

Factor Identification for the Procurement of Raw Material in Food Processing Industry

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Abstract

Procuring raw materials (RM) is essential in the supply chain (SC), particularly in the current business landscape where organisations actively seek innovative ideas to cut costs and maintain competitiveness. The procurement operation enables these organisations to navigate through increasing cost pressures. Within SC logistics, the procurement of RM faces numerous obstacles and complexities. To address these challenges and propose potential solutions, examining the specific issues that impact the procurement of RM in the Food Processing Industry (FPI) is necessary. Therefore, this article explores the challenges affecting the procurement process. The authors also provided recommendations for mitigating the identified challenges. This study utilises interpretive structural model methodology, a qualitative and interpretive approach that produces solutions for complicated issues through discussions based on the structural mapping of intricate relationships between elements to look at and analyse the challenges that affect the procurement process. A systematic review of the existing literature provides a comprehensive understanding of these challenges. The study found that challenges in contract and procurement, infrastructure and transportation, technology, govt regulations, quality and safety standards, etc., are the factors that constitute severe challenges and affect the growth of FPI. Data were collected from only those working in Indian companies or multinational companies operating in India. Every step of the process, starting

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from the development of the questionnaire to the data collection itself, is carried out with a focus on the Indian perspective. Addressing these problems and obstacles will yield advantages for decision-makers and stakeholders, including farmers, manufacturers, customers and consumer Food Business Organisations. It will enhance their comprehension of the current situation, identify issues and confront challenges, thereby facilitating improved planning and management strategies.

Keywords

Inbound logistics, Food Processing Industry, raw material, supply chain management, challenges, ISM

Introduction

With the rise of worldwide patterns and a fiercely competitive market, collaboration within supply chain (SC) has become essential for achieving successful procurement and efficient operational practices, mainly when dealing with perishable goods. Effective SC planning is of utmost importance within the agricultural and food industry as it facilitates the integration of intricate networks consisting of farmers, suppliers, demand and supply. This integration aims to connect with end consumers efficiently and improve overall operational efficiency (Agarwal, 2017). India's Food Processing Industry (FPI) is a crucial link between its industry and agriculture, generating valuable linkages and synergies (Prakash, 2018).

India is the largest producer of vegetables like okra and ginger and fruits like bananas and mangoes and the second largest producer of vegetables such as onion, potato, cauliflower and cabbage. According to Raut et al. (2019), India ranks second in fruit and vegetables cultivation. However, despite impressive production, India's significant challenge is the substantial loss and damage of food products, estimated to be around 25%–30%. These losses primarily occur due to a lack of transportation and distribution facilities, cold storage facilities, temperature-controlled trucks, lack of technology and regulations related to quality and other practices. In 2015, the annual value of losses of primary agricultural produce at the national level was ₹ 92,651 crores (Verma 2022).

Literature Review

Procurement plays a crucial role in inbound logistics, impacting the entire SC. It represents a significant opportunity for cost reduction by addressing productivity factors and streamlining the procurement process. The knowledge about the structure of reasons is necessary for long-term solutions (Faix, 2022). Resolving challenges within the procurement process contributes to smoother operations. This helps reduce costs and contributes to maintaining and enhancing the quality of perishable products. Due to perishability and less shelf life, these products require appropriate transportation, handling and storage infrastructure. The SC

Table 1. Twelve Critical Factors Under the Four Categories.

Category	Factors	Challenges
Contract and procurement	F1	Multiple suppliers and intermediaries
	F2	Contract management
	F3	Pressure due to environmental regulations
Infrastructure and transportation	F4	Asset management
	F5	Location of supplier
	F6	Preference in location
Technology	F7	Assimilation of technology among vendors
	F8	Integration of vendors with information system
	F9	Uniform level of commitment with supplier to sustainability
Quality and govt regulation	F10	Regulatory compliance
	F11	Regulation about protection of produces/farmer
	F12	Regulation for sustainability

suffers from considerable inefficiency and faces numerous issues, prompting the authors to identify the challenges that affect the procurement of raw material (RM) for the FPI. However, the procurement process is filled with various challenges, and addressing these challenges is crucial for smooth and efficient procurement and related operations in FPI. After a literature review and discussions with industry professionals, several significant challenges have been identified that substantially impact the procurement process and the overall industry growth. Twelve critical factors under the four categories that affect RM procurement in FPI were identified and listed in Table 1.

