A Multi-Criteria Decision-Making approach for Supplier Selection in procurement using AHP and ISM-MICMAC

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ABSTRACT

Selectinga supplier is a multi-criteria decision-making technique which includes factors that can both be quantitative and qualitative.The purpose of this paper is to explore various parameters that can affect the process of supplier selection using criteria that have earlier not been explored much. The parameters take into consideration the Services provided by the Supplier, their inclination towards the practice of building a sustainably driven organization, the overall profile of the supplier as well as certain behavioural factors that are often latent features that somehow drive the supplier selection process. This study presents an integrated framework that involves the incorporation of AHP, ISM and MICMAC to determine the factors' and their attributes' driving and dependence power. Basedon the Literature review, a total of 16 parameters were identified. Subsequently, surveys and interviews were conducted to judge the importance of each of the factors. The final results were depicted as a MICMAC Graph incorporated with the AHP ratings. It was found out that Reliability and Compliance to Standards rated the highest in terms of weights. The inter-relationships between the parameters can be expressed as a 6-level structure. This study can help procurement managers understand their existing suppliers better as well as would be a stepping stone for decision making while onboarding any new suppliers.

Keywords

AHP, Interpretive Structural Modelling (ISM), cross-impact matrix multiplication applied to classification (MICMAC), supplier selection, factors, parameters

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Introduction

The Supply Chains throughout the world have become very complex these days. There are multiple stages and each stage has a complicated set of members who play key role in driving the supply chain; most of them being involved in more than one stage of the chain. With the involvement of multiple stakeholders at each step, it has become very important to clearly identify how are these stakeholders influencing the working of the organization (Sudarshan, 2013). To do this, the main aim should be to identify a list of factors that can influence the decision making of the stakeholder, how does one factor influence the other, how is one factor more relevant than the other etc. and then implement the knowledge gained by this study to one's future approach to doing business with the stakeholder.

In the procurement function, the most important task is to select and do business with suppliers who can be of utmost advantage to us. When it comes to suppler selection, we cannot limit our choices to only the suppliers who supply the products at the minimum cost or maximum quality. There are multiple other factors that also influence the decision making and some of these criteria can be difficult to compare or may not be quantitative. The business decision making taken at a strategic level involves evaluating criteria that are both tangible and intangible (Zhexuan, 2018). A majority of the factors like Promptness in sending back RFIs, how easily does the supplier agree to the rates quoted by us(do they agree right in the first round or are they adamant on their rates until the 13th round also), how efficient are they in adhering to the protocols that the buyers' organization entailsetc. might seem like very unimportant factors while selecting a supplier but in the long run they might reveal some hidden information which otherwise is difficult to interpret.This paper studies a list of 16 factors that can, somehow or the other, influence the decision making of preferring one supplier over the other.

A list of these factors has been made by carefully studying research papers and interacting with Procurement professionals. A survey was also carried out to gain some detailed insights as the models of Analytic Hierarchy Process(Saaty, 1980) and Interpretive Structural Modellling (ISM) (Warfield, 1973; Mohammad, 2017) require the opinions of a team of experts. The paper consists of sections that begin with Literature review in Section 2 followed by Section 3 that explains about the parameters that can be influencing the process of supplier selection and have been considered for this study. Section 4 describes the methodology undertaken. The findings of the analysis have been mentioned under Section 5 Resultspost which the paper continues with section Discussion and in the end comes the Conclusion.

Literature Review

The most important aspect of any procurement process is the step of Supplier Selection as it directly relates to the core competency of any organization (Dong, 2007). The supplier we choose to do business with has a direct impact on the overall cost of the business, the product quality and the customer response time. As the world focusses more on becoming "Vocal for Local", a lot of manufacturing hubs will be setup in India now. This would in-turn lead to an increase in Supplier demand and competition. Decision

makers will have to consider multiple factors before selecting any supplier as their stakeholder.

