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Clarification and Evaluation of the Effectiveness of Company Strategies using a Combined BSC and FAHP Model

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ABSTRACT

Today, one of the crucial challenges faced by organizations is the effectiveness of organizational strategies and their evaluation. Therefore, the accuracy in examining options and selecting strategies that guide the organization towards its goals is a determinant of organizational success or failure. In this research, the Balanced Scorecard model, along with the fuzzy analytic hierarchy process and structural equation modeling, is employed to evaluate the effectiveness of strategies in a petrochemical company from financial, customer and market, internal process, and growth and learning perspectives. The main objective is to clarify the effectiveness of strategies in the petrochemical company in terms of financial, customer, internal process, and growth and learning perspectives. The research population consists of experts from the petrochemical company. Accordingly, samples of 70 and 10 experts were selected for surveying. The data collection tool was a questionnaire. The results indicate that the Balanced Scorecard has a positive impact on the strategies of the petrochemical company in all four perspectives, with financial indicators, customer and market indicators, internal process indicators, and growth and learning indicators being of greater importance, respectively.

1. INTRODUCTION

The effectiveness of organizational strategies refers to the extent to which an organization, utilizing its specific resources without wasting them and without unnecessarily exhausting its members and society, achieves its goals [1]. The complexity of the competitive business environment and increasing customer expectations highlight the need for awareness of the organization's strengths and weaknesses and continuous improvement of processes [2]. Therefore, today's managers are in search of a comprehensive, reliable, and flexible solution to evaluate their organizational performance. This evaluation not only ensures the implementation of their strategies but also provides accurate and sufficient information about their current position among competitors. Moreover, it enables them to enhance and improve their organization's future outlook [3].

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The Balanced Scorecard (BSC) is not just a comprehensive performance measurement method; it is a new strategic management approach introduced by Kaplan and Norton in the 1990s [4]. The BSC method presents a diverse set of performance indicators in four perspectives, including the financial perspective, customer and market perspective, internal business process perspective, and growth and learning perspective. Using BSC for evaluating the effectiveness of a company's strategies can be highly effective [5].

The Fuzzy Analytic Hierarchy Process (FAHP) is a mathematical model for multi-variable decision-making that has found widespread applications in various decision-making contexts. It combines the advantages of Fuzzy logic with the Analytic Hierarchy Process (AHP) to improve results and reliability [6]. The aim of this research is to employ the FAHP method to weight the perspectives and indicators of the effectiveness of strategies with a BSC approach in a petrochemical company. This will be accomplished through constructing a hierarchical framework and pairwise comparisons derived from the standard AHP questionnaire distributed among decision-makers. The objective is to enhance the evaluation of the effectiveness of strategies.

2. LITERATURE REVIEW

The Balanced Scorecard (BSC) is a set of quantitative measures selected based on the organization's strategy, linking overall goals, criteria, quantitative objectives, plans, and initiatives [7]. In other words, it is a comprehensive system aligning performance criteria with organizational strategies [8]. Initially introduced as a novel performance evaluation method, the BSC later evolved into a tool to assist in achieving the stated strategy. Its goal is to provide key success factors for business managers and create alignment between overall organizational performance and strategy [9].

In the strategy map, the organization is divided into four perspectives (or more), and the key (strategic) objectives of the organization outlined in the strategic plan are categorized in these four perspectives. These perspectives essentially represent all the elements and processes of the organization, including the financial perspective, customer perspective, internal business process perspective, and growth and learning perspective. Each organization can structure its strategy map more or less depending on its industry structure and dynamics. Objectives such as developing value-creating businesses, job creation and income generation, improving customer satisfaction, nurturing talents and innovative initiatives in corporate groups, increasing satisfaction among stakeholders and employees can be among the strategic objectives of the organization [10].

The BSC comprises four distinct perspectives that scrutinize the organization from different viewpoints. These perspectives are:

Financial Perspective:

- This perspective is employed to identify financial needs and organizational financial performance. It constitutes one of the most crucial elements of the BSC.

Customer Perspective:

- In business strategy, how an organization differentiates itself from its competitors to attract, retain, and deepen relationships with its targeted customers is of great importance. This perspective is used to gain insight into the level of customer satisfaction.

Internal Business Process Perspective:

- This perspective is used to evaluate the necessary processes within the organization. It encompasses criteria that must exist within the internal processes of the company to create satisfaction for stakeholders and customers.

Growth and Learning Perspective:

- The aim of this criterion is to address actions that should be taken in the growth, learning, and training of employees. This ensures the achievement of a desirable situation for stakeholders and customers, focusing on presence and survival in the competitive market [11].

