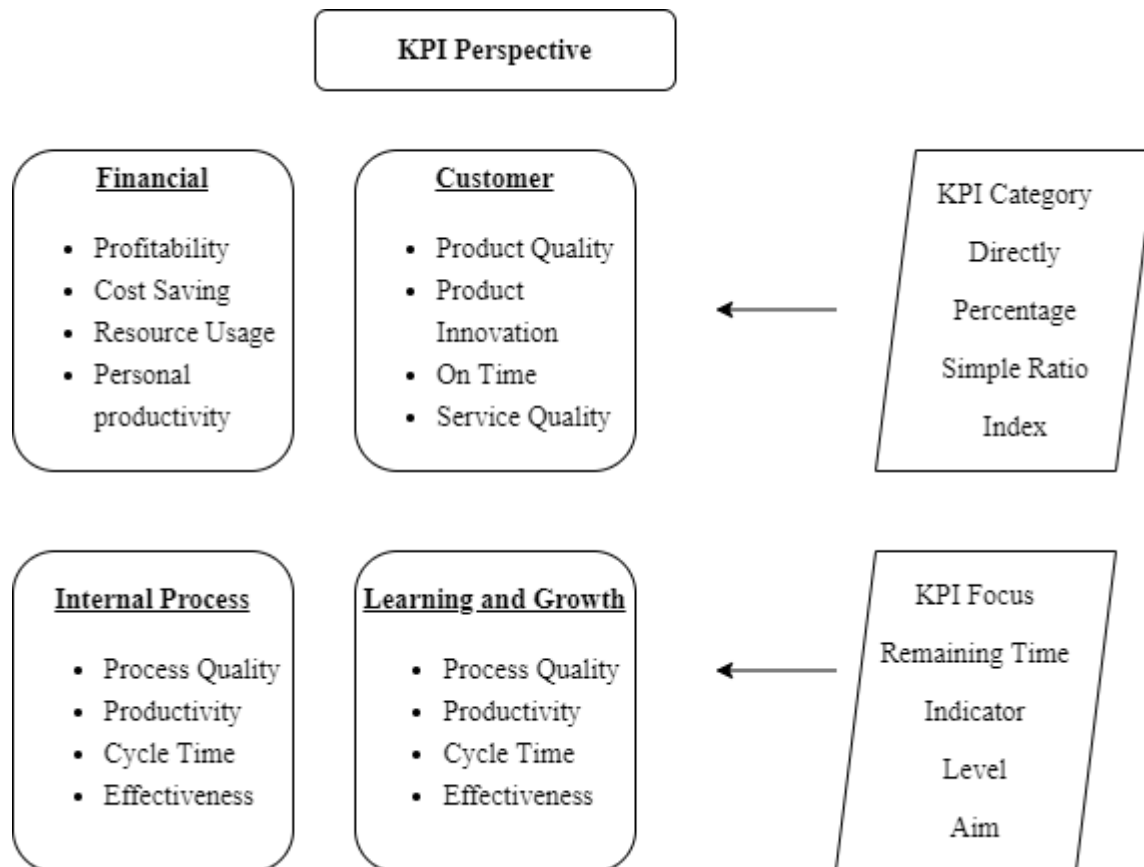


Figure 3. 9. KPI Size Chart (Bauer, 2004)

KPIs can be direct or indirect indicators. Direct gauges are special and can be easy to measure. For example, a defined time frame represents a direct measurement. Documents in a business can be shown as an example of indirect indicators. They are defined as indirect indicators due to their ability to be accessible when necessary. An answer is searched for the question of what exactly should be measurable? (Victoria, 2010).

Businesses prepare the KPI application according to the business strategy. The "Strategic Alignment Pyramid" in Figure 3.10, prepared by Bauer, shows the strategic position of the KPI within the business. This pyramid indicates the order of strategy preparation. In each step, questions suitable for the definition are asked and the next step is implemented according to the answer.

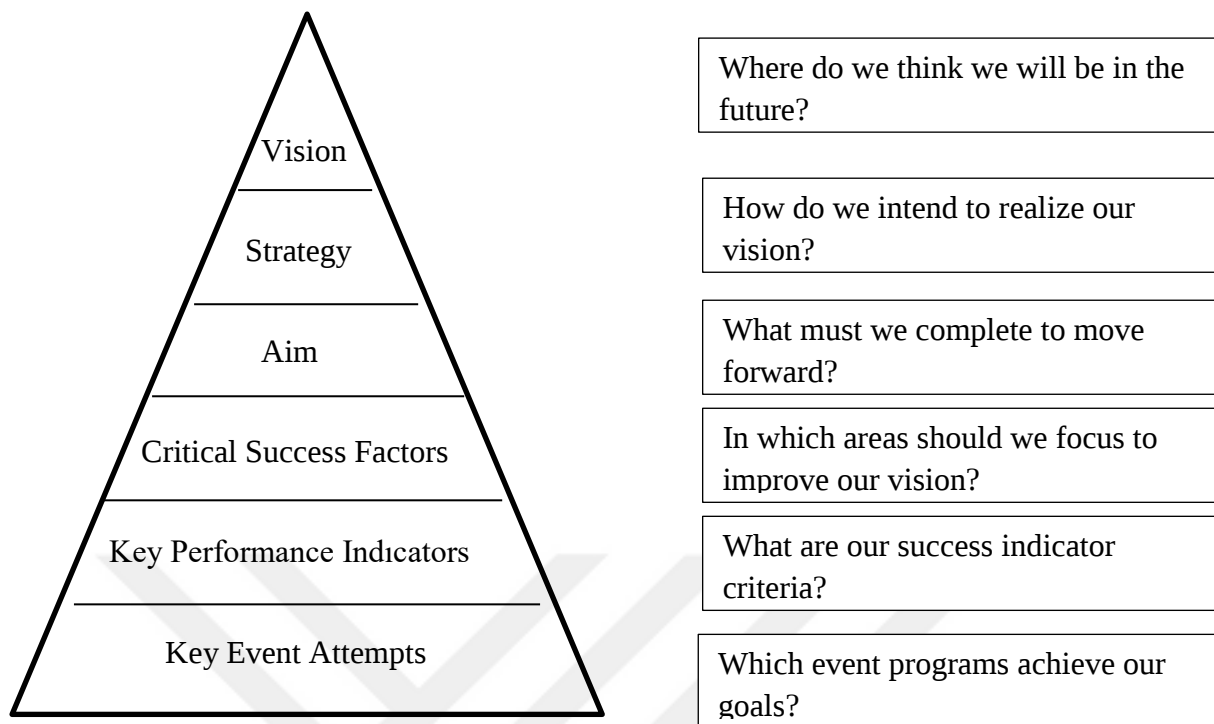


Figure 3. 10. Strategic Adaptation Pyramid (Bauer, 2004)

Another use of the schema is to help identify the two levels of the KPI. These are the strategic KPI and the operational KPI. The strategic KPI begins at the executive level, the vision level, and continues down the ladder. It records business characteristics, services provided, and management and managerial responsibilities. The operational KPI starts from the bottom up. At this level, it measures the operational structure of KPI metrics and functions and activities and the activities of records management services. It is collected step by step and presented to the management as a report (Victoria, 2010).

To apply performance measurement effectively, it is necessary to have a good command of performance management. Good performance management concerns information technology management. It is an approach that information technology managers use to monitor and execute business strategies and to help the business achieve its success and goals (Eckerson, 2009). To be comprehensive and coherent, the pyramid needs to be structured from the top down.

When creating KPIs, it should be noted that they should serve different purposes. For example, to increase business performance, such as improving the functions, activities, or services of the criteria for business efficiency, individual performance growth, continuous improvement initiatives, organizing BSC programs, improving the change in the new or existing process, providing broader planning about risks and problems, raising the business profile. affects the functions (Victoria, 2010).