Multiple Suppliers and Intermediaries

Using many suppliers and intermediaries in the SC has several difficulties and complications for organisations. It might take a lot of time and resources to monitor the performance of numerous suppliers, ensure that quality and delivery requirements are met and negotiate contracts with each of them. Different suppliers' RMs of varying quality can impair overall product uniformity and result in lower-quality products. Furthermore, relying on several suppliers can raise procurement prices, reduce the buyer's bargaining power and increase SC risk. Coordination and communication with numerous providers can make finding quick and practical solutions to problems more difficult (Amorim et al., 2016; Bourquard et al., 2022; Kamble & Raut, 2019; Kanani, 2019; Singh & Akoijam, 2020).

Using intermediaries in the FPI's RM procurement process has several downsides and difficulties. First, intermediaries incur additional expenses, which raises the cost of RM for food producers and drives up consumer prices. Second,

there may be concerns with quality control because intermediaries might uphold different standards than the original suppliers, which could affect the general quality of the product. The employment of intermediaries can also lead to uneven supply and delayed deliveries, slowing manufacturing and creating inefficiencies. Additionally, food processors might have fewer customisation possibilities and less control over the purchasing procedure. A lack of openness in the handling and procuring of RM might harm the reputation of the finished foods (Agarwal, 2017; Kamble & Raut, 2019; Negi & Anand, 2015). Finally, because they rely on intermediaries, food processors are vulnerable to changes in the market and SC disruptions.

Contract Management

Effective contract management is essential for efficient operations and financial success in the FPI. However, several difficulties make the process difficult. Lack of clarity in contract conditions, which causes disagreements and delays, is one of the main problems. Furthermore, rigid contracts make it difficult for food processors to adjust to market shifts, which results in RM shortages or surpluses. Misunderstandings and quality issues might be further exacerbated by poor communication with suppliers. Furthermore, exploring new sourcing opportunities and suppliers is difficult due to constrained supplier pools and rigorous contract requirements, which could result in increased costs or inputs of worse quality. Additionally, the industry's ongoing growth needs flexibility for innovation (Abebe et al., 2013; Agarwal, 2017; Bahinipati, 2014; Kamble & Raut, 2019; Kanani & Buvik, 2018; Reiner et al., 2014). However, agreements that limit the adoption of new RM or sourcing techniques can make it challenging to keep up with consumer trends and miss chances for product innovation.

Pressure Due to Environmental Regulations

Environmental rules have a variety of effects on RM procurement for food processors. They result in higher costs since new technology and sustainable practices are required, and they also make some resources less accessible in designated environmental zones. The complicated regulatory environment presents compliance problems requiring significant paperwork and auditing, which can lead to delays and inefficiencies. Penalties and legal proceedings are potential consequences of non-compliance. Thus, procurement strategies should be cautious. Additionally, the stringent restrictions may put businesses that cannot achieve sustainability standards at a competitive disadvantage, reducing their market share (Prakash, 2018).

Asset Management

Managing RM and inventory might present several difficulties. Production delays or shortages may result from the lack of visibility into inventory levels. A lack of

stock or too much inventory due to inaccurate forecasting can tie up capital. Bad supplier relationships might bring on delays in receiving critical materials. Production delays are another effect of ineffective procurement procedures. Production plans can be disrupted, and shortages might result from inadequate inventory and faulty demand projections. Partnerships are strained by poor supplier connections, which makes it harder to get vital RM. Inadequate asset management may lead to quality control issues, endangering the safety of the final product. Ineffective inventory management and storage practices may lead to higher costs. Ineffective risk management can expose businesses to financial losses and SC disruptions.

Location of Supplier

The Food Business Organisation (FBO) may face several difficulties while acquiring RM from far-off providers. First, higher transportation costs could result in higher total and product costs. Second, lengthier lead times could throw off production plans and make inventory management more challenging. Perishable commodities are also susceptible to spoiling during protracted transportation, which could result in losses. Misunderstandings and delays in procurement might result from communication problems brought on by language limitations or time zone discrepancies (Amorim et al., 2016; Dhanorkar et al., 2015; Kanani, 2019). Lastly, the industry's operations and dependability may be impacted by the industry's restricted availability and SC weaknesses.