Table 1. Sub-Indicators of the Four Perspectives

Perspectives	Sub-Indicators
Financial Perspective	- Asset Management
	- Sustainable Profitability
	- Revenue Growth
Customer and Market Perspective	- Product Delivery Cycle within Domestic Sales
	- Customer Loyalty
Internal Business Process Perspective	- Achievement of Nominal Capacity
	- Self-sufficiency in Manufacturing and Equipment Procurement
	- Waste Reduction
	- Sustainability and Quality Improvement of Products and Services
	- Optimal Management of Equipment and Technology
	- Energy and Environmental Pollutants Management
Growth and Learning Perspective	- Improvement of Organizational Leadership and Leaders' Style
	- Increase in Creativity and Innovation Culture
	- Strengthening Participation and Teamwork
	- Increase in Knowledge and Skills of Employees
	- Enhancement of Employees' Occupational Health Level

3. RESEARCH METHODOLOGY

This research is based on an applied objective and follows a descriptive-survey method. Data relevant to theoretical foundations and the extraction of primary factors and indicators were collected from library and internet sources, including books, articles, and case studies. To gather the necessary information for evaluating the effectiveness of strategies in the Petrochemical Company and examining the research hypotheses, a questionnaire was employed in two stages. The first questionnaire aimed to establish the validity and reliability of the research indicators and finalize the model. The second to fifteenth questionnaires were used for pairwise comparison of model options based on FAHP.

Given the nature of the research, in the first stage, a sample of 70 individuals was selected, and in the second stage, a sample of 10 experts from the Petrochemical Company was chosen for opinion gathering. Company experts are individuals who have received necessary training in the field of strategies and key concepts and can play an influential role in formulating strategies.

In this research, a questionnaire was used to collect primary data. A two-stage process was employed to analyze the collected data from the questionnaires. In the first step, the extracted indicators were incorporated into the dimensions of the BSC method. Subsequently, confirmatory factor analysis was used to determine the final indicators of the model, and based on standard coefficients, the final model indicators were extracted. In the second step, using FAHP, the weights of various factors and indicators of BSC were calculated. Additionally, structural model modeling was utilized to substantiate the research hypotheses. Overall, the software used in this research included SPSS, Lisrel, and Expert Choice.

To determine the validity of the factors and criteria that facilitated the selection process of model indicators, Cronbach's alpha coefficient was employed. Accordingly, regarding the influential indicators on the effectiveness of Petrochemical Company strategies, an initial questionnaire with 16 indicators based on the four main perspectives of BSC was designed, distributed, collected, analyzed, and confirmed.

4. RESEARCH RESULTS

4.1. Solving the Model with Fuzzy Analytical Hierarchy Process (FAHP)

Various methods have been developed for the FAHP technique, with the best one being a method called Developmental Analysis presented by a Chinese researcher named Dayong Zhang in 1996. The numbers used in this method are fuzzy triangular numbers. The basis of the current research is the method of comparative analysis.

As mentioned, six questionnaires were utilized to collect data in this research. The first questionnaire was designed to determine the validity and reliability of the research indicators. The second to sixth questionnaires were

used for pairwise comparison of model options based on FAHP. The questionnaires used for pairwise comparison of options are presented in Table 2.

Table 2: Specifications of Questionnaires Used in the Study

Measurement Dimensions	Purpose	Questionnaire No.
• Financial • Customer and Market • Internal Processes • Growth and Learning	Evaluation of the Effectiveness of Company Strategies	**1**
• Asset Management • Sustainable Profitability • Revenue Increase	Financial Evaluation	**2**
• Duration of delivery for domestic sales products • Customer loyaltyTop of Form	Evaluation from the Customer and Market Perspective	**3**
• Achieving nominal capacity • Self-sufficiency in manufacturing and equipment procurement • Waste reduction • Sustainability and improvement of the quality of products and services • Optimal management of equipment and technology • Energy management and environmental pollutants	Evaluation from the Aspect of Internal Processes	**3**
• Improving organizational and leadership styles • Increasing the culture of creativity and innovation • Strengthening participation and teamwork • Enhancing the knowledge and skills of employees • Elevating the level of occupational health for employees	Evaluation from the Aspect of Growth and Learning	**5**

4.2. Analysis of Questionnaire No. 1

The first level of the model refers to creating a pairwise comparison matrix related to the four dimensions of financial, customer and market, internal processes, and growth and learning, aiming to evaluate the effectiveness of the strategies of Petrochemical Company. The mentioned steps have been carried out in the previous section sequentially.

