

# Identifying Constraints in Decision-Making in Sago Industries in Tamil Nadu, India

## ABSTRACT

Entrepreneurship is critical to economic progress. Entrepreneurs act as catalysts in the industrialization and economic growth processes. Entrepreneurial achieving is characterized by high uncertainty, ambiguity, time pressure, emotional intensity, and risk, all of which can have a significant impact on how entrepreneurs evaluate specific situations and make decisions. In addition, making decisions and prioritizing them is crucial in the entrepreneurial context. This study aims to identify and prioritize the potential decisions for sustainable development of the Sago cluster through Interpretive Structural Modelling (ISM). ISM assists in obtaining qualitative data rather than quantifiable aspects as a result of modeling. Ten drivers of decisions were finalized after the expert's consultation. The interaction between drivers was developed. The study's findings will assist entrepreneurs in developing methods to promote the growth of firms in the Sago cluster.

*Keywords: Entrepreneurs, Sago Industries, Constraints, Decision Making, Interpretive Structural Modelling*

## 1. INTRODUCTION

Entrepreneurs play a vital part in a country's economic development. The desire to pursue entrepreneurship stems from a strong passion and certain compulsions. Entrepreneurial achieving is characterized by high uncertainty, ambiguity, time pressure, emotional intensity, and risk, all of which can have a significant impact on how entrepreneurs evaluate specific situations and make decisions (Mullins & Forlani, 2005). Entrepreneurial decision-making is critical because the decisions made by firm leaders have a significant impact on the firm's future direction and performance (Carpenter et al., 2004). In addition, making decisions and prioritizing them is a crucial role in the entrepreneurial context. Interpretive Structural Modelling (ISM) is a multi-criteria decision-making technique used to identify the critical constraints faced by the entrepreneurs in the Sago clusters. This also aids in establishing the interrelationship among the critical constraints that affect decision-making.

## 2. LITERATURE REVIEW

According to Malone (1975), ISM is considered to be a very helpful tool for people who want to approach complex situations with deliberate, logical thinking and then convey the results of that reasoning to others. According to Warfield (1974), ISM is a method of interactive education. This method involves organizing a variety of aspects that are both directly and indirectly related in a thorough, systematic mode. According to Jharkharia and Shankar (2005), ISM is a well-known technique for determining links between particular elements that characterize a problem or a concern. Agarwal et

al., 2007 described ISM begins with the identification of variables that are pertinent to the issue or problem, and it then develops with a technique for collaborative problem-solving. The choice of a contextually appropriate subordinate relation follows. Using pairwise comparison of the variables, a structural self-interaction matrix (SSIM) is created when the element set and contextual relation have been chosen. The SSIM is transformed into a reachability matrix (RM) and its transitivity is examined in the following phase. A matrix model is created following the completion of transitivity embedding. After that, the elements are divided up, and the structural model known as ISM is extracted. George and Pramod (2014) have explored these three dimensions of ISM. I (interpretive) stands for the result or judgement based on expert opinions, S (structural) implies the extraction of structure among complex sets of items or variables, and M (modelling) stands for the graphical representation, i.e. digraph, which depicts the direct and indirect correlation among factors. According to Mudgal et al., 2010, the two fundamental ideas of ISM are transitivity and reachability. As a fundamental idea for simulating the structure, transitivity represents the interrelationship among three elements. In order to extract the link between a complex set of variables, Ravi and Shankar (2005) established an ISM technique that consists of eight steps, beginning with the identification of variables and concluding with a check for conceptual contradiction in the ISM model.

### 3. METHODOLOGY

#### 3.1 Interpretive Structural Modeling (ISM)

Structural interpretation is a powerful technique for transforming conceptual configurations into a confident, well-designed pattern (Ahuja, Polidoro Jr, & Mitchell, 2009). The ISM is the most widely used socioeconomic evaluation tool (Warfield, 1974). ISM provides its customers with a structured and thorough technique for the first time incorporating group assessments in the creation of structural models. It aids in obtaining qualitative data rather than quantifiable aspects as a result of modelling (Janes, 1988). The graphical presentation of results is shown by this technique (Janes, 1988). The steps of ISM methodology are as follow.

Step 1: Based on expert opinion 10 major constraints were identified.

Step 2: The first round identifies contextual relationships between enablers (decisions).

Step 3: The Enabler is built with a structural self-interaction matrix (SSIM) that indicates a pair-to-pair relationship between the investigated facilitators.

Step 4: The ISM methodology emphasizes transitivity. The following formula is used, and if  $X=Y$ ,  $Y=Z$ , the  $X=Z$  is inferred. The original SSIM accessibility matrix is used to check transitivity.