Preference in Location

In the FPI, choosing particular sites can have several effects. The first effect on overall procurement costs is that it can lead to higher shipping costs and longer lead times for sourcing RM. Second, lacking local RM can make obtaining necessary resources challenging, increasing prices or using pricey imported components. Seasonal variations can also interfere with the reliable supply of some RM, which will impact production (Dhanorkar et al., 2015; Kanani, 2019). Customer dissatisfaction may also result from challenges in maintaining the quality and consistency of RM.

Assimilation of Technology Among Vendors

The adoption of new technology by vendors in the FPI has several effects on how RM is purchased. It might result in vendor fusion, giving fewer suppliers more negotiating leverage and raising RM prices. It could be challenging for food processors to locate suppliers who can match their unique requirements due to the standardisation of specifications. The need for traceability is expanding, which makes it challenging to determine where RM comes from. Additionally, the use of new technologies may lead to a rise in the demand for particular RM, a decrease in diversification, dependence on specific suppliers and a decreased ability of the

procurement process to adjust to market changes. These elements could affect the effectiveness and consistency of RM sourcing for food processors (Bahinipati, 2014; Makweba Ruteri & Xu, 2009; Raut et al., 2019; Simayan Pati, 2011; Singh et al., 2022; Singh & Akoijam, 2020).

Integration of Vendors with Information System

There are several issues and factors to consider when integrating vendors into the information system of an FBO. First, there could be problems with data compatibility, which would delay getting RM and mess up production timelines. System security flaws may reveal confidential information, providing rivals an advantage or resulting in product recalls. Vendor lock-in could happen, making switching suppliers difficult and impacting the supply of RM. Successfully managing orders and tracking shipments may be challenging due to the process's complexity. Integration might also reduce the range of available suppliers and foster reliance on technology, which could disrupt the procurement process. The standardised system may be inefficient when dealing with particular supplier requirements due to a lack of flexibility and modification. Reduced direct communication with suppliers can make it more challenging to work together and solve problems, impacting quality control and price discussions (Negi & Anand, 2015; Prajogo & Olhager, 2012; Siddh et al., 2015; Simayan Pati, 2011; Singh & Akoijam, 2020). Additionally, integrating vendors might make companies more susceptible to cyberattacks, compromising supplier and procurement data.

Uniform Level of Commitment with Supplier to Sustainability

Uniform sustainability requirements can have both beneficial and harmful effects on the FBO. While it encourages ethical behaviour, it can also present businesses with restrictions and difficulties. First, requiring suppliers to adhere to strict sustainability criteria may make a smaller pool of suppliers available, making it harder to find specific products and higher prices. Sustainable business practices may also be more expensive, which affects the procurement process. Additionally, if a supplier has problems, the entire SC could be affected, leading to shortages and hurting production (Abebe et al., 2013; Esham & Usami, 2006; Grimm et al., 2014; Negi & Anand, 2015; Singh & Akoijam, 2020; Suryaningrat, 2016). Moreover, a shared commitment to sustainability may result in geographical restrictions, increased prices and innovative restraints.

Regulatory Compliance

Regulations about sustainability and regulatory compliance can significantly impact how food processors purchase their RM. Due to the additional resources needed to achieve requirements, longer procurement lead times and a smaller pool of suppliers, compliance with laws can raise costs. Additionally, firms run a higher liability risk for utilising non-compliant RM, which could result in legal action

and harm to their brand. In extreme circumstances, some companies can decide to avoid a market altogether. On the other hand, sustainability restrictions may restrict the supply of some RM, increasing costs and complicating the SC (Negi & Anand, 2015; Palani & Apdhul, 2016). Geographical limitations and limited supplier possibilities may have an even more significant impact on the purchasing process for food processors.

