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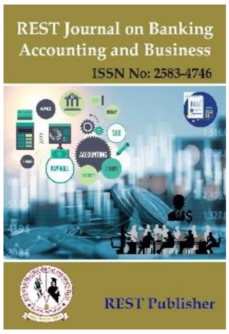

Optimizing Supplier Selection Process in the Dairy Industry: A Comprehensive Framework for Enhanced Efficiency and Quality Assurance

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Abstract: *A key factor in the success of dairy industry enterprises is the supplier selection procedure. With a focus on obtaining high-quality raw materials and ensuring a reliable supply chain, dairy companies must carefully evaluate and choose their suppliers. The supplier selection process involves assessing various factors, including the supplier's reputation, product quality, pricing, delivery capabilities, and compliance with industry standards. Additionally, considerations such as sustainability practices, food safety certifications, and proximity to production facilities are vital. A well-executed supplier selection process in the dairy industry ensures that companies can maintain consistent product quality, meet customer demands, and uphold industry regulations. The dairy industry's supplier selection procedure has the ability to increase operational effectiveness, product quality, and overall competitiveness, which makes it important for research. By carefully examining and comprehending the elements that affect supplier selection choices, this research can provide valuable insights for dairy companies. It can help them optimize their supply chain, minimize risks, and strengthen relationships with reliable suppliers. Additionally, the research can contribute to the development of best practices and guidelines for supplier evaluation and selection, leading to improved industry standards and enhanced consumer trust. Ultimately, an effective supplier selection process can positively impact the entire dairy industry by ensuring a sustainable and reliable source of high-quality raw materials. A combination of qualitative and quantitative methods will be used in the methodology for the research of the dairy industry's supplier selection process. Firstly, a comprehensive literature review will be conducted to gather insights into the existing supplier selection criteria and methodologies used in the industry. This will be followed by qualitative interviews and surveys with key stakeholders such as dairy company managers, procurement professionals, and suppliers to gather their perspectives on the supplier selection process. To find recurring themes and patterns, the obtained data will be examined utilizing qualitative data analysis approaches. Additionally, using statistical techniques and models like the Analytic Hierarchy Process (AHP) and TOPSIS, quantitative analysis will be done to assess the significance and effectiveness of various supplier selection criteria. To provide a comprehensive understanding of the supplier selection procedure in the dairy business, the results from both qualitative and quantitative assessments will be merged. Alternative parameters: Price, Product, On-time delivery, supply capacity, and track record of performance. Price, Product, Delivery on time, supply capacity, and performance history. Both the Alternative and Evaluation Parameters are Same. By using the DEMATEL for Supplier Selection Process in Dairy Industry in Price is on 1st Rank, Product is on 2nd Rank, Performance History is on 3rd Rank, Capacity of Supply is on 4th Rank and on time delivery is on 5th Rank.*

Keywords: Supplier selection, sustainability, multi-criteria decision-making (MCDM), and grey relational analysis fuzzy logic are all covered by DEMATEL (Decision Making Trail and Evaluation Laboratory).

1. INTRODUCTION

There are various steps in the approach for examining the supplier selection process in the context of ecological effectiveness and environmental issues in the dairy industry. Firstly, a comprehensive review of existing literature will be conducted to identify the gap in previous studies regarding the consideration of environmental issues in supplier selection. This will aid in determining the study's research importance. In order to gain understanding of the significance of environmental sustainability in the supply chain and the specific green criteria that may be