Step 1: Creating a pairwise comparison matrix and determining the geometric mean based on the pairwise comparison matrix (Table 3).

Table 3. Geometric Mean Matrix Based on Pairwise Comparison Matrix - Questionnaire 1

Evaluation of the effectiveness of strategies	Financial Aspect			Aspect of Customer and Market			Aspect of Internal Processes			Aspect of Growth and Learning		
Financial Aspect	1	1	1	1.269	2.605	4.516	1.712	3.37	5.33	2.954	4.444	6.025
Customer and Market Aspect	0.221	0.384	0.788	1	1	1	1.311	2.758	3.215	2.357	4.483	6.376
Internal Processes Aspect	0.188	0.297	0.584	0.267	0.394	0.896	1	1	1	1.001	2.078	3.834
Growth and Learning Aspect	0.166	0.225	0.338	0.157	0.223	0.424	0.261	0.481	0.992	1	1	1

Step2: Calculations of Fuzzy Analytic Hierarchy Process (FAHP)

A. Calculation of the value for each criterion

S1= (0.639, 11.419, 16.871) *(0.027, 0.039, 0.063) = (0.187, 0.445, 1.063)

S2= (4.889, 8.625, 11.379) *(0.027, 0.039, 0.063) = (0.132, 0.336, 0.717)

S3= (2.456, 3.769, 6.314) *(0.027, 0.039, 0.063) = (0.066, 0.147, 0.398)

S4= (1.584, 1.929, 2.754) *(0.027, 0.147, 0.063) = (0.066, 0.147, 0.398)

B. Calculation of the Probability of Superiority for Each of the Above Elements

V(S1≥S2)=1	**V(S2≥S1)=0.829**	**V(S3≥S1)=0.414**	**V(S4≥S1)=0.002**
V(S1≥S3)=1	V(S2≥S3)=1	V(S3≥S2)=0.585	V(S4≥S2)=0.139
V(S1≥S4)=1	V(S2≥S4)=1	V(S3≥S4)=1	V(S4≥S3)=0.600
V(S1≥S2, S3, S4)=1	V(S2≥S1, S3, S4)=0.829	V (S3≥S1, S2, S3) =0.414	V (S4≥S1, S2, S3) =0.002

C. Calculation of normalized weights or coefficients in FAHP:

W= (0.445, 0.369, 0.184, 0.001)

In this manner, the weights for the financial aspect, customer and market aspect, internal process aspect, and growth and learning aspect are calculated as 0.445, 0.369, 0.184, and 0.001, respectively. Subsequently, questionnaires two to five have been examined and analyzed in the same order. A summary of the weighted ranking of the four dimensions (financial, customer and market, internal processes, and growth and learning) and their respective sub-indicators is provided individually in Table 4.

Table 4. Final Results of Weighted Index Dimensions

Dimensions 16-Index Indicators			**Four Quadrant**		
Rank	Weight	Indicator	Rank	Weight	Aspects
3	0.214	Asset Management	1	0.445	Financial Aspect
1	0.494	Stable Profitability			
2	0.292	Increase in Revenue			
1	0.770	Internal Sales Product Delivery Time	2	0.39	Customer and Market Aspect
2	0.230	Customer Loyalty			
1	0.512	Attainment of Nominal Capacity	3	0.184	Internal Process Aspect
6	0.000	Self-Sufficiency in Manufacturing and Equipment Procurement			
4	0.061	Waste Reduction			
2	0.257	Stability and Improvement of Product and Service Quality			
3	0.158	Optimal Management of Equipment and Technology			
5	0.012	Energy Management and Environmental Pollutants			
1	0.433	Improvement of Organizational Leadership Style and Leaders	4	0.001	Growth and Learning Aspect
2	0.271	Increase in Culture of Creativity and Innovation			
3	0.167	Enhancement of Team Participation and Activities			
4	0.129	Increase in Employee Knowledge and Skills			
5	0.000	Asset Management			

To examine the hypotheses in this research, structural equation modeling has been employed after ranking using Fuzzy Analytic Hierarchy Process (FAHP). It is noteworthy that the questionnaire utilized in this section is the same as Questionnaire Number 1. The software utilized for analysis is LISREL. Two analyzable outputs from LISREL include the model in the significant state and the model in the standard state, depicted in Figures 1 and 2, respectively.

As observed in the execution of the model in the significant state, the standardized coefficients of the relationships within the range (-1.96 and +1.96) are not present. Therefore, this relationship will be significant at a 99% confidence level. The execution of the model in the standard state also indicates that all factor loadings of the model are above 0.5 and acceptable.