Regulation About the Protection of Produces/Farmer

Regulations in the FPI can significantly impact the availability and pricing of RM. They might result in more significant agricultural production expenses for farmers, raising the cost of RM and making it harder for food processors to remain profitable. Furthermore, strict regulations may reduce RM availability since some farmers may find it challenging to meet the standards, creating shortages in the market. Interruptions in traditional farming may impact the supply of particular RM practices brought on by legislative changes. At the same time, barriers to the entrance for new producers may further limit the options accessible to food processors. Additionally, adhering to administrative requirements may result in time-consuming procedures for both farms and food processors, reducing the effectiveness of RM sourcing (Negi & Anand, 2015; Palani & Apdhul, 2016; Rais et al., 2013; Simayan Pati, 2011).

Regulation for Sustainability

Regulations about sustainability provide food processors with several difficulties while sourcing raw ingredients. First, compliance might raise expenses because of investments in new technologies or procedures. Second, limiting the use or sourcing to particular areas may decrease the supply of RM and increase costs. These regulations' intricacy increases bureaucracy and paperwork, which makes procurement more challenging and expensive. The regulatory environment continuously changes, which adds to the uncertainty and delays (Bahinipati, 2014; Kanani, 2019; Palani & Apdhul, 2016; Rais et al., 2013). It becomes more costly to meet strict sustainability criteria, which impacts budget-constrained smaller enterprises. Limited supply and probable shortages may occur, which would increase competition and pricing. SC modifications required to shift to sustainable practices result in brief disruptions. Furthermore, navigating worldwide standards and certifications is difficult due to compliance constraints and trade ramifications, which impact purchasing decisions (Prakash, 2018; Siddh et al., 2017).

Objective of Study

Procurement is part of inbound logistics and is laden with significant issues due to various factors. By overcoming these challenges, decision-makers and stakeholders, including farmers, suppliers and FBOs, can optimally plan and manage their operations.

Therefore, the present study has been conducted with the objective of 'Factor identification for the procurement of raw material in the Food Processing Industry'. The knowledge about the structure of reasons is necessary for long-term solutions.

Methodology

An interpretive structural model (ISM) was created to clearly understand the connections between the many challenges in the procurement of RM. ISM is a qualitative and interpretive approach that produces solutions for complicated issues through discussions based on the structural mapping of intricate relationships between elements to look at and analyse the challenges that affect the procurement process. A systematic review of the existing literature provides a comprehensive understanding of these challenges.

Development of Structural Self-interaction Matrix (SSIM)

Based on the literature review, 12 critical factors under the four categories that affect the RM procurement in FPI were identified as the first step of ISM. With the help of expert opinions, SSIM was developed. The group of seven people with an average experience was involved in brainstorming sessions. To develop this SSIM, the four symbols V, A, X and O were used, and SSIM was formed between the 12 factors. As indicated in Table 2, these factors were labelled F1–F12 in order. The SSIM matrix is available in Table 3. The conventional meaning of V, A, X and O is mentioned in Table 4 by taking *i* and *j* as two factors.

An ISM builds a conceptual framework. A framework is a structure between the variables. Two types of frameworks are created: (a) Theoretical—Relation between the variables is envisaged from theory; it may include one or more theories. (b) Conceptual—Conceptual framework is the proposed relationship between the variables.

ISM for Challenges in RM Procurement

ISM is an approach applied in this study to categorise the difficulties based on their driving and dependent power and to find inter-relationships among the RM procurement challenges for the FPI. ISM is a practical methodology for structuring complex problems with the movement of RM procurement. In other words, the better the input to ISM is prepared, the better the result and representation. The input to the algorithm needs to be well-defined to provide the user with a clear grasp of all challenges that need to be assessed. In conclusion, when using the procedure, a moderated process is more accurate than an evaluation based solely on paper surveys.

ISM is a qualitative and interpretive methodology that develops answers to complicated issues through discussions based on the structural mapping of complex interactions between elements (Malone, 1975; Sage, 1977; Watson,

Table 2. Literature Review.