According to Eckerson (2009), the overall performance management cycle revolves around data and metrics. It expresses which strategic activity will be in which management process. Businesses determine the appropriate strategies, make and implement the necessary plans, and evaluate the results by observing the current situation (Eckerson, 2009).

KPIs are also used to distinguish between ordinary and strategic measures. The difference between measurement and KPI measurement is applied independently in every area or every unit of the business. KPI, on the other hand, is aimed at strategic goals and helps to achieve goals easily. KPIs can be created for any business and person/employee. The structure, vision, and mission of the business are evaluated and revealed. KPIs can also be created with various applications. According to the results, it helps the business to interpret its strategic goal and see the overall business performance (Eckerson, 2009).

A similar process operates in business management. Managers do feasibility and analysis by producing a corporate strategy. Plans are made to achieve the goals and templates are created by following these goals. They report the deviations to senior management. The obtained result and the expected results are compared. KPIs and targets that are not compatible with the targets are reviewed and adjusted again. In Figure 3.11, the operation of the process is described in the Business Performance Management Cycle Model:

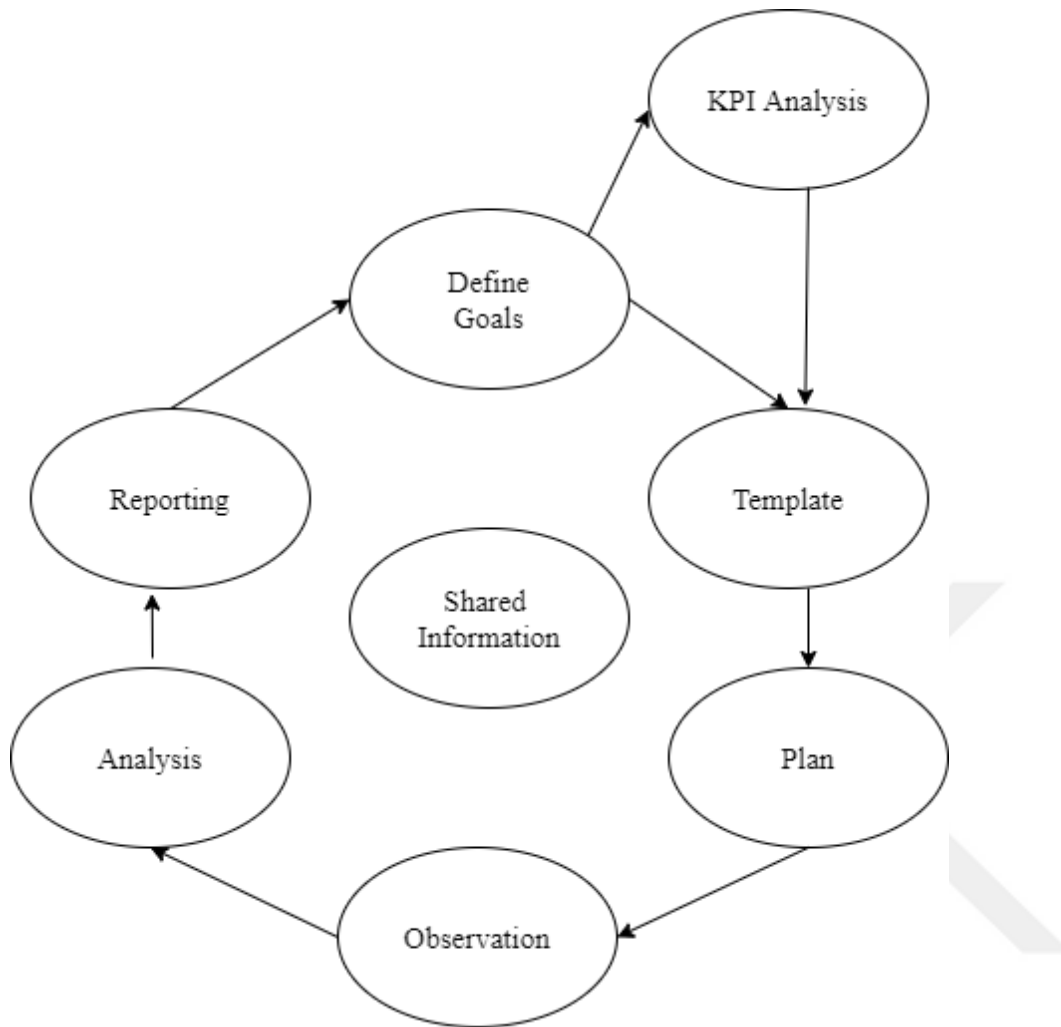


Figure 3. 11. The Business Performance Management (Eckerson, 2009)

As seen in Figure 3.11, the management provides the general KPI formation and starts the implementation process.

The definitions of these processes are as follows:

- Define goals: define KPIs and establish goals.
- KPI analysis: KPI analyzing, calculating cost, finding advanced models.
- Template: Define operational factors, create management models, and adapt performances.
- Plan: Suggesting the plans, choosing the plans, and fitting the budget.
- Observation: Gathering information, reporting KPI statuses, publishing performances.

- Analysis: find KPI gaps, sync KPIs, and change templates.
- Report: presenting results, consolidating reports

The created KPIs are selected according to the growth steps and analyzed for use in the business. These steps (The BSC Institute, 2016):

- Identification of the desired result,
- Taking alternative measures,
- Choosing the right measurement for each purpose and target,
- To show the relevant indicators correctly,
- The good setting of targets and levels,
- Defines and documents selected performance scales.

After defining the performance growth, the businesses move on to the performance analysis stage, respectively. Respectively:

- Choosing the most suitable automation tool
- Collect data and monitor performance
- Analyze and determine results
- Improving the resulting performance

While determining the necessary criteria in performance measurement, KPIs are determined according to the answers to the following questions (Bauer, 2004):

- How many measurements should be made?
- How often should measurements be made?
- Who is responsible for the measurements?
- How complex should the measurements be?
- How should the measurements be compared to normal conditions?
- How and for what purpose should the assessment be used?

Tables are created by evaluating the answers to the questions and based on the results of this table, a confidence interval is determined by using statistical data, and performance indicators are evaluated.

Based on the results, indicators' effectiveness are determined, and gaps are corrected if there are any managers have great duties for the functioning of the business in businesses performance measurement. "Manager Performance Indicators" are used for good management. Performance indicators created for managers have been prepared to determine whether managers are successful in the management process. For example, seventy-five KPIs are created by evaluating them in terms of finance, customer, marketing, operation or process, personnel, and external environment (Marr, 2012). These indicators support the manager and the management by showing the deficiencies of the management and the areas where it is successful. Each manager creates a strategy against where she/he wants to go by creating a suitable indicator in line with her/his goals. The seventy-five indicators that depend on the business structure expressed in Figure 3.12 achieve corporate goals by applying some or all of them.