implemented into the supplier selection process, data will then be gathered from a variety of sources, including industry reports, case studies, and expert interviews. To ascertain the effect of environmental requirements on supplier selection decisions, the obtained data will be analysed using qualitative and quantitative methodologies. To evaluate the qualities of possible suppliers and give preference to those who support the environmental objectives of the dairy industry, the House of Quality (HoQ) model will be used. By integrating green criteria into the supplier selection process, this research aims to contribute to the understanding of environmental sustainability in supply chain management and provide practical guidelines for selecting environmentally responsible suppliers in the dairy industry.[1] A thorough examination of sustainable supplier selection was undertaken in a study by Luthra et al. (2017), taking into account 22 different parameters. Product quality, cost, flexibility, dispatching, technical capability, production, service, location and position, market, financing, organisational management, communication, and attitude were among the economic criteria that were prioritised.. The environmental criteria covered things like ecodesign, environmental management systems, pollution control, resource use, pollution reduction and recycling. The social criteria were broken down into internal and exterior components. The internal components took into account the staff's rights, safety, and well-being, as well as supportive activities. The external components covered the effects on regional communities, stakeholders, and information disclosure. This extensive framework offers an integrative perspective on the numerous aspects of sustainable supplier selection.[2] The tendency in research to combine several methods for gauging suppliers' performance in sustainable supplier selection (SSS) has been developing in recent years. The goal of this method integration is to get over the drawbacks of using solitary procedures and offer more thorough solutions. Several studies have utilized multi-criteria decision-making (MCDM) tools to contribute to SSS, employing approaches such as Bottani and Rizzi (2008), Chen and Wang (2009), Awasthi, Chauhan, and Goyal (2010), and Amindoust et al. (2012). Nevertheless, building decision-making procedures for SSS through integrated methods can be difficult because each method has unique capabilities that only produce stable solutions when properly combined. To address these issues, the literature on choosing green suppliers largely uses single model approaches based on fuzzy analysis (Govindan et al., 2015).[3] De Boer et al. (2001) did a thorough analysis of supplier selection techniques, classifying them according to the various stages of the selection procedure. In the final decision step, they emphasised the use of linear weighting models, and several authors recommended the Analytic Hierarchy Process (AHP) as a dependable and consistent methodology. De Boer et al. (1998) investigated the usefulness of outranking techniques for supplier selection, such as ELECTRE. These techniques have benefits for dealing with uncertainty and enabling compensating comparisons between options. AHP was discovered to be a useful and adaptable strategy for decision-making by Yahya and Kingsman (1999). AHP was also suggested as a method for supplier selection in several research, such as Nydick and Hill (1992), Masella and Rangone (2000), Morlacchi (1999), and Kahraman et al. (2003).[4] Companies are concentrating more and more on strengthening their competitive edge over competitors today (Jadidi et al., 2015). By increasing the effectiveness of their supply chain systems, they hope to provide customers with high-quality, reasonably priced goods and services (Moghaddam, 2015). Suppliers, distributors, retailers, and customers often make up the supply chain structure (Hugos, 2011). Since purchasing expenditures account for a sizable amount of internal expenses, choosing suppliers is an important activity for the majority of businesses (Aissaoui et al., 2007). This procedure requires taking into account a variety of factors, some of which may be interdependent and at odds. Traditional approaches for generating multi-criteria decisions call for laborious calculations and may not be useful or appropriate in ambiguous situations (Karbasian et al., 2011). Fuzzy neural networks (FNN) and fuzzy analytic hierarchy process (FAHP)-fuzzy goal programming (FGP) are recent approaches that have evolved to address these problems. These techniques provide high precision, effectiveness, and the capacity to tackle difficult and ambiguous issues. For businesses and organisations, the supplier selection issue is a crucial part of supply chain management. Optimising supply chain operations requires a significant investment of time, money, and skill, with supplier selection playing a key role.. Companies and manufacturing facilities take into account a variety of elements that affect the opinions of decision makers in order to make educated judgements and choose the best supplier from a pool of options. Industry-specific variations in these variables force businesses to specify and hone the standards they use to fairly assess providers. In the supplier selection dilemma, the selection criteria are crucial since suppliers' preferences are greatly influenced by how the criteria are presented and described. Companies and manufacturing facilities frequently concentrate on specifying parameters or standards linked to the technical components of the issue.[6]
Small and medium-sized businesses (SMEs) in Malaysia's food processing sector frequently choose suppliers based on pricing, which can lead to poor supplier decisions. These SMEs also struggle to retain their competitiveness due to a lack of managerial skills and a slower adoption of management techniques for raising quality and improving operations. This study uses the Analytic Hierarchy Process (AHP) methodology to determine the optimal supplier criterion for SMEs in Malaysia's food processing industry in order to address these problems. By using this model, the research aims to offer SMEs a systematic method of supplier selection that

takes into account elements other than price, ultimately resulting in more precise and efficient supplier selections.[7] Processes used by businesses to pick their suppliers (SSPs) must take both qualitative and quantitative variables into account. These tactics are regarded as major operational decisions and have a substantial effect on the performance of the entire business. Six steps make up the usual strategic sourcing process: evaluating prospects, internal and external profiling, designing the sourcing strategy, screening vendors, conducting supplier selection, and negotiating and implementing agreements.. Kralijc's concept divides supplies into four quadrants according to their level of complexity/risk and potential worth. The problem definition, criterion formulation, qualifying, and final choice processes are included in the SSP framework. Based on their unique needs, buyers should develop criteria for evaluating suppliers. Important factors for choosing suppliers include quality, delivery, performance history, warranties and claim policies, production facilities and capacity, net price, technical capabilities, and financial status, which have all been found in various studies. Depending on the procurement situation, different factors may rank differently.[8] Pakistan's cold supply chain concept is still in its infancy, and there has been little research done specifically on sustainable initiatives for frozen goods. Few studies have examined the cold supply chain for fresh food items, health, or Medicare. The vast majority of current literature is centred on agriculture and the conventional food supply chain.The hazards connected to the fresh food supply chain were emphasised in a Pakistani study, along with potential solutions. The study (Mehmood et al., 2010) emphasised the necessity for appropriate training and operational methods to address the difficulties in the cold supply chain for fresh food. In a further study, cold chain best practises in Pakistani high-polio risk areas were optimised. To guarantee that polio vaccination campaigns are effective, the research highlighted the significance of enhancing cold chain procedures at the sub-district and district levels (Khan et al., 2017).In addition, a study evaluated the practical expertise of health professionals in Quetta with reference to cold chain procedures at health facilities. The goal was to assess health workers' knowledge of cold chain practises and their level of understanding of them (Buledi et al., 2017).Although these studies shed light on Pakistani cold chain practises, they don't pay enough attention to sustainability and supplier choice in the context of the cold supply chain. For the Pakistani cold supply chain, this research study attempts to discover and choose efficient, sustainable, and socially responsible providers.[12] The subsequent portions of the essay give an analysis of the pertinent literature with an emphasis on the supplier selection issue. The solution the authors propose for the supplier selection issue includes the Analytic Network Process (ANP), Quality Function Deployment (QFD), and a Markov chain.. The technique is demonstrated by using it in a real-world business context, proving its usefulness and effectiveness in supplier selection. Discussion of the application's outcomes and conclusions highlights the advantages and new knowledge that may be gleaned from applying the suggested approach. The study ends with a brief assessment of the research's ramifications and contributions to the supplier selection sector. The main conclusions and possible future study directions in this field are summarised by the authors.[13].