Step 5: The accessibility matrix is further classified into levels.

Step 6: Transitivity is eliminated by drawing a digraph. A diagram has been created based on the contextual relationship in the accessibility matrix.

Step 7: When converting diagrams to interpretive models, the final result is produced by replacing the nodes in a digital digit with assertions.

Some of the important constraints faced by the entrepreneurs of Sago cluster were selected and further analyzed using interpretive structural equational modelling to prioritize them to make up suitable measures for sustainable development of Sago cluster on a priority basis. The list of table of constraints faced by the entrepreneurs is presented in the table 1.

**Table 1 Constraints faced by the entrepreneurs of Sago cluster**

S.No	Constraints	Representation
1	Decreased human labor	F1
2	Improper inventory management	F2
3	Non availability of raw materials round the year	F3
4	Improper transportation	F4
5	Inadequate electricity power	F5
6	Poor technology innovation	F6
7	Inadequate working capital	F7

8	Lack of entrepreneurial activity	F8
9	Ineffective waste management	F9
10	Poor plan layout	F10

## 4. RESULTS AND DISCUSSION

### 4.1 APPLICATION OF ISM

#### 4.1.1 Structural Self Interaction Matrix (SSIM) and Reachability Matrix

Following the ideas of industrial experts, contextual linkages have been developed between the decision-making constants. Four symbols (V, A, X, O) were used to construct the contextual relationship that led to the formation of the SSIM matrix. Individual symbols are described in greater depth below.

V: I will assist you in obtaining j element A: j contributes to I element X: I and j elements both contribute to the achievement of O: I and j are unrelated.

Table 2 describes the four symbol relevance (V, A, X, O).

**Table 2 Self Structural Interaction Matrix**

Factors	10	9	8	7	6	5	4	3	2	1
1	V	A	O	O	O	O	V	O	V	-
2	V	X	X	A	X	A	X	A	-	
3	V	V	O	O	X	A	O	-		
4	V	A	O	O	A	A	-			
5	O	V	O	V	V	-				
6	V	X	O	O	-					
7	O	A	V	-						
8	X	V	-							
9	O	-								
10	-									

From SSIM, initial reachability matrix was constructed by converting the variables into binary from 1 and 0 by using the following rules

- When the entry (I, J) in SSIM is V, I to J transaction will be 1 and 0 for vice versa
- When the entry (I, J) in SSIM is A, I to J transaction will be 0 and 1 for vice versa
- When the entry (I, J) in SSIM is X, both I to J and J to I transaction will be 1
- When the entry (I, J) in SSIM is O, both I to J and J to I transaction will be 0

Initial reachability matrix was constructed and presented in table 3

**Table 3 Initial reachability matrix**

Factors	1	2	3	4	5	6	7	8	9	10
1	1	1	0	1	0	0	0	0	0	1
2	0	1	0	1	0	1	0	1	1	1
3	0	1	1	0	0	1	0	0	1	1
4	0	1	0	1	0	0	0	0	0	1
5	0	1	1	1	1	1	1	0	1	0
6	0	1	1	1	0	1	0	0	1	1
7	0	1	0	0	0	0	1	1	0	0
8	0	1	0	0	0	0	0	1	1	1
9	1	1	0	1	0	1	1	0	1	0
10	0	0	0	0	0	0	0	1	0	1

The final reachability matrix is constructed once transitive in the initial reachability matrix is ensured. The resulting final accessibility matrix is shown in Table 4.

**Table 4 Final Reachability Matrix**

Factors	1	2	3	4	5	6	7	8	9	10	A
1	1	1	0	1	0	1*	0	1*	1*	1	7
2	1*	1	1*	1	0	1	1*	1	1	1	9
3	1*	1	1	1*	0	1	1*	1*	1	1	9
4	0	1	0	1	0	1*	0	1*	1*	1	6
5	1*	1	1	1	1	1	1	1*	1	1*	10
6	1*	1	1	1	0	1	1*	1*	1	1	9
7	0	1	0	1*	0	1*	1	1	1*	1*	7
8	1*	1	0	1*	0	1*	1*	1	1	1	8
9	1	1	1*	1	0	1	1	1*	1	1*	9
10	0	1*	0	0	0	0	0	1	1*	1	4
B	7	10	5	9	1	9	7	10	10	10	

The driving power (A) and dependence power (B) for each constraint was calculated by summing up ones along the rows and columns respectively.

