# On an Exploration into Various Challenges Faced by Rubber Industry in India and Studying the Possible Hierarchical Interrelationships amongst them

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## ABSTRACT

The importance of industrialization in achieving economic growth has been recognized in India's development strategy ever since the inception of economic planning in the country. Stupendous efforts have been made by the government since the commencement of planning and particularly since 1950s to industrialize the Indian economy and develop the infrastructural base for sustained industrial development. Rubber has multiple uses and it is used in different industry in India.

India is the fourth largest consumer of natural rubber in the world and the third largest producer. Still this industry suffers from serious drawbacks and faces challenges thereby . This paper explores the hierarchical interrelationships amongst various challenges faced by rubber industry in India and further studying the possible interrelationships amongst them using ISM methodology.

## Keywords

Rubber industry; Hierarchical inter-relationships; ISM methodology

## 1. INTRODUCTION

Rubber has multiple uses and it is used in different industry in India. India is the fourth largest consumer of natural rubber in the world and the third largest producer. India is a booming market and has a base of 720 million consumers across the country. Many agencies have projected a GDP growth of 9% until 2020. This growth will be driven by the expansion of the industrial sector. The industrial activity has recovered and global trade has finally picked up which has led to the industry seeing an upward trend. Rubber product manufacturing is a labour-intensive industry [Ref 3] and has nearly 6,000 MSMEs that collectively employ around 6 lakh people directly. Further 7 lakh people are employed indirectly. Consumption of natural rubber is dominated by the automotive sector which accounts for nearly 60% of all sales. In 2019-20, India's rubber products exports stood at $3,193.97 million.

India is the 6th largest producer and 2nd largest consumer of natural rubber as per natural rubber statistics 2016-17. The most important use of rubber is in transportation. The role of rubber is unique in the manufacturing of mechanical goods such as belting, packaging and moulding goods which are very essential for running industries. Apart from this , rubber also plays an important role in communication and transmission in the form of insulation for cables. Its use is also included in homes , farms, sports and games , medical field and in defense strategy . There are as many as 6,711 manufacturing units operating in the non-tyre manufacturing sector in the country. These include tread rubber products, footwear products, foam products, moulded goods, adhesives, gloves, tyre tube and flaps, beltings, auto and cycle parts etc. Indian holds a strong advantage in the global rubber industry. Auto tyres and tubes consume the largest share of rubber in the country at 61% which is followed by Cycle types and tubes at 10%.

Present research work studies the hierarchical inter-relationships amongst the various challenges faced by rubber industry .The research paper is written as follows: Section 2 discusses the main challenges faced by rubber and natural rubber industry in India. Thereafter, ISM methodology is discussed in section 3 and section 4 discusses the case example. Finally, conclusions are discussed in section 5.

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## 2. LITERATURE REVIEW: IDENTIFYING THE CHALLENGES

**2.1: Segregation of units [SoU] :** The biggest challenge faced by the rubber industry is the segregation of the units. Most micro units are yet to be a part of the fast changing scene of business.

**2.2: Operational challenges [OOC]**: There are operational challenges, technology priorities, innovation needs, new product development, talent management, cost of material, pressure of price reduction, inventory management, stiff competition and logistic costs.

**2.3 Challenge due to free import of rubber products [FIRP]:** There are many strengths of the industry but the government needs to extend support in order to meet the challenges posed by the free import of rubber products and high cost of interest.
Other challenges include increased imports due to the inverted duty structure which is harming the industry. Policy makers need to focus on the industry to tide over the crisis caused by free import of rubber products.

**2.4 High interest costs [ HIC]** : There is a slow shift in high technology equipment caused due to the high interest costs.

**2.5 Meagre assistance from government and financial institutions [ MAGFI] :** Getting inappropriate or meagre assistance from government could be one of the challenge for manufacturers of rubber or rubber industrialists. This obviously hampers the growth.

**2.6 Lack of coordination between central and state government [ LoC] :** Often, it is traced as one of the hidden challenge for any manufacturing industry and rubber industry is no exception .