2. MATERIALS & METHODS

Price: Price plays a crucial role in the supplier selection process in the dairy industry. It is important to evaluate and compare the prices offered by different suppliers to ensure competitiveness and cost-effectiveness.While price is an important factor, it should not be the sole determinant in supplier selection. It is essential to consider other factors such as quality, reliability, and service in order to strike the right balance between cost and value for the dairy industry.

Product: The quality and suitability of the product offered by a supplier are key considerations in the supplier selection process in the dairy industry. It is important to assess factors such as freshness, taste, nutritional content, and compliance with industry standards to ensure the delivery of high-quality products to customers.The variety and range of products offered by a supplier also play a significant role in supplier selection. Dairy industry businesses often require a diverse range of products, such as milk, cheese, yogurt, and butter. Choosing a supplier that can provide a comprehensive product portfolio can help meet the diverse needs of the market and enhance customer satisfaction.

On time delivery: Timely delivery is a critical factor in supplier selection for the dairy industry. Given the perishable nature of dairy products, it is essential for suppliers to have a reliable track record of delivering orders on time. This ensures that products reach the market and customers in a fresh and timely manner, preventing any potential disruptions in the supply chain.On-time delivery also helps maintain production schedules and meet customer demand. In the dairy industry, where products have specific shelf lives, delays in delivery can result in product spoilage, increased inventory holding costs, and dissatisfied customers. Selecting suppliers with a proven track record of consistently meeting delivery deadlines helps ensure smooth operations, minimize waste, and enhance customer satisfaction.

Capacity of supply: When choosing a supplier for the dairy business, the capacity of the supply is a key factor. Suppliers must be able to regularly supply the demand for dairy products. This includes having the necessary production facilities, equipment, and resources to ensure a sufficient supply of milk, cheese, butter, and other dairy products to meet customer requirements.Assessing the capacity of supply involves evaluating the supplier's production capabilities, inventory management systems, and their ability to scale production based on market demands. A supplier with a robust and flexible supply capacity can accommodate fluctuations in demand, seasonal variations, and potential growth opportunities. Choosing suppliers with adequate capacity ensures a reliable and uninterrupted supply of dairy products, minimizing the risk of stockouts and production delays.
Performance history: Performance history is a key factor in the supplier selection process for the dairy industry. It involves evaluating a supplier's track record and past performance in terms of delivering quality products, meeting delivery schedules, and maintaining consistent product standards. A supplier with a strong performance history demonstrates reliability and consistency, which is essential for ensuring the smooth operation of the dairy production and supply chain.When assessing performance history, factors such as adherence to food safety and quality standards, customer satisfaction ratings, and any previous instances of product recalls or quality issues should be considered. Suppliers with a positive performance history indicate their commitment to delivering high-quality dairy products and their ability to consistently meet the industry's stringent requirements. This information helps dairy industry stakeholders make informed decisions and select suppliers with a proven track record of excellence in performance.
DEMATEL Method: It is suggested that the Decision Making Trial and Evaluation Laboratory (DEMATEL) method be expanded with fuzzy logic in order to overcome the drawbacks of utilising crisp values in decision-making and to better handle the fuzziness and imprecision of real-world problems. When employing a causal diagram to visualise causal linkages between sub-systems, the DEMATEL approach is a potent way for acquiring group knowledge.. But when it comes to making decisions, human assessments of preferences are frequently ambiguous and challenging to describe properly using numerical numbers.Fuzzy logic offers a practical framework for dealing with issues characterised by ambiguity and imprecision.. By incorporating fuzzy logic into the DEMATEL method, decision-makers can make more informed and effective decisions in fuzzy environments. This extension allows for a more flexible representation of preferences and provides a better understanding of the interrelationships among sub-systems. By combining the strengths of the DEMATEL method and fuzzy logic, decision-makers can overcome the limitations of crisp values and better capture the complexities and uncertainties inherent in real-world decision-making scenarios.[1] The DEMATEL approach was used in the setting of Show Chwan Memorial Hospital to determine the critical success criteria for raising the general level of medical care service quality. A second questionnaire was created with this goal in mind and distributed to the hospital management. The questionnaire had two goals: first, to rank the significance of the defined criteria, and second, to create the causal connections between these criteria.. The DEMATEL technique and input from the management allowed the major success elements for improving the quality of medical care services to be determined. Through a causal diagram, the DEMATEL technique makes it possible to visualize the causal linkages among criteria. By understanding the causal relationships among the identified key success factors, the hospital management can gain insights into how changes or improvements in one factor may impact others. This knowledge facilitates decision-making and the formulation of strategies to improve the overall medical care service quality. The Show Chwan Memorial Hospital can discover areas for improvement and take the necessary steps to improve the quality of their medical care service based on the prioritized key success criteria by using the DEMATEL approach and the analysis of causal correlations.[2] Although DEMATEL has been successfully used to address a variety of real-world issues in a variety of sectors, the paper acknowledges that current approaches have limits when it comes to complicated systems with a large number of variables. Due to societal and economic progress, it has become more crucial than ever to handle the complexity of factor analysis problems in these systems. The goal of this study is to offer a hierarchical DEMATEL method that is targeted at the challenge of critical factor identification in complex systems. Complex systems, as referred to in the paper, are characterized by a large number of factors, multiple types of influences, and the presence of a hierarchy. By establishing a hierarchical DEMATEL method, the paper aims to provide a solution for effectively analyzing and identifying critical factors in complex systems. This method will enable a deeper understanding of the relationships and influences among factors, taking into account the hierarchical structure inherent in complex systems. The proposed method is expected to contribute to the advancement of factor analysis in complex systems and provide insights for decision-making and problem-solving in various domains.[3] A new approach based on DEMATEL (Decision Making Trial and Evaluation Laboratory) is suggested in this work to change the data model. DEMATEL is renowned for its ability to analyse both direct and indirect links between system elements while taking into account the nature and gravity of these linkages. A deeper knowledge of the structural linkages and the best method for resolving issues with complex systems can be attained by using DEMATEL to analyse