Financial Performance	Customers	Market and Marketing Performance	Operational Performance	Employee Performance	Environmental and Social Sustainability
Net Profit	Net Promoter Score (NPS)	Market Growth Rate	Six Sigma Level	Human Capital Value Added (HCVA)	Carbon Footprint
Net Profit Margin	Customer Retention Rate	Market Share	Capacity Utilisation Rate (CUR)	Revenue Per Employee	Water Footprint
Gross Profit Margin	Customer Satisfaction Index	Brand Equity	Process Waste Level	Employee Satisfaction Index	Energy Consumption
Operating Profit Margin	Customer Profitability Score	Cost per Lead	Order Fulfilment Cycle Time	Employee Engagement Level	Saving Levels Due to Improvement Efforts
Profit Before Excess Tax and Depreciation	Customer Lifetime Value	Conversion Rate	Delivery In Full, On Time (DIFOT) Rate	Personal Advocacy Score	Supply Chain Miles
Revenue Growth Rate	Customer Turnover Rate	Search Engine Rankings and click-through rate	Inventory Shrinkage Rate (ISR)	Employee Churn Rate	Waste Reduction Rate
Total Shareholder Return (TSR)	Customer Engagement	Page Views and Bounce Rate	Project Schedule Variance (PSV)	Average Employee Tenure	Waste Recycling Rate
Economic Value Added (EVA)	Customer Complaints	Customer Online Engagement Level	Project Cost Variance (PCV)	Absenteeism Bradford Factor	Product Recycling Rate
Return on Investment (ROI)		Online Share of Voice (OSOV)	Earned Value (EV) Metric	360-Degree Feedback Score	
Return on Capital Employed (ROCE)		Social Networking Footprint	Innovation Pipeline Strength (IPS)	Salary Competitiveness Ratio (SCR)	
Return on Assets (ROA)		Klout Score	Return on Innovation Investment (ROI2)	Time to Hire	
Return on Equity (ROE)			Time to Market	Training Return on Investment	
Debt-to-Equity (D/E) Ratio			First Pass Yield (FPY)		
Cash Conversion Cycle (CCC)			Rework Level		
Working Capital Ratio			Quality Index		
Operating Expense Ratio (OER)			Overall Equipment Effectiveness (OEE)		
CAPEX to Sales Ratio			Process or Machine Downtime Level		
Price Earnings Ratio (P/E Ratio)			First Contact Resolution (FCR)		

Figure 3. 12. Business Structure

While evaluating the performance indicators of the businesses, the number of measurements to be used should be kept at an optimum level. Twelve characteristics should be considered in a good KPI application (Eckerson, 2009). These features can be given as follows:

- Aligned: KPIs should always be aligned with corporate strategy and goals.
- Owner: Each KPI must be owned by the individual or group owned.
- Strong predictive aspect: They are leading indicators of desired performance as they measure the values of businesses.
- Suitable for business: It should be filled with appropriate data at the right time so that users can take early precautions and intervene for performance improvement.
- Infrequent: Focus on high-value KPIs without too much distraction to users.
- Easy to understand: KPIs should be easy to understand.
- Balanced and connected: KPIs must balance and reinforce each other.
- Triggering change: Management should initiate a reaction to positive changes within the business.
- Standardized: KPIs are generally based on standard definitions and rules. This provides a link to dashboards within the business.
- Content-driven: KPIs are created based on performance issues. Thus, the progress of users over time should be observed.
- Strengthened with incentives: Businesses can increase the use of KPIs by adding compensation or incentives.
- Linked: KPIs lose their effectiveness over time. Therefore, it should be periodically reviewed and renewed.

These features have emerged from experience and businesses should know the corrective actions that need to be taken to improve performance.

4. RESULTS AND DISCUSSIONS

4.1. Information About the Company

This study has been applied in a factory that produces materials for the insulation sector operating on the Tarsus Adana highway. The factory was established in Mersin in 1986. It continues its activities in an approximately closed area of 30000 m² and a total area of 135000 m². The facility operates with an annual capacity of 55000 tons. It exports to 43 countries, mainly in the Balkans, the United States of America, the Middle East, and Africa.

Within the factory, the products are formed by melting the locally supplied inorganic raw materials at 1200°C - 1250°C. It can be produced in different sizes and technical features, with different coating materials, in the form of mattresses, plates, pipes, and costs, depending on the place and purpose of use. It provides fire safety together with heat insulation, sound insulation, and acoustic arrangement.

It aims to provide permanent superiority by creating differences in the insulation sector with a total of 161 people, including 6 managers, 35 white-collar and 120 blue-collar workers. Considering the importance of customer satisfaction and the quality of the products, it aims to provide reliable and sustainable service in the insulation sector.

It is offered to the market with the CE mark, which means the material that allows the product to meet the basic requirements specified in the regulation. The products have the EUCEB certificate given to the by-product category. It is also produced in accordance with the requirements of the Turkish Institute of Standards (TSE). Continuous improvement studies are carried out at the facility, and Kaizen and 5S projects are actively carried out.

4.2. Application of AHP-Based BSC to Company's KPI

In this study, an integrated AHP and BSC methodology is applied to evaluate the company's KPI data. In the BSC method, there are main criteria and sub-criteria related to performance. The main criteria are the financial dimension, customer dimension, internal processes dimension, learning, and growth dimension.

- The sub-criterion of finance is divided into six sub-criteria: net saleable output ratio, energy consumption ratio, stock turnover ratio, recycle ratio, ROI ratio, and total cost ratio.
- The main criterion of customer dimension has three sub-criteria: quality ratio, claim production ratio and claim logistics ratio.
- The main criterion of the internal processes dimension has five sub-criteria: OEE ratio, utilization ratio, availability ratio, performance rate, and overtime ratio.
- The main criterion of the learning and growth dimension has three sub-criteria: absenteeism ratio, holiday pay ratio, and personnel turnover ratio.

Calculating net saleable output ratio is an important factor that helps understanding actual sales of a business. Gross sales are helpful, but can be exaggerated if there are excessive returns, discounts, or loss of inventory. By subtracting these variables, a business can evaluate its actual sales and make important decisions based on sales figures. Likewise, the net sales ratio provides a more accurate understanding of how much money the business is making. It is important to understand market conditions and how consumers spend their money.

Adding the energy consumption ratio to the targets allows to prevent unnecessary energy use, reduce costs, protect the environment, and use energy efficiently.

Stock turnover ratio indicates how long it takes to replace or dispose of inventories in the business. It is an important item in inventory cost planning. When the stock turnover ratio is calculated as high, it is understood that there is a high demand for the products and the storage costs are not unnecessary. In addition, the stock turnover ratio shows that the goods are sold with an effective sales policy and are updated quickly.

The total cost is equal to the total cost of a certain amount of short-term commodity plus the fixed cost plus the variable cost. Total cost is the sum of all costs associated with producing a product or delivering a service. Costs such as the waste rate of a raw material or semi-finished product, processing difficulty, negative effects on production efficiency, maintenance costs, quality returns, inventory costs, payment deadlines directly affect the total cost.

It is very important to accurately forecast the demand for the products to be produced to plan the capacity and inventory requirements. Estimating the amount of goods or services that consumers will demand in the future should be followed up with monthly and annual targets. Following the claim production and logistics forecast ratio is important in this respect.

Recycling is the recycling of waste which can be re-used and transformed into secondary raw materials by various physical and/or chemical processes and included in the production process. The recycle ratio is important for the protection of nature and resources. It also contributes to energy saving.

Return on investment is the numerical data obtained by calculating the ratio between the profit and cost of an investment. ROI helps to clearly see the status of past investments and get the ideas needed to invest in the right area in the future. To maintain the profitability of existing investments, these numerical data should be used.

The calculation of the quality ratio, which is very important for the development of the enterprises, affects the product or service demand positively. This will contribute significantly to the growth and branding of the business.

OEE is a tool to calculate how efficiently production operation is used in a business. It helps to measure all losses in OEE production line and machines.

The utilization ratio which shows how much of the total production capacity is used, based on an enterprise or country scale. Changes in the rate of capacity utilization are one of the indicators which should be closely monitored, as they bring about significant changes in the costs, profitability, and cash flows of enterprises.

The availability ratio is the ratio of machine availability to planned production time. An excellent availability rate means that your operation operates continuously at programmed production hours. Monitoring machine operating times is an important indicator for the assessment of KPI objectives.

The success and sustainability of an organization are measured by performance evaluation. Performance ratio evaluation focuses on making the basic strategic decisions of the organization more economic and rational.

If the personnel turnover ratio is too high or close to zero, it negatively affects the corporate reputation. In addition, it leads to loss of customers, new talents not choosing the company, and negative performance of employees and human resources units. For this reason, the company must be in its goals.

The absenteeism ratio is obtained by dividing the total number of hours of work recorded in each period by the total planned hours of work. It should be part of the company's goals to find out what absenteeism issues are and why they are occurring, and what solutions can be implemented.