**2.7 Shortage of working capital [ SWC] / Inadequate credit [ IC] :** Inadequate credit is another challenge . There is required an amount of funds demanded which if inadequate pose a challenge.

**2.8 Expensive and ineffective consultancy service[ E&ICS]** : Among total 17 percent were considered labour welfare fund as the main problem. Labour welfare fund provide facilities to labourers in order to improve their working conditions provide social security and raise their standard of living . In Kerala , labour welfare fund obtained monthly from equal contribution of employee and employer . Therefore, it causes an additional payment over wages which deducted from the employer in every month .

**2.9 Inability to keep modern technology [ IMT] :** In this high technology phase , even the technology need to be kept up to date and this requires funds as well . Infrastructure supporting the modern day technological demand of the industry therefore is of importance.

**2.10 Antiquated and low cost machinery [ALCM**]: Among over all rubber based industries 53% of them are unable to keep modern technology because of high cost . These mini and small scale industries are forced to use antiquated and low cost machinery and equipment to continue the production.

**2.11 Lack of quality control & facility [ LQC] :** The facility needs to have good quality control and modern facility in order to cope up the demands of the customers or clients .

**2.12 Shortage of skilled labour [ SSL]** : From the primary survey conducted, the fact realised is the shortage of skilled labour is the main problem faced by all types of rubber based industries. The work needs special skills for the production of rubber manufacturing goods . Therefore, skill development training is necessary for new employees in the field.

**2.13 Strike and unionism [ S&U]** : Another fact is strike and unionism is not a problem in the case of immigrant labours. But the problem is in the form of skill development and training, because after earning much income, or after marriage , these immigrant labourers refused to come and work. Therefore, entrepreneurs could employ new labourers in order to continue the work and they should bear the cost for skill development training for the new employees .

**2.14 Disruption in global economic activities [DGEA]** : Covid-19 impacted the rubber industry in multiple ways. On one hand, there was a supply disruption of raw materials. On the other hand, a delay in farming operations and latex collection further compounded the issue. Due to disruption of global economic activities and restrictions on imports, crucial inputs such as carbon black and rubber chemicals were in short supply.

## 3. INTERPRETIVE STRUCTURAL MODELLING METHODOLOGY

Interpretive Structural Modelling (ISM)[12] is an interactive learning process in which a set of unique, interrelated variables are structured into a comprehensive model presented as a hierarchy graph. It involves the steps such as *Identification of elements* ; *Establishing the contextual relationship* between elements with respect to which pairs of elements will be examine. Thereafter, d*eveloping a self-interaction matrix (SSIM*) which includes establishing VAXO relationship amongst the two variables i.e. 'i' and 'j'. Thereafter, reachability matrix is formed which first includes an initial reachability matrix and thereafter and final reachability matrix . Thereafter , level partition matrices and canonical matrices are created from the final reachability matrix using reachability set , antecedent set and the intersection set . The element for which the reachability and intersection sets are the same is the top-level element. The whole process of partitioning is based on establishing the precedence relationships and arranging the elements in a topological order. *Classification of Variables Based on relative driving power and dependence power,* factors are classified in various categories like autonomous, dependent, driver and linkage and finally d*evelopment of Diagraph/ ISM from the canonical matrix form.*

## 4. CASE EXAMPLE

14 major challenges *viz*. Segregation of units [SoU]; Operational challenges [OOC]; Challenge due to free import of rubber products [FIRP]; High interest costs [ HIC]; Meagre assistance from government and financial institutions [MAGFI]; Lack of coordination between central and state government [LoC]; Shortage of working capital [SWC] / Inadequate credit [IC] ; Expensive consultancy service [ ECS]; Inability to keep modern technology [IMT]; Antiquated and low cost machinery [ALCM]; Lack of quality control & facility [LQC]; Shortage of skilled labour [SSL]; Strike and unionism [S&U] ; Disruption in global economic activities [DGEA] are studied with the help of ISM methodology for the possible hierarchical interrelationships amongst them .