all relationships among system components..The key idea behind using DEMATEL in this study is to deal with a large amount of interrelated evidence, which forms a complex system. DEMATEL helps identify the negative or detrimental information within this complex system. The basic steps of the DEMATEL method involve generating a total-relation matrix based on the similarity of evidence.By utilizing this modified DEMATEL method, the study aims to provide insights into the relationships among system components and identify key factors that contribute to system performance or problems. This approach can assist in decision-making processes and provide a systematic way to address complex system issues.[4] The fuzzy decision-making trial and evaluation laboratory (DEMATEL) method is utilised in this study to choose appropriate suppliers for businesses. This study makes a unique addition by using the DEMATEL approach to determine the relationship between variables that can impact supply chain management (SCM) performance. The DEMATEL approach has the benefit of revealing the connections between different criteria and how they affect one another during the supplier selection process.This study uses the fuzzy DEMATEL approach to discover the direct and indirect influences among supplier selection criteria. The supplier selection criteria' causal linkages and the strength of those associations are calculated. The DEMATEL technique has the benefit of not requiring a lot of data, which makes it a practical method for analysing complicated systemsOverall, by utilising the fuzzy DEMATEL technique, this study aims to improve knowledge of the correlations between supplier selection criteria and offer useful information for businesses to use when selecting suppliers in the context of supply chain management.[5] Determining the causes and consequences of relationships among components in a complex system is in reality a task that the DEMATEL approach is well equipped for. It is efficient at determining how these parameters are interdependent on one another and creating a detailed map that illustrates their connections. This map offers insightful information and assists in resolving challenging decision-making issues. The capacity of DEMATEL to divide interdependency interactions between elements into two distinct groups—cause and effect—is one of its main advantages. Understanding the causal connections and the effects that each element has on others is made easier by this categorisation.. By analyzing the influential relation map generated by DEMATEL, it becomes possible to identify critical factors within the complex structural system.In summary, DEMATEL is a powerful tool for studying the relationships between factors and determining their significance in a complex system. Its ability to uncover interdependencies and identify critical factors contributes to more informed decision-making processes.[6] The Decision-making trial and evaluation laboratory (DEMATEL) method was initially developed by the Science and Human Affairs Program of the Battelle Memorial Institute of Geneva between 1972 and 1976. It was designed to address complex and intertwined problem groups. Since its development, DEMATEL has found extensive applications in various fields.Some of the areas where DEMATEL has been applied include airline safety management, emergency management, web advertising effects, auditing and risk control in enterprise resource planning, evaluation of intertwined effects in e-learning programs, identification of key success factors for hospital service quality, evaluation of performance criteria for employment service outreach programs, selection of cost of quality models, choice of mobile banking system service, evaluation of failure risk, and identification of critical factors in the auto spare parts industry.One of the major characteristics of the DEMATEL method is its ability to identify the interdependence among elements within a system. It accomplishes this by utilizing a causal diagram that represents the contextual relationships between elements. The hierarchical structure of DEMATEL allows for a clear understanding of the strength of influence between elements.In summary, DEMATEL is a powerful method for analyzing complex systems and understanding the interdependencies and strengths of influence among their elements. Its applications have been wide-ranging and have contributed to decision-making processes in various domains.[7] Indeed, when implementing the DEMATEL approach to identify Critical Success Factors (CSFs), the degree of direct influence between each pair of elements needs to be determined. Typically, these degree scores are obtained through expert surveys. However, human judgment in decision-making is often subjective and can be challenging to express precisely with numerical values. This is where fuzzy logic comes into play. Fuzzy logic is a valuable tool for handling problems that involve vagueness and imprecision. It allows for the representation and manipulation of uncertain or subjective information. By incorporating fuzzy logic into the DEMATEL method, better decisions can be made in fuzzy or uncertain environments. Fuzzy logic enables a more nuanced and flexible representation of the relationships between elements, taking into account the inherent uncertainties and ambiguities in human judgment. Extending the DEMATEL method with fuzzy logic enhances its capability to deal with the inherent fuzziness in decision-making processes. It allows for a more accurate and realistic representation of the interdependencies and influences among elements, leading to better-informed decisions in complex and uncertain situations.[8] The Science and Human Affairs Programme of the Battelle Memorial Institute of Geneva created the Decision-Making Trial and Evaluation Laboratory (DEMATEL) approach between 1972 and 1976. Its goal was to investigate and find solutions for intricately related problem groupings. Through a hierarchical framework, the DEMATEL technique is renowned for its capacity to enhance understanding of particular issue areas and support the identification of practical solutions. The DEMATEL method focuses on detecting the dependency of elements within a system, as opposed to conventional methodologies like the Analytic Hierarchy Process, which presuppose independence among constituents. This is accomplished by using a causal diagram, which uses directed graphs (digraphs) to illustrate the contextual relationships and levels of impact between the elements.[9]