Category	Factors	Challenges	References
Contract and procurement	F1	Multiple suppliers and intermediaries	Amorim et al. (2016), Bourquard et al. (2022), Kamble and Raut (2019), Kanani (2019), Singh and Akoijam (2020) Agarwal (2017), Kamble and Raut (2019), Negi and Anand (2015)
	F2	Contract management	Abebe et al. (2013), Agarwal (2017), Bahinipati (2014), Kamble and Raut (2019), Kanani and Buvik (2018), Reiner et al. (2014)
	F3	Pressure due to environmental regulations	Prakash (2018)
Infrastructure and transportation	F4	Asset management	
	F5	Location of vendors	Amorim et al. (2016), Dhanorkar et al. (2015), Kanani (2019)
	F6	Preference in location	Dhanorkar et al. (2015), Kanani (2019)
Technology	F7	Assimilation of technology among vendors	Bahinipati (2014), Makweba Ruteri and Xu (2009), Raut et al. (2019), Simayan Pati (2011), Singh et al. (2022), Singh and Akoijam (2020)
	F8	Integration of vendors with information system	Agarwal (2017), Bahinipati (2014), Kamble and Raut (2019), Negi and Anand (2015), Prajogo and Olhager (2012), Siddh et al. (2015), Simayan Pati (2011), Singh and Akoijam (2020)
	F9	Uniform level of commitment with supplier to sustainability	Abebe et al. (2013), Esham and Usami (2006), Grimm et al. (2014), Negi and Anand (2015), Singh and Akoijam (2020), Suryaningrat (2016)
Quality and govt regulation	F10	Regulatory compliance	Negi and Anand (2015), Palani and Apdhul (2016), Rais et al. (2013), Simayan Pati (2011)
	F11	Regulation about protection of produces/ farmer	Bahinipati (2014), Kanani (2019), Palani and Apdhul (2016), Rais et al. (2013)
	F12	Regulation for sustainability	Prakash (2018), Siddh et al. (2017), Mishra (2022)

Table 3. SSIM for Factors that Create Challenges in RM Procurement.

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
F1	–	X	A	X	X	X	A	A	X	A	A	A
F2		–	O	X	X	A	V	A	V	A	V	V
F3			–	O	O	V	V	V	V	O	A	X
F4				–	O	O	A	O	O	A	O	O
F5					–	X	X	O	X	X	A	A
F6						–	X	X	X	X	O	X
F7							–	X	X	A	O	A
F8								–	X	A	A	X
F9									–	X	X	X
F10										–	X	X
F11											–	X
F12												–

Table 4. Meaning of Symbols Used in SSIM.

Symbol	Meaning
V	‘i’ affects ‘j’, but ‘j’ does not effects ‘i’
A	‘i’ does not affect ‘j’, but ‘j’ affects ‘i’
X	‘i’ and ‘j’ both affect each other
O	neither ‘i’ effect ‘j’ nor ‘j’ effects ‘i’

1978). An element structure emerges inside the ISM environment depending on the relation that explains how the elements are connected . The method helps discover and arrange the intricate connections among system parts so that the effects on the components may be examined. Using directed graphs (digraph), modelling transforms the object system into a clear and representative system. In addition to the structural interpretation, the object system is also interpreted in terms of its content, which involves adding context (information) to the digraphs. The ‘fundamental structural model’ is the object system mapped as digraphs. The final result of the content expansion is an ‘interpretive structural model’.

We have used the ISM approach to problems in RM procurement based on the nomenclature described in the preceding subsections, prior research and chosen theories.

Steps involved in ISM methodology

The following are the different ISM method steps:

Selection of Elements Relevant to the Problem.

Identifying components relevant to the issue is an excellent place to start. Primary research (survey, group problem solving) or secondary research methods can accomplish this.

Establishing Contextual Relation Type.

The contextual relation must be clearly expressed as a potential expression of the relationship among the elements. Many relationships exist, including comparative, influence, neutral and temporal (Warfield, 1978).

Construction of SSIM by Pairwise Comparison.

The most challenging and complex phase of construction of ISM. The participants in this step must choose the pairwise relationship between the components. While considering the contextual relationship for each element, whether there is a relationship between any two sub-elements (i and j) and the direction in which the relationship runs is questioned. One of four symbols indicates how the components i and j relate to one another.

Future Course of Research and Conclusion

This research can be used for imperial testing about challenges in procurement for FPI. Another extension of the research can be the development of interrelationships among different challenges of procurement for FPI. This research can also be utilised for policy development of food processing reforms at the managerial theatre. This research is helpful by providing the challenges impacting the inbound SC of the FPI. Decision makers for Food SC and FPI can use this work to smooth the process. This research can also be utilised for simulations as input of Food SC.

This research listed the challenges for the food procurement industry and summarised them in the context of research works citing them.

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