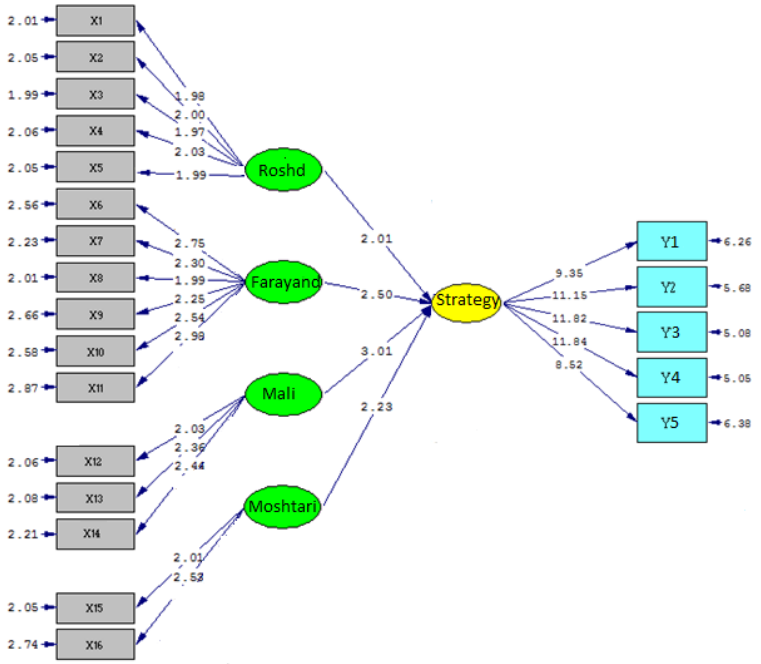

Fig. 1. Implementation of the Model in a Significant State

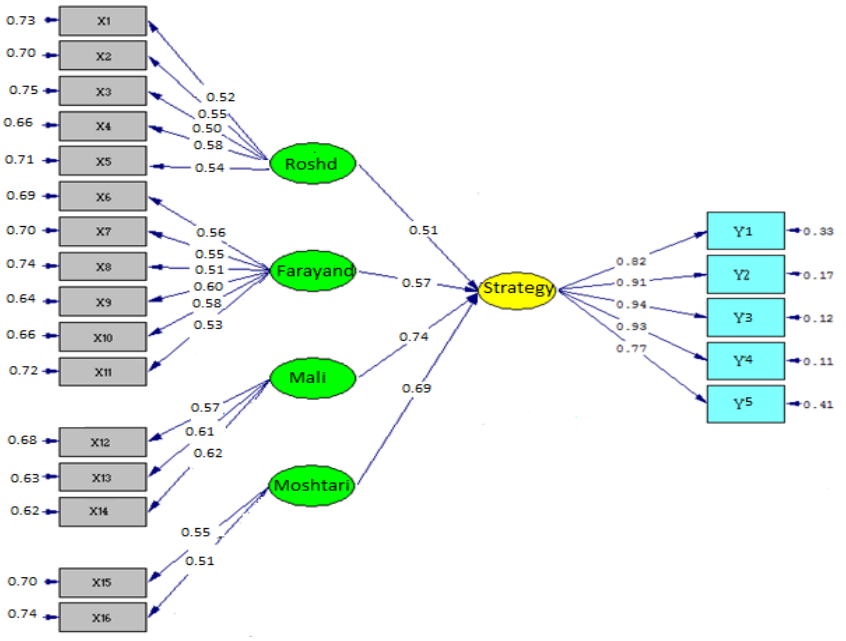

Fig. 2. Implementation of the Model in the Standard State

Additionally, it is essential to assess the model fit. This process is accomplished by calculating fit indices. In Table 5, values related to model fit indices are presented.

Table 5. Model Fit Indices

Value	Fit Index
0.907	**Loreskog GFI**
0.782	**Loreskog AGFI**
0.956	**Bentler-Bonett NFI**
0.910	**Bentler-Bonett N-NFI**
75.506667	**ML chi-square**
40	**Degrees of Freedom**
0.043	**p-level**
0.032	**RMS standardizel**

One of the common indices for assessing model fit is the Chi-Square divided by degrees of freedom, known as the Chi-Square/df ratio. Most researchers recommend accepting model fit when this ratio is less than 3. Therefore, considering that the obtained ratio is 1.8 and the significance level is also 0.043 (less than 0.05), the goodness of fit for the conceptual model hypotheses using the Chi-Square/df ratio and significance level is confirmed.