The DEMATEL approach was first created to investigate the structural connections in complex systems. It has been modified and used over time to address complex issues in many academic domains. To create novel models and solutions, researchers have linked DEMATEL with other mathematical ideas including fuzzy theory, the Analytic Hierarchy Process (AHP), and grey relational analysis. For instance, Wu and Lee (2007) used DEMATEL in conjunction with fuzzy theory to categorise the necessary competences for global managers and encourage the development of such competencies. To develop a selection model for assessing entwined effects in e-learning programmes, Tzeng, Chiang, and Li (2007) used DEMATEL, AHP, and fuzzy integral. Fuzzy logic and DEMATEL were used by Liou et al. (2007) to create a successful safety management system for aero planes. DEMATEL and grey relational analysis were used by Huang, Shyu, and Tzeng (2007) to restructure innovation policy portfolios and specify governmental policies in Taiwan. These studies show the DEMATEL method's adaptability and potency in tackling complicated issues and offering insightful solutions across a range of fields.[10]

3. RESULT AND DISCUSSION

TABLE 1. Supplier Selection Process in Dairy Industry

	Price	Product	On time delivery	Capacity of supply	Performance history	SUM
Price	0	2	4	2	3	11
Product	4	0	2	1	2	9
On time delivery	2	1	0	3	1	7
Capacity of supply	1	3	2	0	2	8
Performance history	2	4	1	3	0	10

Table 1 shows the Data Set of both the Alternative parameters: Price, Product, On time delivery, Capacity of supply, Performance history and Evaluation parameters: Price, Product, On time delivery, Capacity of supply, Performance history here both the Alternative Parameters and Evaluation Parameters are Same.

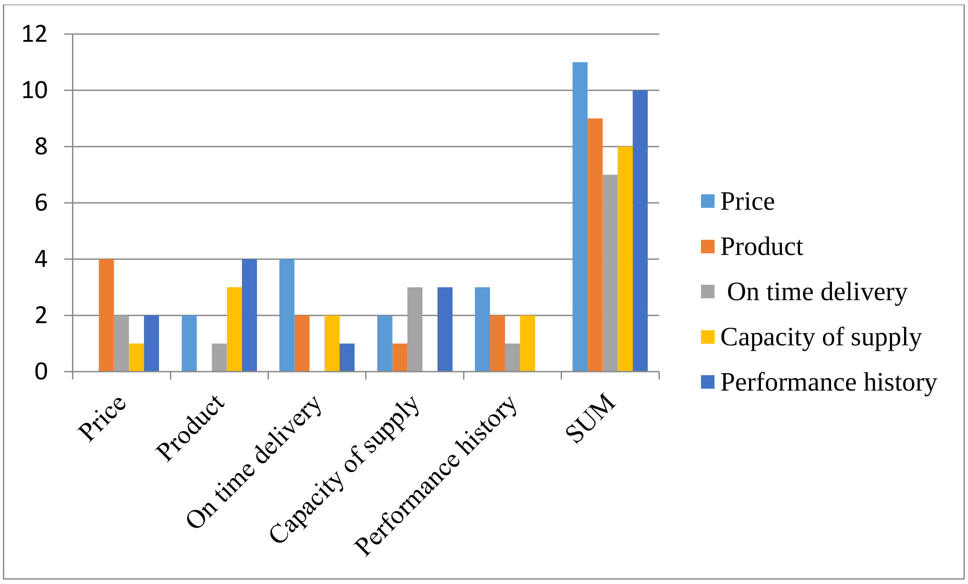

FIGURE 1. Supplier Selection Process in Dairy Industry

Figure 1. shows the data set of Supplier Selection Process in Dairy Industry like Price, Product, On time delivery, Capacity of supply, Performance history.

TABLE 2. Normalization of direct relation matrix

	Price	Product	On time delivery	Capacity of supply	Performance history
Price	0	0.181818182	0.363636364	0.181818182	0.272727273
Product	0.363636364	0	0.181818182	0.090909091	0.181818182
On time delivery	0.181818182	0.090909091	0	0.272727273	0.090909091
Capacity of supply	0.090909091	0.272727273	0.181818182	0	0.181818182
Performance history	0.181818182	0.363636364	0.090909091	0.272727273	0

Table 2 shows the Normalisation of direct relation matrix of both the Alternative and Evaluation Parameters.