**Fig 1: SSIM matrix for pair wise relationship amongst barriers of rubber industry**

| S. No. | Barriers | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | SoU | OOC | FIRP | HIC | MAGFI | LoC | SWC | ECS | IMT | ALCM | LQC | SSL | S&U | DGEA |
| 1 | SoU | | V | V | V | V | V | V | V | V | V | V | V | V | V |
| 2 | OOC | | | V | V | V | V | V | V | V | V | V | V | V | V |
| 3 | FIRP | | | | V | V | V | V | V | V | V | V | V | V | V |
| 4 | HIC | | | | | A | A | X | A | A | A | A | A | A | A |
| 5 | MAGFI | | | | | | V | V | V | V | V | V | V | V | V |
| 6 | LoC | | | | | | | A | A | A | A | A | A | A | A |
| 7 | SWC | | | | | | | | A | V | V | V | V | V | X |
| 8 | E&ICS | | | | | | | | | V | V | V | V | V | V |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | IMT | | | | | | | | | | V | V | V | V | X |
| 10 | ALCM | | | | | | | | | | | X | X | X | X |
| 11 | LQC | | | | | | | | | | | | X | X | X |
| 12 | SSL | | | | | | | | | | | | | V | V |
| 13 | S&U | | | | | | | | | | | | | | V |
| 14 | DGEA | | | | | | | | | | | | | | |

**Fig 2: IRM for pair wise relationship amongst barriers of rubber industry**

| S. No. | Barriers | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | SoU | OOC | FIRP | HIC | MAGFI | LoC | SWC | ECS | IMT | ALCM | LQC | SSL | S&U | DGEA |
| 1 | SoU | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | OOC | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3 | FIRP | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4 | HIC | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | MAGFI | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 6 | LoC | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 00 | 0 | 0 |
| 7 | SWC | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 8 | E&ICS | 0 | 00 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 9 | IMT | 0 | 0 | 00 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 10 | ALCM | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 11 | LQC | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 00 | 1 | 1 | 1 | 1 | 1 |
| 12 | SSL | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 13 | S&U | 0 | 0 | 0 | 1 | 00 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| 14 | DGEA | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 |

**Fig 3: FRM for pair wise relationship amongst barriers of rubber industry**

| S. No. | Barriers | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | SoU | OOC | FIRP | HIC | MAGFI | LoC | SWC | ECS | IMT | ALCM | LQC | SSL | S&U | DGEA | D.P |
| 1 | SoU | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 14 |
| 2 | OOC | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 13 |
| 3 | FIRP | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 12 |
| 4 | HIC | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 5 | MAGFI | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 11 |
| 6 | LoC | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 00 | 0 | 0 | 12 |
| 7 | SWC | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| 8 | E&ICS | 0 | 00 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 11 |
| 9 | IMT | 0 | 0 | 00 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| 10 | ALCM | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 8 |
| 11 | LQC | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 00 | 1 | 1 | 1 | 1 | 1 | 7 |
| 12 | SSL | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 7 |
| 13 | S&U | 0 | 0 | 0 | 1 | 00 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 6 |
| 14 | DGEA | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 6 |
| | De.P | 1 | 2 | 3 | 14 | 4 | 13 | 7 | 5 | 8 | 12 | 12 | 10 | 11 | 12 | |

4→6→10,11,14→13→12→9->7→8→5→3→2→1

D.P : Driving power ; De.P : dependence power

## 4.3 Level Partition

From the final reachability matrix, reachability and final antecedent set for each factor are found. The elements for which the reachability and intersection sets are same are the top-level element in the ISM hierarchy. After the identification of top level element, it is separated out from the other elements and the process continues for next level of elements. Reachability set, antecedent set, intersection set along with different level for elements have been shown below in table 4.