The study aims to evaluate the last 3 years' performance of the company according to the AHP-based BSC method. AHP, which is the one of the multi-criteria decision-making methods, is applied to determine the importance levels of the main and sub-criteria of each main criterion of the BSC. The priorities of the main and sub-criteria obtained with the AHP is also being used while evaluating the KPI with the BSC method.

4.3. Creation AHP Decision Hierarchy

The BSC is a performance evaluation method created specifically for each company. It is a systematic approach that shows where companies have been in the past and enables them to predict where they might be in the future. Sub-criteria of all main criteria are not considered when creating a company specific BSC. The criteria that the firm wants to evaluate are taken into consideration and evaluated.

In the study, the company's KPI data is presented to company managers to evaluate in the AHP decision hierarchy. Managers have decided on the sub-criteria that are important for the company to be used in practice. The AHP decision hierarchy created in the study is shown in Figure 4.1.

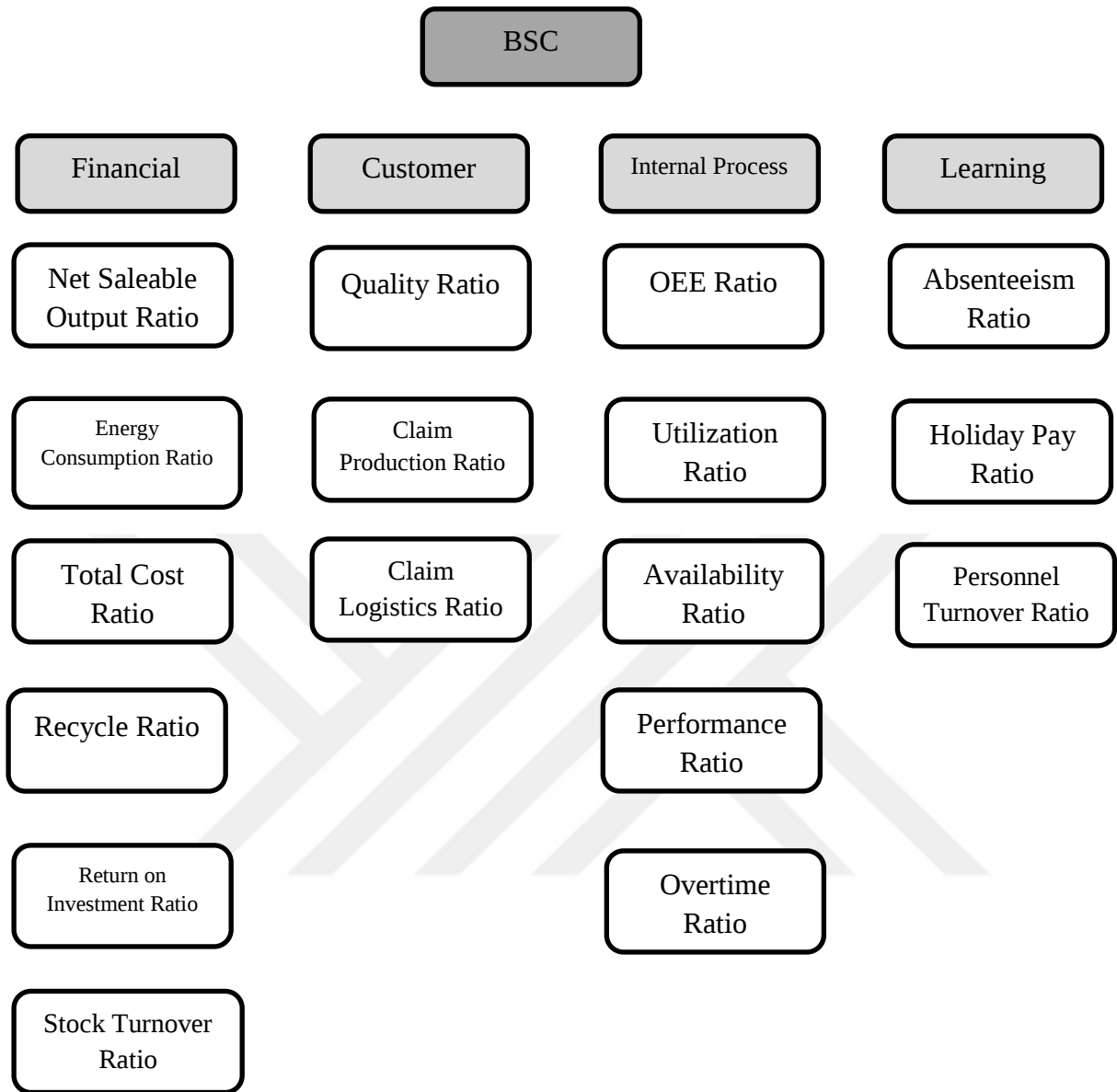


Figure 4. 1. AHP Decision Criteria

The first step of decision-making by AHP is to examine the problem and create a hierarchical structure to provide a better understanding as in Figure 4.1. The purpose of this hierarchical structure is to determine the criteria and alternatives. After the hierarchical structure is created, it comes to the stage of making pairwise comparisons of the main and sub-dimensions.

4.3.1. Creating The Comparison Matrix

Paired comparisons of the main and sub-criteria are made separately by the managers working in the company with the AHP method. Pairwise comparisons are made according to the 9-point scale developed by Saaty (2008) and paired comparison matrices are created. Pairwise comparison matrices reflecting the group decision are obtained by taking the geometric mean of the comparison matrices made by the administrators. The computational results are given in Table 4.1, Table 4.2, Table 4.3, Table 4.4, and Table 4.5.

Table 4. 1. Geometric Mean Values of Comparison Matrix for Main Criteria

	Financial Dimension	Customer Dimension	Internal Process Dimension	Learning and Growth Dimension
Financial Dimension	1	3,74	3,42	5,96
Customer Dimension	0,24	1	2,32	5,43
Internal Process Dimension	0,29	0,39	1	4,26
Learning and Growth	0,13	0,15	0,19	1

Table 4. 2. Geometric Mean Values of Comparison Matrix for Finance Dimension Sub-Criteria

	Net Saleable Output	Energy Consumption	Total cost	Recycle	ROI	Stock Turnover
Net Saleable Output	1	3,79	3,54	4,39	3,52	2,75
Energy Consumption	0,23	1	1,32	2,42	0,44	0,69
Total cost	0,29	0,65	1	4,42	1,65	0,45
Recycle	0,24	0,36	0,24	1	0,60	0,54
ROI	0,23	2,12	0,45	1,45	1	0,22
Stock Turnover	0,32	1,43	2	3	4,18	1

Table 4. 3. Geometric Mean Values of Comparison Matrix for Customer Size Sub-Criteria

	Quality Rate	Claim Production	Claim Logistics
Quality Rate	1	1,58	4,98
Claim Production	0,65	1	1,26
Claim Logistics	0,18	0,89	1

Table 4. 4. Geometric Mean Values of Comparison Matrix for Internal Process Size Sub-Criteria

	OEE	Utilization	Availability	Performance Rate	Overtime
OEE	1	0,72	0,49	1,47	1,55
Utilization	1,39	1	1,54	3,78	4,76
Availability	2,02	0,58	1	1,67	4,10
Performance Rate	0,61	0,28	0,44	1	3,65
Overtime	0,54	0,22	0,22	0,21	1

Table 4. 5. Geometric Mean Values of Comparison Matrix for Learning and Growth Size Sub-Criteria

	Absenteeism	Holiday Pay	Personnel Turnover
Absenteeism	1	3,18	0,16
Holiday Pay	0,28	1	0,12
Personnel Turnover	5,23	6,34	1

4.3.2. Creating Priority Matrices and Prioritizing Criteria

After the pairwise comparison matrices are obtained, each column is summed to normalize the matrices. The elements of the comparison matrix are divided by the sum of the respective columns. In the next step, the row sum and row average are taken for each criterion in the matrix. In this way, priority values for the criteria are obtained. Priority values for the main criteria and sub-criteria of BSC calculated by the AHP method are given in Table 4.6, Table 4.7, Table 4.8, Table 4.9, and Table 4.10.