Significant studies have been performed on Supplier Selection. Supplier selection using Fuzzy TOPSIS has been performed (Stefanovic, 2014). Using Fuzzy hesitant sets, a model was also built to select supplier for a logistics system closed looping (Yu, 2016). Supplier performance has also been evaluated using a technique called Triangular Fuzzy Information (Zhou, 2016). Various Multi-criteria decision-making techniques have also been used to evaluate Green suppliers (Cao, 2015). Models with merged concepts of AHP and TOPSIS have also been built to devise methods for selecting the most relevant equipment for tomography (Barrio, 2016). Using FAHP and FTOPSIS, an integrated Multi-criteria decision-making model was setup to select the best mining method (Yazdanichamzini, 2012). Multi-objective models have also been built to judge criteria like quality, cost and product lead time (Dong, 2007).

Many studies have been conducted to find out what factors can influence the process of supplier selection. But not a lot of findings revolve around finding the importance of one factor over the other. Such research has been done for the field of logistics and in improving last mile delivery (Xiahong, 2019), but looks skim in the function of procurement for supplier evaluation. The significance of every factor/influencing component can be explained by computing the weight, yet the connections between the factors/influencing components can't be determined. Previous examinations on the process of supplier evaluation and selection were constrained to the assessment strategy and results. However, not a lot of studies have concentrated on the links between the influencing factors in procurement in order to provide more insightful information towards an informed decision making when it comes to supplier selection (Xiahong, 2019). This study also considers a mix of Behavioural and Physical factors to arrive at the final decision.

The concept of Analytical Hierarchy Process (AHP)(Saaty, 1980) for multi-criteria decision-making analysis. It is a hypothesis of estimation through pairwise examinations and depends on the decisions of specialists to infer prioritization scales. One of its focal points is its usability. Its utilization of pairwise examinations can permit decision makers to weigh coefficients and compare alternatives more lucrativelyalthough it requires enough information to appropriately perform pairwise correlations. Because of the methodology of pairwise examinations, factors need to be judged in correlation with the rest.

Interpretive Structural Modelling (ISM)(Warfield, 1973; Mohammad, 2017)is a well-defined methodology to identify linkages among various factors, which characterize an issue or a situation. This concept was first explained by Warfield in 1974. ISM approach begins with identifying all the factors that one can think off will influence the decision making in a scenario. Then, a Structural Self Interaction Matrix (SSIM) (Warfield, 1973) is created dependent on the pairwise examination of factors. After this, SSIM is modified into a Reachability Matrix (RM) (Warfield, 1973) and the transitivity of the matrix is examined. When transitivity inserting is finished, a matrix model is framed that divides the components.

Cross-Impact Matrix Multiplication Applied to Classification (MICMAC) (Chandramowli, 2011),is a methodology that is used to classify the identified factors based on their ability to influence the other factors. In the case of indirect relationship, one can take a note of the flow: variable AinfluencesB and variable BinfluencesC, then variable AinfluencesC (cross-relation). MICMAC analysis involves constructing a graph to segregate factors based on their “Driving Power” and “Dependence Power”. MICMAC also helps us understand if some factors can be grouped based on their Dependence and Driving scores. The output of ISM becomes the input for MICMAC analysis.

Variables considered for the study

3.1. Years into the business

If considering a new supplier, this factor states for how long has the supplier been in the business i.e., its Year of Establishment. For an existing supplier, this can mean for how long has that supplier been doing business with our organization. The older the supplier, the more is the trust in them in terms of capability to understand the market and buyer preferences.

3.2. Client base

To understand the supply strength of a vendor, it is very essential to judge its client base i.e., which other competitors are they supplying to. This data is mostly available on the websites of those suppliers under their Distribution Network or Regional Presence

3.3. Delivery Schedule

This is a major driving factor in cases of suppliers that supply at a PAN India Level. Suppliers that take a longer time to deliver to our units, cannot be chosen for perishable items. Also, the supplier should be competent enough to be able to stand by the delivery schedules that they have provided. The entire delivery schedule and supply network should be accessible in order to be able to deliver to the customer right on time.

3.4. Service Support

The competency of the supplier to tackle the various issues or questions raised by the buyer efficiently also define how capable and open is the supplier in terms of resolving issues be it terms of quality, delivery, general information or technology. The supplier that is more prompt in addressing these issues will be at an advantage.