**Table 1: Iteration I**

| Reachability set | Antecedent set | Intersection set | Iteration |
|---|---|---|---|
| **4** | **1,2,3,4,5,6,7,8,9,10,11,12,13,14** | **4** | **I** |
| 4,6 | 1,2,3,5,6,7,8,9,10,11,12,13,14 | 6 | |
| 4,6,10,11,14 | 1,2,3,5,7,8,9,10,11,12,13,14 | 10,11,14 | |
| 4,6,10,11,13,14 | 1,2,3,5,6,7,8,9,10,11,13 | 13 | |
| 4,6,10,11,12,13,14 | 1,2,3,5,6,7,8,9,10,11,12 | 12 | |
| 4,6,9,10,11,12,13,14 | 1,2,3,5,6,7,8,9 | 9 | |
| 4,6,7,9,10,11,12,13,14 | 1,2,3,5,7,8 | 7 | |
| 4,6,7,8,9,10,11,12,13,14 | 1,2,3,5,8 | 8 | |
| 4,5,6,7,8,9,10,11,12,13,14 | 1,2,3,5 | 5 | |
| 3,4,5,6,7,8,9,10,11,12,13,14 | 1,2,3 | 3 | |
| 2,3,4,5,6,7,8,9,10,11,12,13,14 | 1,2,3 | 2 | |
| 1,2,3,4,5,6,7,8,9,10,11,12,13,14 | 1,2,3 | 1 | |

**Table 2: Iteration II**

| Reachability set | Antecedent set | Intersection set | Iteration |
|---|---|---|---|
| **6** | 1,2,3,5,6,7,8,9,10,11,12,13,14 | 6 | **II** |
| 4,6,10,11,14 | 1,2,3,5,7,8,9,10,11,12,13,14 | 10,11,14 | |
| 4,6,10,11,13,14 | 1,2,3,5,6,7,8,9,10,11,13 | 13 | |
| 4,6,10,11,12,13,14 | 1,2,3,5,6,7,8,9,10,11,12 | 12 | |
| 4,6,9,10,11,12,13,14 | 1,2,3,5,6,7,8,9 | 9 | |
| 4,6,7,9,10,11,12,13,14 | 1,2,3,5,7,8 | 7 | |
| 4,6,7,8,9,10,11,12,13,14 | 1,2,3,5,8 | 8 | |
| 4,5,6,7,8,9,10,11,12,13,14 | 1,2,3,5 | 5 | |
| 3,4,5,6,7,8,9,10,11,13,14 | 1,2,3 | 3 | |
| 2,3,4,5,6,7,8,9,10,11,12,13,14 | 1,2,3 | 2 | |
| 1,2,3,4,5,6,7,8,9,10,11,12,13,14 | 1,2,3 | 1 | |

**Table 3: Iteration III**

| Reachability set | Antecedent set | Intersection set | Iteration |
|---|---|---|---|
| **10,11,14** | 1,2,3,5,7,8,9,10,11,12,13,14 | 10,11,14 | |
| 10,11,13,14 | 1,2,3,5,6,7,8,9,10,11,13 | 13 | **III** |
| 10,11,12,13,14 | 1,2,3,5,6,7,8,9,10,11,12 | 12 | |
| 9,10,11,12,13,14 | 1,2,3,5,6,7,8,9 | 9 | |
| 7,9,10,11,12,13,14 | 1,2,3,5,7,8 | 7 | |
| 7,8,9,10,11,12,13,14 | 1,2,3,5,8 | 8 | |
| 5,7,8,9,10,11,12,13,14 | 1,2,3,5 | 5 | |
| 3,5,7,8,9,10,11,12,13,14 | 1,2,3 | 3 | |
| 2,3,5,7,8,9,10,11,12,13,14 | 1,2,3 | 2 | |
| 1,2,3,5,7,8,9,10,11,12,13,14 | 1,2,3 | 1 | |