Table 4. 6. Priority Matrix Values of Main Criteria

BSC Dimensions	Priority Matrix Values
Finance Dimension	0,56
Customer Dimension	0,23
Internal Process Dimension	0,13
Learning and Growth	0,08

According to the weights obtained by the AHP method, the most important dimensions of the BSC for the managers of the company is the financial dimension with 56%. Also, the customer dimension is about 23%. According to company managers, the internal processes dimension with approximately 13% value, and the learning and growth dimension is in the least degree of importance with 8%.

Table 4. 7. Priority Matrix Values of Sub-Criteria of Finance

Financial Dimension Criteria	Priority Matrix Values
Net Saleable Output	0,36
Energy Consumption	0,13
Total cost	0,12
Recycle	0,07
ROI	0,09
Stock Turnover	0,22

According to the order of importance determined by the AHP method for the financial dimension criteria of the company, the net saleable output ratio is 36%, the change in the energy consumption ratio is 13%, the total cost ratio is approximately 12%, the recycling is 7%, the return on ROI is 9%, and the stock turnover is 22% (Table 4.7.).

Table 4. 8. Priority Matrix Values of Sub-Criteria of Customer

Customer Dimension Criteria	Priority Matrix Values
Quality Rate	0,54
Claim Production Ratio	0,29
Claim Logistics Ratio	0,16

The weight ratings of the customer dimension, which is the second dimension of the BSC. The quality ratio is approximately 54%, the claim production ratio is 29% and the claim logistic ratio is 16%. In the sub-criteria of the customer dimension, the greatest importance belongs to the quality ratio with a ratio of 54%.

Table 4. 9. Priority Matrix Values of Sub-Criteria of Internal Process

Internal Process Dimension Criteria	Priority Matrix Values
OEE Ratio	0,18
Utilization	0,32
Availability Rate	0,28
Performance Rate	0,14
Overtime	0,07

Considering the weights, the degree of importance of the sub-criteria of the internal processes dimension are given in Table 4.9. The ratio OEE is calculated as 18%, the utilization ratio is 31%, the availability ratio is 28%, the performance ratio is approximately 14%, and the ratio of overtime is found as 7%.

Table 4. 10. Priority Matrix Values of Sub-Criteria of Learning and Growth

Learning and Growth Dimension Criteria	Priority Matrix Values
Absenteeism	0,19
Holiday Pay	0,08
Personnel Turnover	0,72

When it comes to the learning and growth dimension, which is the last criterion of the BSC, importance levels emerge as the ratio of absenteeism value is 19%, the ratio of holiday pay is 8% and the personnel turnover ratio is 72%.

The weight table of the main and sub-criteria to be used in the BSC method, which was created as a result of the calculations, is given in Table 4.11.

Table 4. 11. BSC Model Dimensions and Sub-Criteria Weights

Abbreviations	Criterion	Size weight	General weight
F1	Net Saleable Output Ratio	36,15	56 %
F2	Energy Consumption Ratio	13,36	
F3	Total cost Ratio	12,14	
F4	Recycle Ratio	7,22	
F5	ROI Ratio	9,08	
F6	Stock Turnover Ratio	22,05	
Financial Dimension Weight		100 %	
C1	Quality Ratio	54,32	23 %
C2	Claim Production Ratio	29,20	
C3	Claim Logistics Ratio	16,48	
Customer Dimension Weight		100 %	
I1	OEE Ratio	18,22	13 %
I2	Utilization Ratio	31,13	
I3	Availability Rate	28,12	
I4	Performance Rate	14,03	
I5	Overtime Ratio	8,50	
Internal Process Dimension Weight		100 %	
L1	Absenteeism Ratio	19,34	8 %
L2	Holiday Pay Ratio	8,26	
L3	Personnel Turnover Ratio	72,40	
Learning and Growth Dimension Weight		100 %	

As seen from Table 4.11, the financial dimension has a significantly higher degree of importance than the other three dimensions. The net saleable output, one of the sub-criteria of the financial dimension, is more important than the other sub-criteria, and the receivables turnover ratio has the least importance among the financial sub-criteria. While the most important criterion in the customer dimension sub-criteria is the quality rate, the least important criterion is the claim logistics ratio. In the internal processes dimension, the utilization ratio is more important than other criteria and the ratio of overtime to sales has lower importance. Finally, according to calculations made based on the views of the managers in the dimension of learning and growth, the most important criterion is the personnel turnover, and the least important is the ratio of change of holiday pay ratio.

4.3.3. Calculation of Consistency Ratios

For the priority matrix values, the consistency ratio needs to be calculated. Saaty (2008) argued that for priority values to be meaningful, the consistency ratio should be less than 0.10. To calculate the consistency ratio, the column matrix values of each criterion are multiplied by the priority values, and the weighted total matrix is obtained. The weighted total matrix values are proportioned to the priority matrix values. By taking the average of these values, the lambda max value is calculated. Then the Consistency Index and Randomness Index are calculated. It is investigated whether the consistency ratio is less than 0.10. The computational results of these values are shown in Table 4.12.

Table 4. 12. Lambda Max, Consistency Index and Consistency Ratio Values of Main Criteria and Sub-Criteria

	Main Criteria	Financial Dimension Sub Criteria	Customer Dimension Sub Criteria	Internal Process Sub Criteria	Learning and Growth Sub Criteria
Lambda Maks	4,34	6,45	3,08	5,12	3,02
Consistency Index	0,07	0,11	0,07	0,07	0,05
Consistency Rate	0,07	0,08	0,06	0,04	0,09

The consistency ratio of each main criterion and sub-criteria is less than 0.10. It can be said that the calculated priority values are consistent.

4.4. Evaluation of Firm Performance with The BSC Method

The 4 main criteria of the BSC and the sub-criteria of each main criterion are compared with each other using the AHP method and their importance levels are determined, and the BSC method is applied to evaluate the performance of the company.

The calculation of the criteria and sub-criteria that are considered while creating the BSC table is shown in Table 4.13.



Table 4. 13. Formulas of Criteria and Sub-Criteria Considered While Creating the BSC Table

BSC	Sub-Criteria of Dimensions	Form of Measurement
Financial Dimension	Net Saleable Output Ratio	$\text{Gross Sales} - (\text{Sales Discounts and Returns}) / \text{Total Saleable Output} \times 100 (\%)$
	Energy Consumption Ratio	$\text{Total Annual Amount of Energy Consumed} / \text{Amount of Production} \times 100 (\%)$
	Total Cost Ratio	$(\text{Fixed Cost Amount} + \text{Variable Cost Amount}) / \text{Total Sale Amount} \times 100 (\%)$
	Recycle Ratio	$\text{Total Recyclable Product Amount} / \text{Total Product Amount} \times 100 (\%)$
	Return on Investment Ratio	$\text{Total Profit (Revenue-Cost)} / \text{Total Cost} \times 100 (\%)$
	Stock Turnover Ratio	$\text{Total Sales Amount} / ((\text{Beginning Stock of Period} + \text{End of Stock Period}) / 2) \times 100 \%$
Customer Dimension	Quality Rate	$\text{Quality Product Quantity} / \text{Total Product Amount} \times 100 (\%)$
	Claim Production Ratio	$\text{Total Amount of Damaged Product} / \text{Net Profit Earned} \times 100 (\%)$
	Claim Logistics Ratio	$\text{Total Damaged Shipment Amount} / \text{Net Profit Earned} \times 100 (\%)$
Internal Process Dimension	OEE Ratio	$\text{Availability} (\%) \times \text{Productivity} (\%) \times \text{Quality} (\%)$
	Utilization Ratio	$\text{Total Billable Hours} / \text{Total Available Hours} \times 100 (\%)$
	Availability Rate	$\text{Uptime} / (\text{Uptime} + \text{Downtime}) \times 100 (\%)$
	Performance Rate	$(\text{Cycle Time} \times \text{Total Production Amount}) / (\text{Planned Production Time} - \text{Breakdown Time}) \times 100 (\%)$
	Overtime Ratio	$\text{Total Overtime Hours} / \text{Total Regular Hours} \times 100 (\%)$
Learning Growth and	Absenteeism Ratio	$(\text{Average Number of Employees} \times \text{Missed Workdays}) / (\text{Average Number of Employees} \times \text{Total Workdays})$
	Holiday Pay Ratio	$\text{Average Out the Number of Hours Worked} / \text{The Amount Paid} \times 100 (\%)$
	Personnel Turnover Ratio	$\text{Employees Who Left} ((\text{Employees at The Beginning} + \text{Employees at The End}) / 2) \times 100 (\%)$