From the table 4, it could be observed that, in accordance to driving with higher to lower driving power (A), inadequate electricity power (F5) (5), non-availability of raw materials round the year (F3) (4), decreased human labor (F1) (3), inadequate working capital (F7) (3), improper transportation (F4) (2), poor technology innovation (F6) (2), improper inventory management (F2) (1), lack of entrepreneurial activity (F8) (1), ineffective waste management (F9) (9) and poor plant layout (F10) (1). High driving power denotes the ability of the factors in influencing the other factors.

**4.1.2 Level Partitioning**

From the final reachability matrix, reachability set, antecedent set, and interaction set for each constraint were framed.

Reachability set consist of,

- Set 1: Particular constraint
- Set 2: other constraint helped by the particular constraint, in achieving or resolving either directly or indirectly

Antecedent set consist of,

- Set 1: Particular constraint
- Set 2: Other constraint that helped to advice or receive the particular constraint either directly or indirectly

Interaction set consist of the constraints common in both reachability and antecedent set.

Level partitioning was done, when the reachability and interaction was same, the constraints was eliminated and it could be occupied the top level in ISM structure. Further iteration were made until the last constraint was eliminated and the ISM structure was complete. The level partitioning is presented in table 5 and table 6.

**Table 5 Level partitioning – Iteration 1**

Factors	Reachability Set	Antecedent Set	Intersection set	Level
1	1,2,4,6,8,9,10	1,2,3,5,6,8,9	1,2,8,9	
2	1,2,3,4,6,7,8,9,10	1,2,3,4,5,6,7,8,9,10	1,2,3,4,6,7,8,9,10	I
3	1,2,3,4,6,7,8,9,10	2,3,5,6,9	2,3,6,9	
4	2,4,6,8,9,10	1,2,3,4,5,6,7,8,9	2,4,6,8,9	
5	1,2,3,4,5,6,7,8,9,10	5	5	
6	1,2,3,4,6,7,8,9,10	1,2,3,4,5,6,7,8,9	1,2,3,4,6,7,8,9	
7	2,4,6,7,8,9,10	2,3,5,6,7,8,9	2,6,7,8,9	
8	1,2,4,6,7,8,9,10	1,2,3,4,5,6,7,8,9,10	1,2,4,6,7,8,9,10	I
9	1,2,3,4,6,7,8,9,10	1,2,3,4,5,6,7,8,9,10	1,2,3,4,6,7,8,9,10	I
10	2,8,9,10	1,2,3,4,5,6,7,8,9,10	2,8,9,10	I