**Table 4: Iteration IV**

| Reachability set | Antecedent set | Intersection set | Iteration |
|---|---|---|---|
| **13** | 1,2,3,5,6,7,8,9,10,11,13 | 13 | **IV** |
| 12,13 | 1,2,3,5,6,7,8,9,10,11,12 | 12 | |
| 9,12,13 | 1,2,3,5,6,7,8,9 | 9 | |
| 7,9,12,13 | 1,2,3,5,7,8 | 7 | |
| 7,8,9,12,13 | 1,2,3,5,8 | 8 | |
| 5,7,8,9,12,13 | 1,2,3,5 | 5 | |
| 3,5,7,8,9,12,13 | 1,2,3 | 3 | |
| 2,3,5,7,8,9,12,13 | 1,2 | 2 | |
| 1,2,3,5,7,8,9,12,13 | 1 | 1 | |

**Table 5: Iteration V**

| Reachability set | Antecedent set | Intersection set | Iteration |
|---|---|---|---|
| **12** | 1,2,3,5,6,7,8,9,10,11,12 | **12** | **V** |
| 9,12 | 1,2,3,5,6,7,8,9 | 9 | |
| 7,9,12 | 1,2,3,5,7,8 | 7 | |
| 7,8,9,12 | 1,2,3,5,8 | 8 | |
| 5,7,8,9,12 | 1,2,3,5 | 5 | |
| 3,5,7,8,9,12 | 1,2,3 | 3 | |
| 2,3,5,7,8,9,12 | 1,2 | 2 | |
| 1,2,3,5,7,8,9,12 | 1 | 1 | |

**Table 6: Iteration VI**

| Reachability set | Antecedent set | Intersection set | Iteration |
|---|---|---|---|
| **9** | 1,2,3,5,6,7,8,9 | 9 | **VI** |
| 7,9 | 1,2,3,5,7,8 | 7 | |
| 7,8,9 | 1,2,3,5,8 | 8 | |
| 5,7,8,9 | 1,2,3,5 | 5 | |
| 3,5,7,8,9 | 1,2,3 | 3 | |
| 2,3,5,7,8,9 | 1,2 | 2 | |
| 1,2,3,5,7,8,9 | 1 | 1 | |

**Table 7: Iteration VII**

| Reachability set | Antecedent set | Intersection set | Iteration |
|---|---|---|---|
| **7** | 1,2,3,5,7,8 | 7 | **VII** |
| 7,8 | 1,2,3,5,8 | 8 | |
| 5,7,8 | 1,2,3,5 | 5 | |
| 3,5,7,8 | 1,2,3 | 3 | |
| 2,3,5,7,8 | 1,2 | 2 | |
| 1,2,3,5,7,8 | 1 | 1 | |

**Table 8: Iteration VIII**

| Reachability set | Antecedent set | Intersection set | Iteration |
|---|---|---|---|
| **8** | 1,2,3,5,8 | 8 | **VIII** |
| 5,8 | 1,2,3,5 | 5 | |
| 3,5,8 | 1,2,3 | 3 | |
| 2,3,5,8 | 1,2 | 2 | |
| 1,2,3,5,8 | 1 | 1 | |

**Table 9: Iteration IX**

| Reachability set | Antecedent set | Intersection set | Iteration |
|---|---|---|---|
| **5** | 1,2,3,5 | 5 | **IX** |
| 3,5 | 1,2,3 | 3 | |
| 2,3,5 | 1,2 | 2 | |
| 1,2,3,5 | 1 | 1 | |

**Table 10: Iteration X**

| Reachability set | Antecedent set | Intersection set | Iteration |
|---|---|---|---|
| **3** | 1,2,3 | 3 | **X** |
| 2,3 | 1,2 | 2 | |
| 1,2,3 | 1 | 1 | |

**Table 11: Iteration XI**

| Reachability set | Antecedent set | Intersection set | Iteration |
|---|---|---|---|
| **2** | 1,2 | 2 | **XI** |
| 1,2 | 1 | 1 | |

**Table 12: Iteration XII**

| Reachability set | Antecedent set | Intersection set | Iteration |
|---|---|---|---|
| **1** | 1 | 1 | **XII** |

## 4.4 Conclusions

The present research highlights the hierarchical inter-relationships amongst the various challenges faced by rubber industry in India with the help of Interpretive Structural Modeling Methodology. The paper is an initial attempt in the field which can be modified in the light of comments from anonymous reviewers.

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