3.5. Responsiveness

Tracking a supplier’s RFP response throughout the year when it deals with items across various categories will give us an idea on the supplier’s likelihood and willingness to become a partner. We can also find out in which category is the supplier most comfortable and competent.Responsiveness can also indicate if a supplier will be able to guide us into achieving the dedicated savings.

Doing business with a supplier over the years helps the business to understand the core competency of the supplier and judge which suppliers can add more value into the business.

3.6 Persona

Capturing data related to how a supplier negotiates and comes to terms with a buyer can help in understanding how successful would our business be in meeting savings expectations with that supplier. If a supplier meets our expectations in one round of negotiation, we might term them "cordial or cooperative". But if, even after negotiating for 12-14 rounds, the supplier does not meet our desired expectations, we might call them "stubborn or difficult to do business with". We can get great insights like if the supplier is "stubborn" in terms of negotiation only for a particular type of product category or purchase manager. Or a new supplier may be cordial in the beginning but might gradually become stubborn once we start doing business with them.Although Persona data might give far less relevant insights than response time, it can help in request optimization, performance management and reducing churn.

3.7 Compliance to Standard

Keeping a note of every time the supplier does not follow the standards set by the receiving party, one can get an idea of how detail oriented is the supplier party and how keenly are they paying attention to the Mission, Vision and Goals of the organization. If any organization fails to adhere to furnish the bid packet mandates, we can infer that the organization is not detail oriented or does not pay attention to the needs of the organization. In this case, we can slowly move towards other suppliers with whom doing business would not mean continuous follow ups and would give us enough time to focus on other critical areas.

3.8 Green R&D Innovation

This attribute talks how much focus is put on checking the reduction in electrical, fuel and electrical energy consumption due to a new product development. It also includes the aspect of reduction in electrical energy consumption due to the manufacturing or procurement process design. The more the importance given to these aspects, the higher will be the supplier's inclination to Sustainable R&D innovation.

3.9 Reaction to demand change

The capability of the supplier to change as indicated by the demand in the market, prices, frequency of ordering and prevailing business situation has more prominent effect on the approach of procuring. It can influence the ability of the firm to perform if there is any unprecedented and unsure demand. Suppliers more capable of adapting and catering to such evolution in the demand can be preferred over the others.

3.10 Management and Organization

The administration mentality and standpoint for what's to come and its ability to change that bearing to fit the system of the buyer's firm is the key direction that the supplier's firm should take, . Objective harmoniousness is an imperative factor as the relationship should mostly be a long term. While strategies may evolve over time, an underlying fit between the purchaser and the supplier to setting up a long-lasting relationship.

3.11 Prices offered

Any organization consistently aims to source a product at the lowest price to achieve as high a profit as it possibly can. The firm in this way should locate a supplier who would be able to supply at a limited cost to lower the manufacturing cost related to the item. The handling charges, support charges, guarantee charges, and different charges identified with the assembling of the item decide the absolute cost of the item.

3.12 Embeddedness

This helps in understanding if there is mutual understanding in terms of each other's business goals, organizational culture and the overall operations. This also talks about any binding contract that might have been created between the two parties that would help them both to be on the same page. There should be a well-established common vision and mission that both the parties need to agree to.

3.13 Reliability

This factorjudges the capability of the organization and its associates to give assurance and deliver a service that is accurate and totally trust-worthy. This includes but is not limited to assurance with respect to professional skills, service level of the organization, goods supplied, logistics services provided and competitiveness of the employees.

3.14Sustainable Packaging/Labelling

Boxes can be easy to recycle but boxes made out of certain materials might not be recyclable. Hence Suppliers need to make sure they also pay attention to sustainably driven packaging methods for their products which might be cost-effective and sustainable. For example, if a supplier uses size customizable boxes, there wouldn't be a requirement of void filling supplies like paper, air pillows, bubble wraps etc.

3.15 Recycling & Pollution prevention

Although this is an old concept, a lot of suppliers still overlook this criterion and do not recycle properly. This would in turn protect consumer and Employee health. A supplier who takes into account best pollution prevention and recycling techniques should be given more preference while doing business.