Table 4. 14. Company's 2020-2021-2022 BSC Table

Criteria	Data			Dimension Weights	Dimension BSC Ratings			General Weights	General BSC Points		
	2020	2021	2022		2020	2021	2022		2020	2021	2022
Financial Dimension				100,00	23,83	27,82	41,1	55,92	13,32	15,56	22,98
F1	10,43	21,56	48,43	36,15	3,77	7,79	17,51	20,22	2,11	4,36	9,79
F2	14,56	9,45	3,23	13,36	1,95	1,26	0,43	7,47	1,09	0,71	0,24
F3	5,42	4,87	4,6	12,14	0,66	0,59	0,56	6,79	0,37	0,33	0,31
F4	22,76	23,44	17,84	7,22	1,64	1,69	1,29	4,04	0,92	0,95	0,72
F5	71,56	42,56	79,21	9,08	6,50	3,86	7,19	5,08	3,63	2,16	4,02
F6	42,24	57,21	64,05	22,05	9,31	12,61	14,12	12,33	5,21	7,05	7,90
Customer Dimension				100,00	35,31	39,80	45,07	23,08	8,15	9,19	10,40
C1	27,4	43,2	43,9	54,32	14,88	23,47	23,85	12,54	3,44	5,42	5,50
C2	47,82	31,38	54,21	29,20	13,96	9,16	15,83	6,74	3,22	2,11	3,65
C3	39,21	43,54	32,74	16,48	6,46	7,18	5,40	3,80	1,49	1,66	1,25
Internal Process Dimension				100,00	45,06	46,11	51,55	12,96	5,84	5,98	6,68
I1	65,18	58,3	68,34	18,22	11,88	10,62	12,45	2,36	1,54	1,38	1,61
I2	39,51	42,8	49,52	31,13	12,30	13,32	15,42	4,03	1,59	1,73	2,00
I3	36,22	39,23	43,54	28,12	10,19	11,03	12,24	3,64	1,32	1,43	1,59
I4	68,6	61,51	76,21	14,03	9,62	8,63	10,69	1,82	1,25	1,12	1,39
I5	12,67	29,46	8,78	8,50	1,08	2,50	0,75	1,10	0,14	0,32	0,10
Learning and Growth				100,00	3,68	6,28	5,28	8,04	0,3	0,51	0,42
L1	3,68	4,96	6,84	19,34	0,71	0,96	1,32	1,55	0,06	0,08	0,11
L2	11,42	7,5	15,43	8,26	0,94	0,62	1,27	0,66	0,08	0,05	0,10
L3	2,8	6,5	3,7	72,40	2,03	4,71	2,68	5,82	0,16	0,38	0,22
Total BSC Point									27,61	31,23	40,49

To evaluate the KPI of the company in the last 3 years using the BSC method, firm data are obtained for each main and sub-criteria dimension, and BSC dimension scores are calculated. While obtaining company data, the formulas in Table 4.13 are used.

Dimensional weights determined by the AHP method are added to the table. The BSC weights of the KPI data determined by the AHP method are calculated as a percentage. For example; The value of F1 in 2020 is 10.43 with the formula in table 4.13. With the AHP method, the BSC weight is 36.15. F1's 2020 value is 3.77 in calculations made by years.

The BSC weights in the middle part of the table are calculated as percentages according to the weights of the main criteria (financial, customer, internal process, learning and growth) in the AHP results. For example, whereas the BSC value of F1 is 3.77 in 2020, it has become 20.22 when assessed in its overall financial dimension (55.92%). F2, F3, F4, F5 and F6 were calculated as 7.47, 6.79, 4.04, 5.08, and 12.33, respectively. In the last columns of the table, the calculated BSC values for each year are collected in sequence. The total BSC score for each year has been reached. As a result, this was calculated as 27.61 in 2020, 31.23 in 2021 and 40.49 in 2022.

BSC evaluates the company from financial and non-financial aspects. As we can see in Table 4.14, several results can be obtained when the performance is evaluated by the company for 2020, 2021, and 2022. The firm displayed the highest performance in terms of the financial dimension, customer dimension, and internal processes dimension in 2022. The highest learning and growth dimension performance is observed in 2021. The firm's net saleable output and stock turnover ratio in 2022 contributed to the financial dimension measures reaching the maximum level. The two most important criteria for the company's internal processes dimensions are utilization and availability in 2022.

When the firm is analyzed every year, the learning and growth dimension performance has always shown a lower performance compared to other dimensions. The company's total performance score is 27.61 in 2020, and this ratio increased to 31.23 in 2021. In the last year, 2022, the company showed maximum performance and its performance reached 40.49.

As a result, the company, whose performance increases every year, can get information from the table and see which criteria should give more importance to be in a better position for the future. As it progresses in the criteria that it acts on, it will be at a better point in terms of

customer loyalty. It will be easier to determine where its employees are lacking and will reach maximum efficiency through orientation training and rotation.



5. CONCLUSIONS

The BSC method is an approach that enables the multidimensional measurement of business performance and thus enables businesses to focus on their strategies. The BSC approach emphasizes that both financial and non-financial metrics such as customer satisfaction, employee loyalty, and intangible values are important for evaluating the overall performance and future potential of a business. Therefore, it will contribute greatly to their future goals that should be measured.

The BSC model applied to a company in the insulation sector revealed that it is possible to evaluate the company's performance in a comprehensive manner by using the predetermined criteria of 4 main and 17 sub-dimensions. Throughout this assessment, the weight of the BSC criteria in the primary and secondary dimensions is determined by the AHP methodology. Subcriteria are created by manager selections, and progression with unnecessary data is eliminated. In this way, it has been tried to ensure that the criteria specific to both the sector and the business are fully included in the performance process. As a result of this study, it can be suggested that different businesses in the same sector can create original corporate performance scorecards by making use of the models and criteria obtained and their effects on corporate performance by applying them for a period of one, two, or three years.

The BSC's classification and evaluation of the business with 4 main criteria are of great importance for companies to see their past and future positions. Does it help to find answers to questions such as What was the position of the company in the past? And which criterion affects getting better future performance? For example, it shows whether the internal processes dimension should give more weight to the OEE or the utilization ratio during the period to have a higher performance in the next year. Answering their questions, BSC sheds light on companies to have a bright future.

Although there are performance measurement and evaluation studies in the insulation sector in the literature reviews, no study has been found in the BSC technique using KPI data in the insulation sector in international and national publications. This study aims to contribute to the

literature about the first BSC model applied in the insulation sector and is thought to shed light on other studies.



REFERENCES

Abdolshah, M., Javadinia, M., Astanbous, M. & Eslami, M. (2002). An integrated approach to analyze strategy map using BSC–Fuzzy AHP: A case study of the auto industry. *Management Science Letters*, 2(2): 705-712.