**Table 6 level portioning – Iteration 1 to 5**

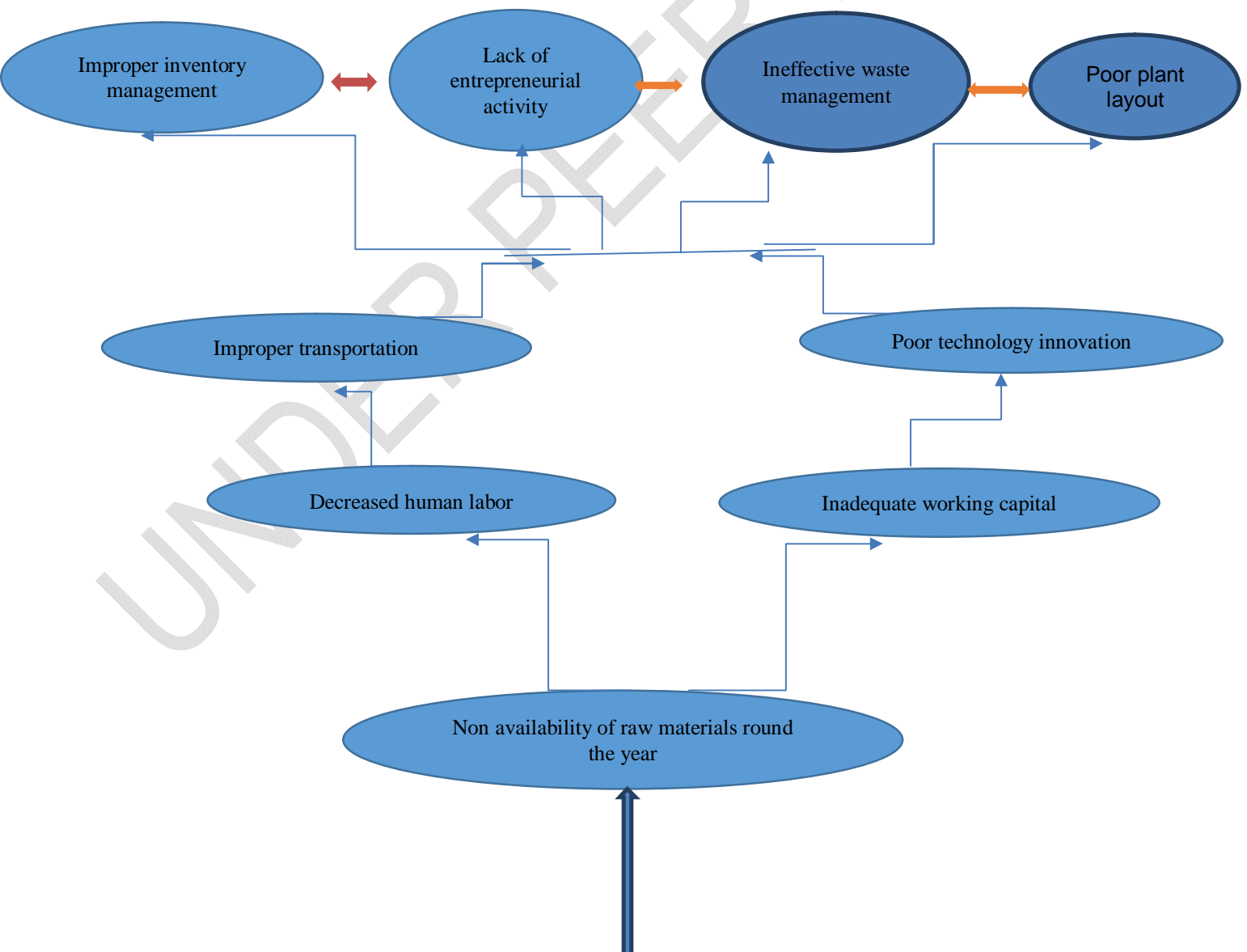
Factors	Reachability Set	Antecedent Set	Intersection set	Level
1	1,2,4,6,8,9,10	1,2,3,5,6,8,9	1,2,8,9	III
2	1,2,3,4,6,7,8,9,10	1,2,3,4,5,6,7,8,9,10	1,2,3,4,6,7,8,9,10	I
3	1,2,3,4,6,7,8,9,10	2,3,5,6,9	2,3,6,9	IV
4	2,4,6,8,9,10	1,2,3,4,5,6,7,8,9	2,4,6,8,9	II
5	1,2,3,4,5,6,7,8,9,10	5	5	V
6	1,2,3,4,6,7,8,9,10	1,2,3,4,5,6,7,8,9	1,2,3,4,6,7,8,9	II
7	2,4,6,7,8,9,10	2,3,5,6,7,8,9	2,6,7,8,9	III
8	1,2,4,6,7,8,9,10	1,2,3,4,5,6,7,8,9,10	1,2,4,6,7,8,9,10	I
9	1,2,3,4,6,7,8,9,10	1,2,3,4,5,6,7,8,9,10	1,2,3,4,6,7,8,9,10	I
10	2,8,9,10	1,2,3,4,5,6,7,8,9,10	2,8,9,10	I

From the table 6, it could be observed that improper inventory management (F2), lack of entrepreneurial activity (F8), ineffective waste management (F9) and poor plant layout (F10) formed the first level and occupied in the top level in ISM structure. Inadequate electricity power (F5) gets fifth level and occupied at the bottom and influential position in ISM structure.

#### 4.2 ISM structure

Based on the levels from the level partitioning, ISM structure was constructed and presented in figure 1. The constraint at the top level was resolved by resolving the constraint at the bottom level of the structure

Figure 1 ISM Structure



Inadequate electricity power

## 5. CONCLUSION

The primary objective of this study was to identify the inter-relationship between constraints in sago industries decision making. This study makes an attempt towards enhancement of decision making in entrepreneurs of sago industries. We used 10 constraints of decision making after recommendation of expert opinion. Further, we conducted ISM methodology to highlight and explore the inter relationship among identifies factors. Figure 1 revealed inadequate electricity power situated at the bottom of hierarchy that depict the highest power.

**Inadequate electricity power:** The shortage of secure and dependable electricity power is a barrier to doing business in the sago industries. Power storage reduces possibility, quantity, and quality, and has a negative impact on firm total production. The impact of power on sago industries by assuring planned outages and providing access to alternate electricity supply such as generators and renewable energy.

**Non availability of raw materials:** The importance of raw materials is obvious to upstream enterprises that harvest, refine, and process goods into finished goods. Factors that complicate procurement and thereby influence raw material lead time, mode of production, and long supply chain legs. The main threat to production in the sago industry is the lack of raw materials with starch content and timely availability. Creating collecting centers for raw materials and dealers throughout Tamil Nadu as a distribution network would aid in recovering from raw material scarcity.