Additionally, for other fit indices:

- If the Chi-Square/df ratio is less than 3, the fit is considered good.
- If RMSEA (Root Mean Square Error of Approximation) and SRMR (Standardized Root Mean Square Residual) are less than 0.5, it indicates good fit. Values between 0.05 and 0.08 are also acceptable for RMSEA.
- In this model, SRMR is 0.032, suggesting a good fit.
- GFI (Goodness of Fit Index) with a value of 0.91, AGFI (Adjusted Goodness of Fit Index) with 0.78, NFI (Normed Fit Index) with 0.96, and NNFI (Non-Normed Fit Index) with 0.91 all indicate good fit.

Now, we can proceed to the confirmation of the research hypotheses (Table 6)

Table 6. Summary of Hypotheses Results

Hypothesis	Aspects	Statistically Significant Values	Standard Coefficient	Confirmation/Rejection
1st	Financial	3.01	0.74	Confirmation
2nd	Customer and Market	2.23	0.69	Confirmation
3rd	Internal Processes	2.5	0.57	Confirmation
4th	Growth and Learning	2.01	0.51	Confirmation

According to Table 6, the significant and standard values for each of the four perspectives (Financial, Customer and Market, Internal Processes, Growth and Learning) elucidate the effectiveness of the strategies employed by the petrochemical company. As their significance coefficients do not fall within the range of (-1.96 and +1.96), the mentioned relationships will be statistically significant at a 99% confidence level. Additionally, their standard coefficients exceed 0.5, making them acceptable. With (sig=0/000), it is indicated that all hypotheses are confirmed.

5. DISCUSSION AND CONCLUSION

As indicated, the weights for the financial aspect, customer and market aspect, internal processes aspect, and growth and learning aspect are 0.445, 0.369, 0.184, and 0.001, respectively. Consequently, among the four perspectives of the Balanced Scorecard (BSC) in the petrochemical company, the financial aspect holds the highest importance, while the growth and learning aspect has the least significance.

This aligns with the findings of Lee et al. (2008), suggesting that financial indicators have a greater impact on company performance among the major BSC perspectives [4]. The research by Haung (2009) also supports the idea that financial indicators play a substantial role in influencing the performance of banks [8]. Zin et al.'s study (2013) indicates that the customer and market perspective has a significant impact on company performance, emphasizing its importance [10].

In the context of the internal process indicators, achieving nominal capacity holds the highest importance, while self-sufficiency in equipment procurement has the least significance. This suggests that long-term goals receive less attention. The high score for nominal capacity (as opposed to actual capacity) indicates a promotional nature and advertising aspects of the issue.

Within the indicators of growth and learning, improving organizational leadership style is of utmost importance, while enhancing employees' job health has the least significance. Although leadership style is crucial for process improvement and organizational efficiency, evidence shows that the safety and health of employees are gaining more importance over time. This issue is reflective of both physical and social/psychological aspects, considering challenges in environmental, organizational, and individual domains in the current world.

In conclusion, the results emphasize the significance of financial aspects in the petrochemical company. Among the financial indicators, stable profitability holds the highest importance, and asset management has the least significance. This result reflects the result-oriented nature of approaches and expectations.

Regarding customer and market indicators in the petrochemical company, the delivery time of products holds the highest importance, while customer loyalty has the least significance. This result indicates a short-term approach and organizational priorities.

Among the internal process indicators in the petrochemical company, achieving nominal capacity holds the highest importance, while self-sufficiency in equipment procurement has the least significance. The results suggest that long-term goals receive less attention, and the high score for nominal capacity indicates a promotional and advertising aspect.

In terms of growth and learning indicators in the petrochemical company, improving organizational leadership style is of utmost importance, while enhancing the job health level of employees has the least significance. While leadership style is crucial for organizational performance, evidence suggests that the safety and health of employees are gaining more importance over time.

Finally, based on the research results, the following recommendations are proposed for improvement:

- To enhance the financial aspect, proper asset management is suggested, such as increasing capital productivity and asset turnover.
- To improve the customer and market aspect, customer-centric systems should be established at the company level. This involves reducing the product delivery time, enhancing communication channels with customers, and creating higher customer loyalty.
- To enhance the internal process aspect, increasing production efficiency and productivity with the goal of achieving nominal capacity are recommended.
- For the growth and learning aspect, creating a culture of creativity and innovation within the company, supporting creative ideas, strengthening teamwork, and encouraging employees to utilize these aspects are recommended. Additionally, promoting the job health level of employees is suggested.

Transparency Statement

The data supporting this study are available upon reasonable request to the corresponding author, subject to ethical and confidentiality considerations.

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Declaration of Interest

The authors declare that they have no competing interests.

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