Acar, O. (2006). Bireysel Bankacılıkta Ürün Geliştirme Sürecinin Bir Alt Süreci Olarak Rekabetçi Fiyatlandırma Stratejisi ve Bu stratejiye Göre Fiyatlandırma Yönetiminin AHP Tekniğiyle Belirlenmesi. İstanbul Üniversitesi Sosyal Bilimler Enstitüsü Yüksek Lisans Tezi. Yanyınlanmamış Tez.

Ağca, V. & Tunçer, E. (2006). Çok Boyutlu Performans Değerleme Modelleri ve bir BSC uygulaması. *Afyon Kocatepe Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 8 (1) , 173-193

Asil, E. , Shahraki A. & Shahgholian K. (2013). Ranking critical success factors in chaos management using BSC and AHP methods. *Management Science Letters*, 3(6): 1649-1654.

Bauer, K. (2004) “KPIs - The Metrics That Drive Performance Management, Information Management and SourceMedia Inc.”, Brookfield USA, 8 October 2009,

Bentes, A. V. , Carneiro J., Da Silva J. F. & Kimura H. (2012). Multidimensional assessment of organizational performance: Integrating BSC and AHP. *Journal of Business Research*, 65(12): 1790-1799.

H. Ahmet Akdeniz, T. T. (2007). Türkiye’de Perakende Sektöründe Analitik Hiyerarşik Süreç Yaklaşımıyla Tedarikçi Performans Değerlendirmesi. *Dokuz Eylül Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 1-17.

Bahar Özyörük, E. C. (2005). Otomotiv Sektöründe Tedarik Seçimine Etki Eden faktörler ve Tedarikçi Seçimi. *V.Ulusal Üretim Araştırmaları Sempozyumu İstanbul Ticaret Üniversitesi*, 625-629.

B. Tutumlu , T. Saraç and M. Sağır. (2022). "Mavi yaka performans değerlendirmesinde kullanılacak ölçütlerin belirlenmesi için AHP temelli bir matematiksel model", *Pamukkale Üniversitesi Mühendislik Bilimleri Dergisi*, vol. 28, no. 1, pp. 173-182, Feb. 2022

Çelikdin, H. K. A. (2013). Balanced Scorecard ile analitik hiyerarşik proses yönteminin kullanılabilirliği üzerine bir uygulama. *Sosyal ve Beşeri Bilimler Dergisi*, 5(2): 142-151.

Coşkun, A. (2006). Bankaların Stratejik Performans Yönetiminde Performans Karnesinin Kullanımı. *Bankacılar Dergisi*, 28-30.

H. Karadal ve A. E. Çelikdin , "Balanced Scorecard Sisteminde Swot Analizi ile Ahp Kullanımı: Yem Sektöründe Bir Uygulama", *Çukurova Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, c. 23, sayı. 1, ss. 211-228, Eki. 2014

Didem Tezsürücü, A. O. (2016). The Implementation of DEAHP and AHP Methods to the New Product Development Process and Comparison of their Results. *Eurasian Academy of Sciences*, 14-25.

Doguc, O. (2022). Eleman İşe Alım Süreci İçin AHP Metodu ile Karar Destek Sistemi. *Ekonomi İşletme ve Maliye Araştırmaları Dergisi*. 4 (2) , 126-145

Domínguez, E., Pérez, B., Rubio, Á. L., Zapata, M. A., 2019, A taxonomy for key performance indicators management. *Computer Standards & Interfaces*, 64, p. 24-40.

Eckerson, Wayne W. (2005). "Performance Dashboards Measuring, Monitoring, and Managing Your Business", USA.

Eckerson, Wayne W. (2009). “Performance Management Strategies, How to Create and Deploy Effective Metrics”, England, 2009

Ensari, H. (2005). 21.YY. *Okulları İçin Etkili Bir Stratejik Yönetim Aracı: Balanced Scorecard*. İstanbul: Sistem Yayıncılık.

FinPa New Media. (2009). “Key Performance Indicators, FinPa New Media”, Melbourne, 24 February 2009.

Gökmen, A. (2009). Balanced Scorecard (Dengeli Başarı Göstergesi): Bsc Oluşturma Süreci ve uygulama Göstergesi. *Hitit Üniversitesi Sosyal Bilimler Üniversitesi Dergisi*, 11-23.

Haddadi, F. & Yaghoobi T. (2014). Key indicators for organizational performance measurement. *Management Science Letters*, 4(9): 2021-2030.

Kaba, M., Kılılı. M., Hatunoglu Z.(2014). Uludağ Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi. *Uludağ Journal of Economy and Society*. Cilt/Vol. XXXIII, Sayı/No. 1, 2014, pp. 71-94

Kohne, A. V. M. A., Yazdani B. & Kamalian A. (2013). Performance measurement in governmental agencies using BSC-AHP: A case study of civil registry office in Tehran. *Management Science Letters*, 3(4): 1255-1260.

Lee, A. H., Chen W. C. & Chang C. J. (2008). A Fuzzy AHP and BSC approach for evaluating performance of IT department in the manufacturing industry in Taiwan. *Expert Systems with Applications*, 34(1): 96-107.

Luis E. Quezada , Daniel E. Aguilera , Pedro I. Palominos & Astrid M. Oddershede (2021): An ANP Model to Generate Performance Indicators for Manufacturing Firms Under a Balanced Scorecard Approach, *Engineering Management Journal*.

Marr. B. (2012). “Key Performance Indicators (KPI): The 75 Measures Every Manager Needs to Know”, Pearson, UK

Nuri Ömürbek, E. A. (2016). Bir Petrol Şirketinin Çok Kriterli Karar Verme Teknikleri ile Performans Değerlendirmesi. *Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 723-756.

Özyörük, B., Şirin Y., Yoksulabakan T., Şanver M. & Saraç M. A. (2014). Performans ölçümünde dengelenmiş skor kart ve analitik hiyerarşi prosesi entegrasyonu. *Tübbas Dergisi*, 7(1): 7-28.

Papatya, N. (2006). İşletmelerde Rekabetçi Zekanın Değişen Yüzü: Girişimci Pazarlama. *PI: Pazarlama ve İletişim Kültürü Dergisi*, 45.

Parmenter, David. (2010). “Developing, Implementing, and Using Winning KPIs”, 2. Edition, USA, 2010

Parmenter, David. (2014). “Key Performance Indicators: Developing, Implementing, and Using Winning KPIs”, Third edition, USA, 2014

Pirtini, S. (2016). *Pazarlamada Müşteri Odaklılık ve Balanced Scorecard*. İstanbul: Beta Basım A.Ş.

Rainey, Hal G. (2010). “Understanding and Managing Public Organizations”, 4. Basım, USA, 2010

Reisinger, H., Cravens K. S. & Tell N. (2003). Prioritizing performance measures within the Balanced Scorecard framework. *MIR: Management International Review*, 43(4): 429-437.

Robert S. Kaplan, D. P. (2015). *Balanced Scorecard Şirket Stratejisini Eyleme Dönüştürmek*. İstanbul: Ceylan Matbaası.

Russ Kershaw, S. K. (2001). Developing a Balanced Scorecard to Implement St. Elsewhere Hospital. *Management Accounting Quarterly*, 28-35.

Saaty, T. L. (2008). Decision Making With The Analytic Hierarchy Process. *Int. J. Services Sciences*, 7.

Samir, K., Khabbazi, M. R., Maffei, A., Onori, M. A., 2018, Key performance indicators in cyber-physical production systems. *Procedia CIRP*, 72, p. 498-502.

Sezerel, B. (2008). AR-GE Departmanı İçin Bir Performans Değerlendirme Modeli: Kurumsal Karne ve Analitik Hiyerarşi Yönteminin Bütünleşik Uygulaması. İstanbul: İstanbul Teknik Üniversitesi Fen Bilimleri Enstitüsü.

Sharma, M. K. & Bhagwat R. (2007). An integrated BSC-AHP approach for supply chain management evaluation. *Measuring Business Excellence*, 11(3): 57-68.