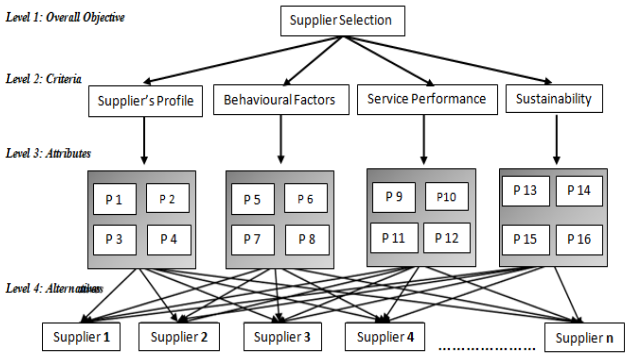
3.16 Optimized Business Operations and Shipping Practices

The Organizations of the suppliers can also adopt Sustainably driven business operations in their premises and while delivering their services. For example, they can take steps to reduce the wastage of energy by recovering and recirculating the otherwise escaped and wasted energy. This re-circulated energy can be used to drive other day-today activities at the premises. Suppliers can also pair up with local and nearby companies to make sure the procurement process does not happen at long distances.

Table 1: Summary of factors and their corresponding variables

Factor	Parameters	Reference
Supplier's Profile	Client Base (P1)	Felix *et al*, 2005
	Years into the business (P2)	Zhi *et al*, 2005
	Management & Organization (P3)	Hossien *et al*
	Prices Offered (P4)	Felix *et al*, 2005
Behavioural Factors	Responsiveness (P5)	Christian, 2020
	Persona (P6)	Christian, 2020
	Compliance to Standards (P7)	Christian, 2020
	Embeddedness (P8)	Zhi *et al*, 2005
Service Performance	Reaction to demand change (P9)	Felix *et al*, 2005
	Delivery Schedule (P10)	Felix *et al*, 2005
	Service Support (P11)	Felix *et al*, 2005
	Reliability (P12)	Xiaohong *et a*,. 2019
Sustainability	Green R&D Innovation (P13)	Mohammad *et a*,. 2017
	Sustainable packaging/labelling (P14)	Mohammad *et a*,. 2017
	Recycling & Pollution Prevention (P15)	Mohammad *et al*, 2017
	Optimized Business Ops & Shipping Practices (P!6)	Joseph, 2018

Figure 1: Hierarchy for defining Supplier Selection (Authors Compilation)



Methodology

In this research paper, a total of 16 factors influencing the supplier selection process has been considered and an integrated method of Analytics Hierarchy Process (AHP) (Saaty, 1980) and Interpretive Structural Modelling (ISM) (Warfield, 1973; Mohammad, 2017)was used. The AHP logic has been used to giveweightage to each of the factors that are influencing and to evaluate the relative importance of each of those factors. The ISM (Warfield, 1973; Mohammad, 2017)has been used to analyse and explain the relationship between these factors. In the end, a model was developed to judge the driving or dependence power using a quadratic diagram which is called the cross-influence matrix (MICMAC). Although the concepts of AHP (Saaty, 1980), ISM (Warfield, 1973; Mohammad, 2017)and MICMAC(Chandramowli, 2011), have been long in use, a combination of all the three have been largely avoided.

Interviews and surveys were conducted with a sample that consisted of industry professionals, academicians and students to judge the importance of one factor with respect to the other. Interviews were also conducted with procurement professionals to take inputs on the influencing ability of one factor on the other. The study was conducted over a duration of 2 weeks.

4.1 AHP

Step 1: Defining the decision goal, which will be the top level of the hierarchy i.e., Selection of the best supplier out of the given alternatives

Step 2: Identifying factors against which alternatives will be evaluated that will form the second level of the hierarchy (In this study, 4criteriawere considered)

Step 3: Finalizing on various sub-criteria under each criterion decided above and entering them as 3rd and 4th levels in the hierarchy plan (4 sub-criteria were decided under each criteria)

Step 4: Placing the alternatives below the sub-criteria as the bottom-most level of the hierarchy

Step 5: Constructing a pair-wise comparison matrix of the criteria with respect to the Overall goal and understanding the importance of each factor relatively. The criterion with the highest criteria weight is the most driving factor.