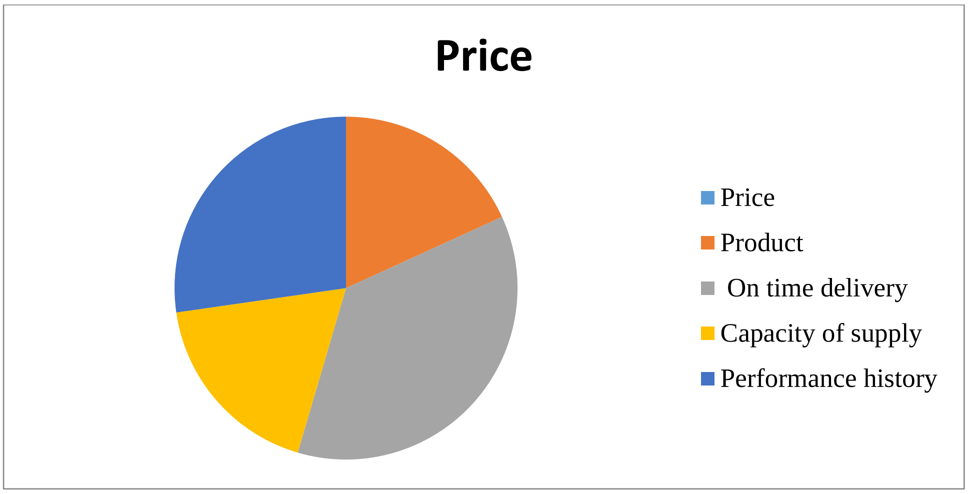

FIGURE 2. Normalization of direct relation matrix

Figure 2 Shows that chart for Normalizing of direct relation matrix like Price, Product, On time delivery, Capacity of supply, Performance history.

TABLE 3. Calculate the Y total relation matrix

	Calculate the Y total relation matrix				
Price	0	0.181818182	0.363636364	0.181818182	0.272727273
Product	0.363636364	0	0.181818182	0.090909091	0.181818182
On time delivery	0.181818182	0.090909091	0	0.272727273	0.090909091
Capacity of supply	0.090909091	0.272727273	0.181818182	0	0.181818182
Performance history	0.181818182	0.363636364	0.090909091	0.272727273	0

Table 3 shows the Calculate the Y total relation matrix of Alternative and Evaluation parameters.

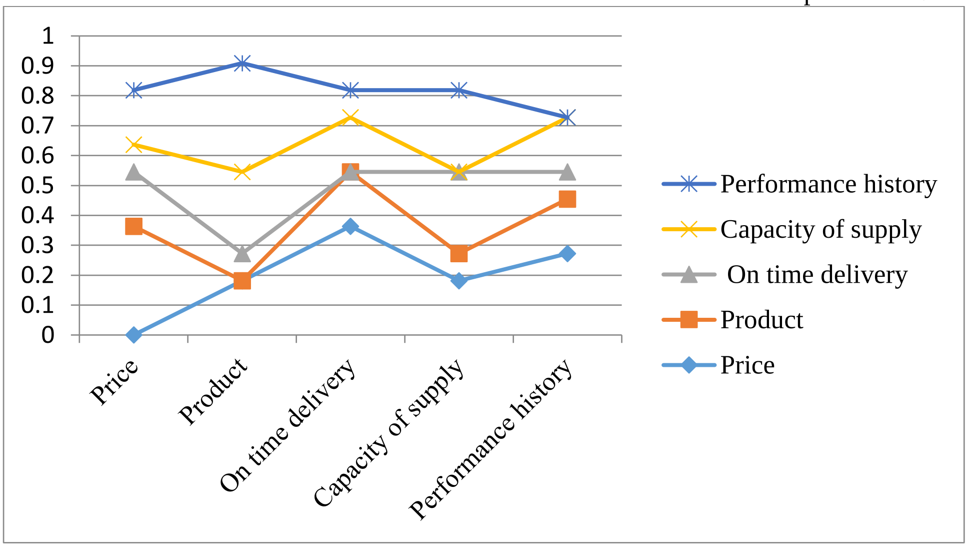

FIGURE 3. Calculate the Y total relation matrix.

Figure 3 shows the Calculate the Y total relation matrix of both the Parameters Price, Product, On time delivery, Capacity of supply, Performance history.

TABLE 4. T= Y(I-Y)-1, I= Identity matrix

I				
1	0	0	0	0
0	1	0	0	0
0	0	1	0	0
0	0	0	1	0
0	0	0	0	1

Table 4 Shows the T= Y(I-Y)-1, I= Identity matrix in Supplier Selection Process in Dairy Industry like Price, Product, On time delivery, Capacity of supply, Performance history.

TABLE 5. Y Value

Y				
0	0.1818182	0.3636364	0.1818182	0.2727273
0.3636364	0	0.1818182	0.0909091	0.1818182
0.1818182	0.0909091	0	0.2727273	0.0909091
0.0909091	0.2727273	0.1818182	0	0.1818182
0.1818182	0.3636364	0.0909091	0.2727273	0

Table 5 Shows the Y Value in Supplier Selection Process in Dairy Industry like Price, Product, on time delivery, Capacity of supply, Performance history is Calculate the total relation matrix Value and Y Value is the same value.

TABLE 6. I-Y Value

I-Y				
1	-0.1818182	-0.3636364	-0.1818182	-0.2727273
-0.3636364	1	-0.1818182	-0.0909091	-0.1818182
-0.1818182	-0.0909091	1	-0.2727273	-0.0909091
-0.0909091	-0.2727273	-0.1818182	1	-0.1818182
-0.1818182	-0.3636364	-0.0909091	-0.2727273	1

Table 6 Shows the I-Y Value in Supplier Selection Process in Dairy Industry with respect to Price, Product, On time delivery, Capacity of supply, Performance history

TABLE 7. (I-Y)-1

(I-Y)-1				
1.890832008	1.1006889	1.1683448	1.0381558	1.0107755
1.081081081	1.8378378	0.963964	0.8648649	0.8738739
0.749867515	0.7355591	1.6122593	0.8155803	0.6331037
0.788553259	0.9523052	0.8325384	1.6661367	0.7668256
1.020137785	1.1950185	0.9365836	1.0317965	1.7682388

Table 7 shows the (I-Y)-1Value in Supplier Selection Process in Dairy Industry like Price, Product, On time delivery, Capacity of supply, Performance history. Table 6 shows the Miners shows used.