Şimşek, O. (2022). Hibrid bir Çkkv modeli ile Türk bankacılık sektöründe finansal performans değerlendirmesi. *Turkish Studies - Economy*, 17(2), 447-470.

Tezel, B. (2009). Balanced Scorecard kullanılarak gıda sektöründeki ERP sistemleri seçimi için Bulanık AHP tabanlı karar destek sistemi (Yayımlanmamış Yüksek Lisans Tezi). İstanbul Teknik Üniversitesi, Sosyal Bilimler Enstitüsü, İstanbul.

Tsai, W. H., Chou W. C. & Hsu W. (2009). The sustainability Balanced Scorecard as a framework for selecting socially responsible investment: An effective MCDM model. *Journal of The Operational Research Society*, 60(10): 1396-1410.

Timor, D. D. (2011). Analitik Hiyerarşi Prosesi. İstanbul: Türkmen Kitabevi.

Tuğba Erciyes Eravcu, T. T. (2018). Çok Boyutlu performans Değerlendirme Aracı Olarak Balanced Scorecard Modelinin Çimento Sektöründe Kullanılması. *Dokuz Eylül Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 523-557.

Victoria, (2010). The Balanced Scorecard Institute, 2016 - <http://balancedscorecard.org/Resources/PerformanceMeasures-KPIs>

Wadugodapitiya, R. R. M. M. K., Sandanayake Y. G. & Thurairajah N. (2010). Building project performance evaluation model. In Proceedings of CIB 2010 World Congress. UK: The Lowry, Salford Quays, (13).

Yazıcıoğlu, Y. & Yıldırım, M. (2022). BİST inşaat endeksinde yer alan şirketlerin finansal performanslarının AHP ve VIKOR yöntemleriyle analizi. *Ömer Halisdemir Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 15 (3) , 647-662 .

Yüksel, İ. & Dağdeviren M. (2010). Using the fuzzy analytic network process (ANP) for Balanced Scorecard (BSC): A case study for a manufacturing firm. *Expert Systems with Applications*, 37(2): 1270-1278.

Yüreğir, Y. O. H. & Nakıboğlu, B. G. (2007). PERFORMANS ÖLÇÜMÜ VE ÖLÇÜM SİSTEMLERİ: GENEL BİR BAKIŞ . *Çukurova Üniversitesi Sosyal Bilimler Enstitüsü Dergisi* , 16 (2) , 545-562 .

APPENDIX

Appendix 1. First Manager's Evaluation of Main Criteria

	Financial Dimension	Customer Dimension	Internal Process Dimension	Learning and Growth Dimension
Financial Dimension	1	8	5	9
Customer Dimension	1/8	1	3	8
Internal Process Dimension	1/5	1/3	1	1/2
Learning and Growth	1/9	1/8	2	1

Appendix 2. First Manager's Evaluation of the Financial Dimension Sub-Criteria

	Net Saleable Output	Energy Consumption	Total cost	Recycle	ROI	Stock Turnover
Net Saleable Output	1	7	6	5	7	3
Energy Consumption	1/7	1	5	2	3	1/2
Total cost	1/6	1/5	1	5	4	1/3
Recycle	1/5	1/2	1/5	1	1/4	1/6
ROI	1/7	1/3	1/4	4	1	1/6
Stock Turnover	1/3	2	3	6	6	1

Appendix 3. First Manager's Evaluation of the Customer Dimension Sub-Criteria

	Quality Rate	Claim Production	Claim Logistics
Quality Rate	1	5	4
Claim Production	1/5	1	9
Claim Logistics	1/4	1/9	1

Appendix 4. First Manager's Evaluation of the Internal Process Dimension Sub-Criteria

	OEE	Utilization	Availability	Performance Rate	Overtime
OEE	1	6	1/5	1/7	4
Utilization	1/6	1	3	5	7
Availability	5	1/3	1	4	8
Performance Rate	7	1/5	1/4	1	6
Overtime	1/4	1/7	1/8	1/6	1

Appendix 5. First Manager's Evaluation of the Learning and Growth Dimension Sub-Criteria

	Absenteeism	Holiday Pay	Personnel Turnover
Absenteeism	1	3	1/4
Holiday Pay	1/3	1	1/5
Personnel Turnover	5	5	1

Appendix 6. Second Manager's Evaluation of Main Criteria

	Financial Dimension	Customer Dimension	Internal Process Dimension	Learning and Growth Dimension
Financial Dimension	1	6	8	6
Customer Dimension	1/6	1	4	5
Internal Process Dimension	1/8	1/4	1	3
Learning and Growth	1/6	1/5	1/3	1

Appendix 7. Second Manager's Evaluation of the Financial Dimension Sub-Criteria

	Net Saleable Output	Energy Consumption	Total cost	Recycle	ROI	Stock Turnover
Net Saleable Output	1	4	8	5	4	7
Energy Consumption	1/4	1	3	2	1/5	1/6
Total cost	1/8	1/3	1	7	6	1/5
Recycle	1/6	1/3	1/5	1	5	1/5
ROI	1/4	5	1/6	3	1	1/8
Stock Turnover	1/7	6	4	4	9	1

Appendix 8. Second Manager's Evaluation of the Customer Dimension Sub-Criteria

	Quality Rate	Claim Production	Claim Logistics
Quality Rate	1	6	6
Claim Production	1/6	1	1/7
Claim Logistics	1/6	7	1

Appendix 9. Second Manager's Evaluation of the Internal Process Dimension Sub-Criteria

	OEE	Utilization	Availability	Performance Rate	Overtime
OEE	1	1/5	1/7	1/6	1/3
Utilization	5	1	3	4	8
Availability	7	1/3	1	3	8
Performance Rate	6	1/4	1/3	1	6
Overtime	3	1/8	1/8	1/6	1

Appendix 10. Second Manager's Evaluation of the Learning and Growth Dimension Sub-Criteria

	Absenteeism	Holiday Pay	Personnel Turnover
Absenteeism	1	4	1/5
Holiday Pay	1/4	1	1/7
Personnel Turnover	5	7	1

Appendix 11. Third Manager's Evaluation of Main Criteria

	Financial Dimension	Customer Dimension	Internal Process Dimension	Learning and Growth Dimension
Financial Dimension	1	6	9	8
Customer Dimension	1/6	1	7	9
Internal Process Dimension	1/9	1/7	1	6
Learning and Growth	1/8	1/9	1/6	1

Appendix 12. Third Manager's Evaluation of the Financial Dimension Sub-Criteria

	Net Saleable Output	Energy Consumption	Total cost	Recycle	ROI	Stock Turnover
Net Saleable Output	1	4	1/5	6	1/3	2
Energy Consumption	1/4	1	1/4	3	1/8	1/6
Total cost	5	4	1	3	1/5	1/3
Recycle	1/6	1/3	1/3	1	1/6	1/4
ROI	3	8	5	6	1	1/7
Stock Turnover	1/2	6	3	4	7	1

Appendix 13. Third Manager's Evaluation of the Customer Dimension Sub-Criteria

	Quality Rate	Claim Production	Claim Logistics
Quality Rate	1	1/6	7
Claim Production	6	1	3
Claim Logistics	1/7	1/3	1

Appendix 14. Third Manager's Evaluation of the Internal Process Dimension Sub-Criteria

	OEE	Utilization	Availability	Performance Rate	Overtime
OEE	1	6	1/7	5	3
Utilization	1/6	1	1/2	5	7
Availability	7	2	1	8	3
Performance Rate	1/4	1/5	1/8	1	4
Overtime	1/3	1/7	1/3	1/5	1

Appendix 15. Third Manager's Evaluation of the Learning and Growth Dimension Sub-Criteria

	Absenteeism	Holiday Pay	Personnel Turnover
Absenteeism	1	5	1/7
Holiday Pay	1/5	1	1/8
Personnel Turnover	7	8	1