4.2 The Interpretive Structural Model (ISM)

Step 1: Identifying thefactors and the variables under those factors post literature review, interviews, surveys and using other tools for research.

Step 2: Constructing "The Adjacency Matrix" or "SSIM Matrix" by creating direct binary relationships, Xij,based on the below four principles:

1) For the relationship Xij, if i has an impact on j, but j does not have an impact on i, mark the cell as V
2) For the relationship Xij, if i does not have an impact on j, but j has an impact on i, mark the cell as A
3) For the relationship Xij, if i has an impact on j and j has an impact on i, mark the cell as X
4) For the relationship Xij, if i does not have an impact on j, and j does not have an impact on i, mark the cell as O

Step 3: Constructing the Initial "Reachability matrix"(Warfield, 1973; Mohammad, 2017)that converts the entries of the "SSIM matrix" to binary entries.

Step 4: The Next step is creating the "Reachability Matrix" where even indirect relationships are represented as 1*.

Step 5: A"Directed Graph" (Warfield, 1973; Mohammad, 2017) is drawn that shows the various relationships. The factorsare positioned based on the hierarchy. The direct linkages are shown by drawing lines.

4.3 The MICMAC Approach

The factors are judged based on their ability to Driveor being driven. The dependence Power is plotted on the x-axis and the driving power, on the y-axis. The overall map area is divided into 4 quadrants:

Table 3: Summary of the quadrants in MICMAC Analysis and what do they indicate

Quadrant	Enabler	Driving Power	Dependence Power	Factors' influence
I	Autonomous	Weak	Weak	Strongly dependent
II	Dependent	Weak	Strong	Strongly dependent
III	Linkage	Moderate	Moderate	Interdependent
IV	Driver	Strong	Weak	Weakly dependent

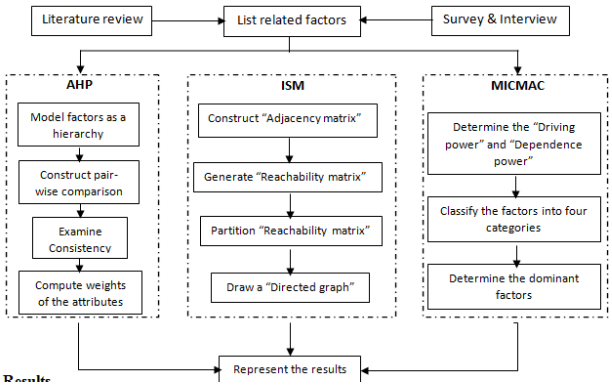


Figure2: Flowchart of the methodology (Authors Compilation)

5. Results

To understand the weightage of each factor in judging their contribution to the decision of selecting one supplier from an alternative of many. For this, a survey was conducted which consisted of respondents from the academics' background, industry experts, students and working professionals.

5.1 AHP Results

For the AHP Analysis, a 4-level hierarchical structure was developed as shown in Figure 1. A varied range of responses were captured as the sample space consisted of a heterogenous pool of respondents. Finally, the Criteria weights for each of the attributes were determined and they were ranked as shown in Table 4. As can be very well understood from the table, rank 11 is held by both the attributes "Persona (P6)" and "Reaction to demand change (P9)". Similarly, parameters like "Green R&D Innovation" (P13) and "Years into thebusiness(P16), have the same weightage and hold a rank of 14. The criterion with the highest weight is Reliability.

Table 4: Weightages and order of the factors for selection of suppliers in procurement

Factors	F1	F2	F3	F4	Weight	Rank
	0.24161	0.25794	0.26225	0.23820		
P1	0.25511	0	0	0	0.06164	7
P2	0.21949	0	0	0	0.05303	16
P3	0.25458	0	0	0	0.06151	8
P4	0.27082	0	0	0	0.06543	5
P5	0	0.26546	0	0	0.06847	3
P6	0	0.23307	0	0	0.06012	11
P7	0	0.26742	0	0	0.06898	2
P8	0	0.23405	0	0	0.06037	10
P9	0	0	0.22925	0	0.06012	11
P10	0	0	0.23890	0	0.06265	6
P11	0	0	0.26062	0	0.06835	4
P12	0	0	0.27124	0	0.07113	1
P13	0	0	0	0.24761	0.05898	14
P14	0	0	0	0.25027	0.05961	13
P15	0	0	0	0.25452	0.06063	9
P16	0	0	0	0.24761	0.05898	14