TABLE 8. Total Relation matrix (T)

Total Relation matrix (T)						Ri
Price	0.890832008	1.1006889	1.1683448	1.0381558	1.0107755	**5.208797**
Product	1.081081081	0.8378378	0.963964	0.8648649	0.8738739	**4.621622**
On time delivery	0.749867515	0.7355591	0.6122593	0.8155803	0.6331037	**3.54637**
Capacity of supply	0.788553259	0.9523052	0.8325384	0.6661367	0.7668256	**4.006359**
Performance history	1.020137785	1.1950185	0.9365836	1.0317965	0.7682388	**4.951775**
Ci	**4.530471648**	**4.82141**	**4.51369**	**4.416534**	**4.052818**	

Table 8 shows the Total Relation Matrix (T) the direct relation matrix is multiplied by the inverse of the value that the direct relation matrix is subtracted from the identity matrix.

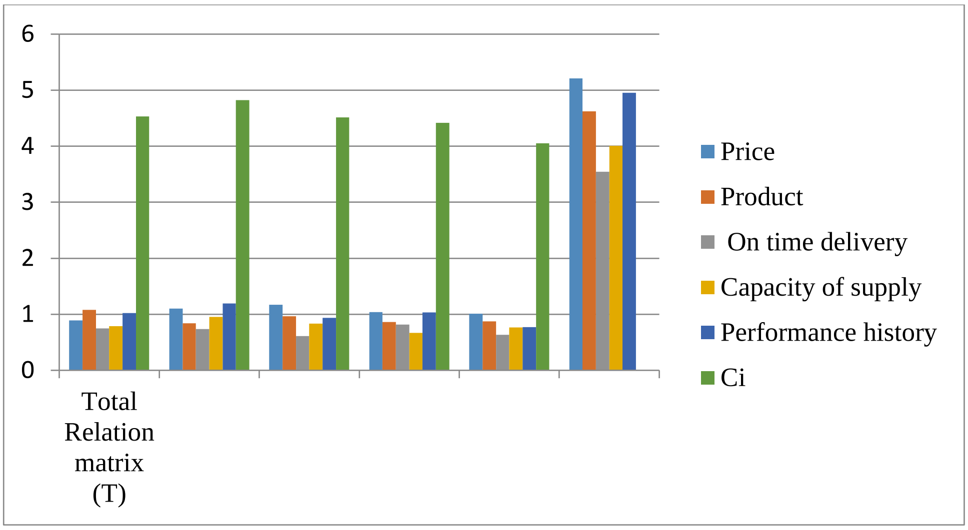

FIGURE 4. Total Relation matrix (T)

Figure 4. shows the Total Relation Matrix (T) the direct relation matrix is multiplied with the inverse of the value that the direct relation matrix is subtracted from the identity matrix.

TABLE 9. Ri& Ci Value

	Ri	Ci
Price	5.208797	4.5304716
Product	4.6216216	4.8214096
On time delivery	3.5463699	4.5136902
Capacity of supply	4.0063593	4.4165342
Performance history	4.9517753	4.0528175

Table 9 shows the Ri & Ci Values for Price, Product, On time delivery, Capacity of supply, Performance history. Price and Performance History is showing the Highest Value for Ri and On time delivery showing the Lowest value for RI. Product and Price is showing the Highest Value for Ci and Performance History is showing the Lowest Value for Ci.

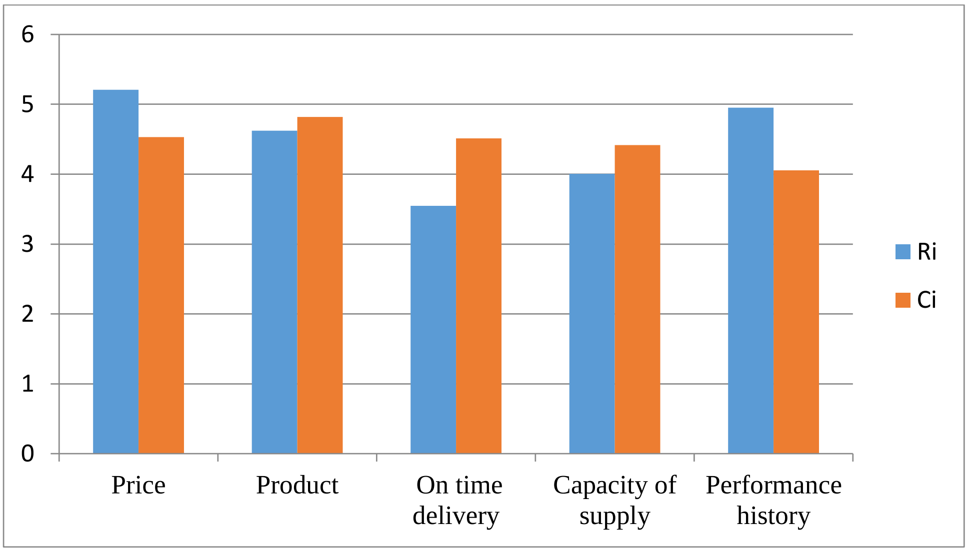

FIGURE 5. Total Relation Matrix (T) Ri, Ci Value

Figure5 shows the Ri & Ci Values for Price, Product, On time delivery, Capacity of supply, Performance history. Price and Performance History is showing the Highest Value for Ri and on time delivery showing the Lowest value for RI. Product and Price is showing the Highest Value for Ci and Performance History is showing the Lowest Value for Ci.