**Inadequate working capital:** The nature of working capital management is determined by the approach chosen by firms. If the firm reduces its investment in working capital by minimizing inventory and account receivables, it will boost its profitability. A fall in both inventory and receivables, on the other hand, may jeopardize output. As a result, firm effectiveness suffers. As a result, sago industries should pursue a strategy that promotes an increase in working capital.

**Decreased human labor:** It is well acknowledged that the failure of a production unit is mostly attributable to human labor mismanagement. Many businesses, in particular, have failed to improve workers' skills and retain human capital. By regulating and enhancing workers' skills in the manufacturing unit, sago enterprises' overall effectiveness and efficiency are improved.

**Poor technology innovation:** Because of the significant rise in labor costs, entrepreneurs have recognized the value of technological innovation in improving their competitiveness. The technological advancement in machineries in sago industries is under-utilized. The explanation could be that technologies are essential for the enterprise's image, and selecting the wrong region for technological upgradation is contradictory. The acquired technology should be fully utilized to improve manufacturing processes in order to fulfil the growing demand for higher quality at a lower cost.

**Improper transportation:** Understanding the impact of transportation in determining where to locate or relocate is critical. Transportation is obviously vital, as improvements in the transportation system open up previously untapped market areas and allow resources to flow from point of production to point of consumption. However, transit investments tend to shift corporate activity in a more efficient direction.

Improper inventory management: Poor inventory management causes overstocking and understocking, both of which have an impact on cost and quality, among other things. Economic order quantity inventory management defines the number of units to be ordered depending on a company's holding expenses, ordering costs, and demand.

Lack of entrepreneurial activity: Every activity in any business is the responsibility of the entrepreneur. It aids in the creation of business structures and numerous decision-making processes that are required for the efficient production of starch and sago in the Sago cluster.

Ineffective waste management: Ineffective waste management can lead to a slew of negative environmental consequences, ranging from water and soil pollution to dwindling natural resources. Sago pith still has a high starch content. Sago pith includes 65.7% starch, 19.8% crude fiber, 1% crude protein, 4.1% ash, and 59.1% moisture. The use of this material as a biomass resource could result in new products rather than waste treatment.

Poor plant layout: A poor plant layout causes waste in transportation, handling, and movement between work stations, as well as delays and extra processing in the event of an overly sophisticated storage system.

Therefore, inadequate electricity can be termed as "base key factor" as well remaining factor directly or indirectly associated with it. It also witnessed that improper inventory management, ineffective waste management, poor plant layout and lack of entrepreneurial activity depend on high driving power factors. The findings of this study may limit to developing sago industries only, as expert consultation only sago industry experts.

## REFERENCES

- Agarwal, A., Shankar, R., & Tiwari, M. (2007). Modeling agility of supply chain. *Industrial marketing management*, 36(4), 443-457.
- Ahuja, G., Polidoro Jr, F., & Mitchell, W. (2009). Structural homophily or social asymmetry? The formation of alliances by poorly embedded firms. *Strategic Management Journal*, 30(9), 941-958.
- Carpenter, M. A., Geletkanycz, M. A., & Sanders, W. G. (2004). Upper echelons research revisited: Antecedents, elements, and consequences of top management team composition. *Journal of management*, 30(6), 749-778.
- George, J. P., & Pramod, V. (2014). An interpretive structural model (ISM) analysis approach in steel re rolling mills (SRRMS). *International Journal of Research in Engineering & Technology*, 2(4), 161-174.
- Janes, F. (1988). Interpretive structural modelling: a methodology for structuring complex issues. *Transactions of the Institute of Measurement and Control*, 10(3), 145-154.
- Jharkharia, S., & Shankar, R. (2005). IT-enablement of supply chains: understanding the barriers. *Journal of Enterprise Information Management*.
- Malone, D. W. (1975). An introduction to the application of interpretive structural modeling. *Proceedings of the IEEE*, 63(3), 397-404.
- Mudgal, R. K., Shankar, R., Talib, P., & Raj, T. (2010). Modelling the barriers of green supply chain practices: an Indian perspective. *International Journal of Logistics Systems and Management*, 7(1), 81-107.
- Mullins, J. W., & Forlani, D. (2005). Missing the boat or sinking the boat: A study of new venture decision making. *Journal of business venturing*, 20(1), 47-69.
- Ravi, V., & Shankar, R. (2005). Analysis of interactions among the barriers of reverse logistics. *Technological Forecasting and Social Change*, 72(8), 1011-1029.
- Warfield, J. N. (1974). Developing interconnection matrices in structural modeling. *IEEE Transactions on Systems, Man, and Cybernetics*(1), 81-87.

UNDER PEER REVIEW