5.2 ISM Results

Upon interaction with the experts, direct relationships amongst the attributes (P1 to P16) were established after asking the question: Are there any direct relations between the two attributes in question. Table 5 depicts the relationships in terms of "V", "A", "X" and "O"(Warfield, 1973; Mohammad, 2017). The "SSIM matrix" (Warfield, 1973; Mohammad, 2017) is then converted to Initial Reachability Matrix (Table 6) ((Warfield, 1973; Mohammad, 2017). The Final Reachability matrix (Warfield, 1973; Mohammad, 2017)and the levels are generated using MATLAB Table (Table 7). Based on the levels generated, a directed graph/digraph is created to establish the relationship more pictorially (Figure 3).

Table 5: Structural Self-Interaction Matrix (SSIM)

	P16	P15	P14	P13	P12	P11	P10	P9	P8	P7	P6	P5	P4	P3	P2	P1
P1	O	A	O	O	V	O	O	O	O	O	O	O	X	O	O	X
P2	V	O	O	O	O	O	O	O	O	O	O	V	O	O	X	
P3	V	O	O	O	O	O	O	O	O	O	O	V	V	X		
P4	O	O	A	O	A	V	O	O	O	O	O	O	X			
P5	O	A	O	O	A	O	A	O	O	O	O	X				
P6	O	O	O	O	O	O	O	A	A	V	X					
P7	O	O	O	O	O	O	O	X	O	X						
P8	V	O	O	O	O	V	O	O	X							
P9	A	O	A	A	A	V	O	X								
P10	O	O	A	A	V	X	X									
P11	O	A	A	O	A	X										
P12	O	O	A	A	X											
P13	O	O	O	X												
P14	V	V	X													
P15	O	X														
P16	X															

Table 6: The Binary Matrix

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
P1	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
P2	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
P3	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1
P4	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
P5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
P6	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
P7	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
P8	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	1
P9	0	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0
P10	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0
P11	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
P12	0	0	0	1	1	0	0	0	1	0	1	1	0	0	0	0
P13	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0
P14	0	0	0	1	0	0	0	0	1	1	1	1	0	1	1	1
P15	1	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0
P16	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1

Table 7: The Final Reachability Matrix

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	Driving
P1	1	0	0	1	1	0	0	0	1	1	1	1	0	0	0	0	7
P2	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	4
P3	1	0	1	1	1	0	0	0	1	1	1	0	0	0	0	1	8
P4	1	0	0	1	1	1	1	0	1	1	1	1	0	0	0	0	9
P5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
P6	0	0	0	0	0	1	1	0	1	1	1	0	0	0	0	0	5
P7	0	0	0	0	0	1	1	0	1	1	1	0	0	0	0	0	5
P8	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	1	10
P9	0	0	0	1	1	1	1	0	1	1	1	1	0	0	0	0	8
P10	0	0	0	1	1	0	0	0	1	1	1	1	0	0	0	0	6
P11	0	0	0	1	1	0	0	0	1	1	1	1	0	0	0	0	6
P12	1	0	0	1	1	1	1	0	1	1	1	1	0	0	0	0	9
P13	1	0	0	1	1	1	1	0	1	1	1	1	1	0	0	0	10
P14	1	0	0	1	1	1	1	0	1	1	1	1	0	1	1	1	12
P15	1	0	0	1	1	1	1	0	1	1	1	1	0	0	1	0	10
P16	1	0	0	1	1	1	1	0	1	1	1	1	0	0	0	1	10
Dependence	8	1	1	12	14	10	10	1	15	14	14	11	1	1	2	5	