TABLE 10. Calculation of Ri+Ci and Ri-Ci to Get the Cause and Effect

	Ri+Ci	**Ri-Ci**	**Rank**	**Identity**
Price	9.7392687	0.6783254	1	cause
Product	9.4430313	-0.199788	2	effect
On time delivery	8.0600601	-0.967320	5	effect
Capacity of supply	8.4228935	-0.410174	4	effect
Performance history	9.0045928	0.8989578	3	cause

Table 10 shows the Calculation of Ri+Ci and Ri-Ci to Get the Cause and Effect. Price, Product, On time delivery, Capacity of supply, Performance history. Price and Performance History is Showing the Highest Value of Cause and Product, on time delivery and Capacity of Supply is showing the Lowest Value of Effect.

TABLE 11. T matrix value

T matrix				
0.890832	**1.100689**	**1.168345**	**1.038156**	**1.010775**
1.081081	0.8378378	**0.963964**	0.8648649	0.8738739
0.7498675	0.7355591	0.6122593	**0.81558**	0.6331037
0.7885533	**0.952305**	0.8325384	0.6661367	0.7668256
1.020138	**1.195019**	**0.936584**	**1.031797**	0.7682388

Table 11. Shows the T matrix calculate the average of the matrix and its threshold value (alpha) **Alpha 0.893396926.** If the T matrix value is greater than threshold value then bolds it.

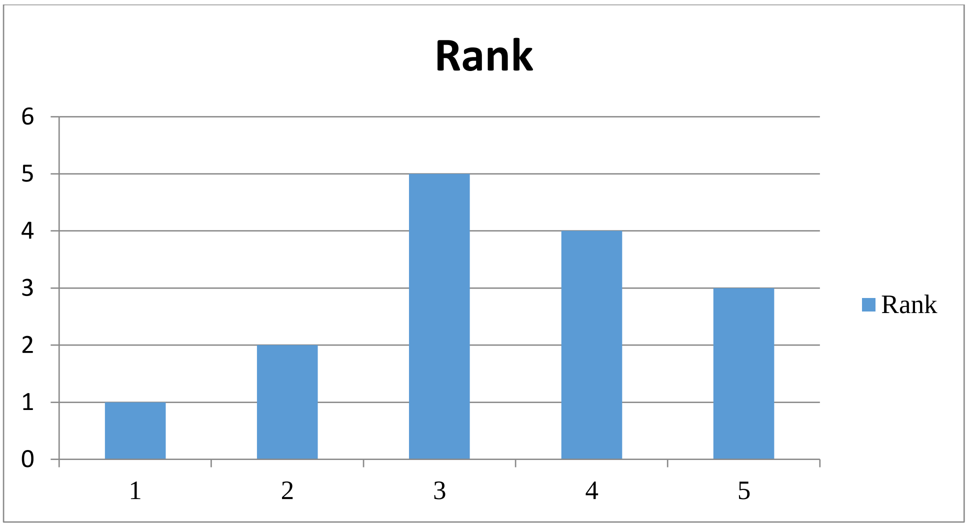

FIGURE 6. Shown the Rank

Figure 6 shows the Rank using the DEMATEL for Supplier Selection Process in Dairy Industry in Price is on 1st Rank, Product is on 2nd Rank, Performance History is on 3rd Rank, Capacity of Supply is on 4th Rank and On time delivery is on 5th Rank.

4. CONCLUSION

In conclusion, the supplier selection process plays a crucial role in the success of the dairy industry. Selecting the right suppliers is essential to ensure the availability of high-quality raw materials, maintain efficient production processes, and deliver superior dairy products to consumers. This process involves assessing various factors, such as product quality, price, delivery reliability, and supplier capabilities. Throughout this paper, we have reviewed the relevant literature on supplier selection methods and explored their applicability in the dairy industry. We found that a combination of approaches, including the Analytic Hierarchy Process (AHP), Quality Function Deployment (QFD), and Markov chain, can be effective in addressing the complexities of supplier selection. Additionally, we discussed the importance of incorporating fuzzy logic into the supplier selection process, as it allows for handling the vagueness and imprecision often associated with human judgments. The Decision-Making Trial and Evaluation Laboratory (DEMATEL) method, in particular, provides a valuable framework for revealing the causal relationships among supplier selection criteria and identifying critical factors. By employing these methodologies, dairy industry stakeholders can make informed decisions and prioritize the selection of suppliers that align with their specific requirements. This will ultimately lead to enhanced operational efficiency, improved product quality, and increased customer satisfaction. However, it is important to acknowledge that supplier selection is a dynamic process that requires ongoing evaluation and adaptation. As the dairy industry continues to evolve, incorporating new technologies, sustainability considerations, and changing consumer preferences, the supplier selection process should remain flexible and responsive to these changes. In summary, the supplier selection process in the dairy industry is a complex task that demands careful consideration of various factors. By utilizing appropriate methods and tools, such as AHP, QFD, Markov chain, and DEMATEL, industry professionals can make informed decisions, identify critical factors, and ensure the selection of reliable and capable suppliers, ultimately contributing to the overall success and competitiveness of the dairy industry.

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