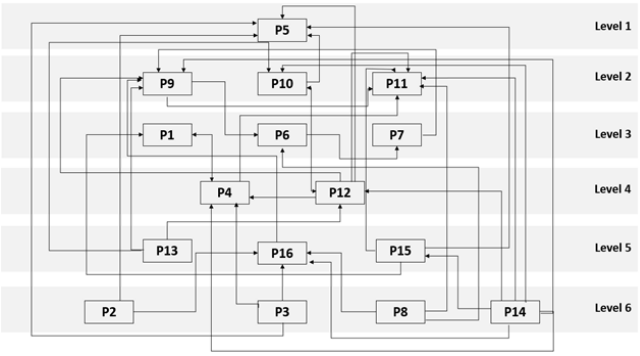
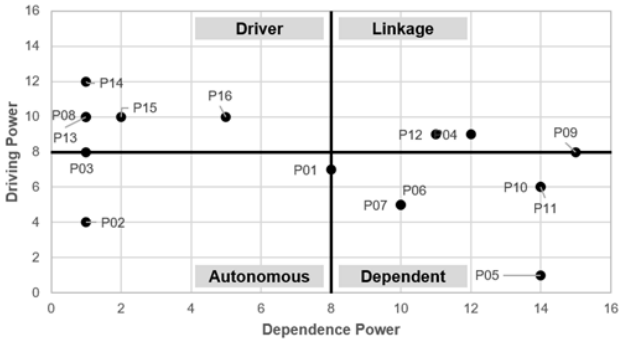


Figure 3: Digraph depicting the relationships between the parameters (Authors compilation)

5.2 micmac results

Based on the overall score of each factor on driving and dependence power, the factors are classified into 4 clusters as shown in Figure 4.

Figure 4: MICMAC Analysis



Discussion & Managerial Implications

Knowing what factors affect the process of supplier selection in the procurement industry is necessary to understand and do business with only the best suppliers who would provide long term benefits. Taking the viewpoints of industry experts and academicians, this study explored the holistic process of implementing AHP, ISM and MICMAC whereinat the beginning the weightage of every parameter was determined and then the directionvia which they were influencing other factors were also established. Reliability (P12) achieved the highest weightage which was followed by Compliance to standards (P7). This meant that while choosing a supplier, these two criteria are the most important.The parameters Prices Offered (P4), Ability to react to demand change (P9) and Reliability (P12) fall under the linkage criteria which imply that if these factors are affected, the system's performance might get affected directly. Of these factors, Responsiveness (P5) have the third highest weightage based on the results from AHP but is highly influenced by the other factors.

The results of MICMAC Analysis indicate that Responsiveness (P5) have high dependence power but the lowest driving power indicating that it is easily affected by the other factors. On the other hand Years Into Business (P02), Management & Organization (P03), Embeddedness (P08) and Sustainable Packaging/labelling (P14) have very low and equal dependence power and Sustainable packaging/labelling has very high driving power thus indicating that Reliability can be one of the factors that influence the decision making process of supplier selection the most.

Conclusion

Significant research has been conducted on Supplier selection methods. However, studies till date have mostly been limited to quantifying the parameters and using the tool of supplier selection as an optimization technique. Specific attention was not paid to incorporating non-quantifiable attributes as well to drive the modelling process. This paper bridged that gap. But there are certain limitations as well. Although a wide variety of parameters were chosen to judge their affect on the process of supplier selection that included behavioural factors as well, it cannot be guaranteed that all such criteria and sub-criteria influencing the decision making has been chosen. Thus, it is indeed necessary to conduct more in-depth analysis to understand what other parameters can be added in such study that will have a high influence on supplier selection. Furthermore, the applicability of this method also needs to be tested by different groups of experts from a wide range of industries to capture results that can be implemented throughout. Since this study is primarily dependent on the judgement criteria of individuals, the interpretation of such criteria in the minds of the respondents play a significant role.Other multi-criteria decision-making methods that are more analytically driven can also be adopted to give better inference and make the process more data oriented. Various factors that also consider the risk profile of the suppliers can also be incorporated. The scope of the study can also be extended to include certain capacity constraints of the supplier, the bargaining power of the supplier and the buying power of the buyer. It might also be a good approach to include some of the limitations of the supplier and buyer.

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