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Analysis of Barriers of Sustainable Supply Chain Management in Electronics Industry: An Interpretive Structural Modelling Approach

Prof. Mr Ashok Kumar , Shashwat Kumar
BBA Logistic and Supply Chain Management
Galgotias University

A B S T R A C T

In the past, industries were solely concerned with the financial aspects of a company's operations. In order to address the social and environmental impact of their supply chain, many organisations are implementing sustainability principles in their operations.

Their supply chain is an example of this. There will be some obstacles to overcome in the process of transforming to a sustainable supply chain.

It is necessary to eliminate or mitigate these risks. It is critical to understand and research these obstacles in order to successfully manage them.

Stumbling blocks in a specific context The purpose of this research is to identify and analyse the most significant obstacles to long-term sustainability.

In the case of the Indian electronics industry, this is how it is implemented. Eleven experts' opinions and a review of the literature were obtained.

Identification and classification of barriers into categories of policy, human resource, and technology are carried out.

The hierarchical structure and interrelationship among these barriers is established using Interpretive Structural Modeling (ISM) methodology.

The Interpretive Structural Modeling technique is used to determine the structure and interrelationships of these barriers (ISM) methodology.

One of the most significant findings of this research is that there is a lack of awareness about the benefits of sustainability, as well as a lack of commitment to it.

The importance of environmental regulations and enforcement, as well as a lack of commitment from top management, cannot be overstated.

Implementation of a sustainable supply chain is hindered by numerous obstacles. The driving and driven forces of these barriers are extremely powerful.

And the degree to which they are interdependent is established. Using MICMAC analysis, it was determined that there were five barriers that were the driving force.

Three barriers serve as dependent variables, and three linkage variables serve as linkage variables. The impediment is a lack of ability to perform.

Metrics/evaluation standards for sustainability have a high degree of dependence power and a low degree of driving power.

Implying that it is heavily influenced by a variety of other factors It is discovered that the majority of the impediments fall into the policy category.

Are self-sufficient and possess significant driving and influencing power The research draws attention to the need to develop targeted interventions.

The implementation of successful policies at the government and organisational levels in the electronics industry is essential for its success.

Supply chain management that is environmentally friendly. Organizations can use the modelling to gain insight into how to deal with obstacles and challenges to manage their resources in an efficient and effective manner while ensuring the long-term viability of their supply chains.

The paper concludes with a discussion of the findings and the scope of future research.

Indtroduction

In today's world, supply chain management is no longer confined to the production and distribution of goods that are cost-effective, competitive, and in demand by consumers, investors, and the government. In addition to these, it has a wide range of other considerations.

A company's supply chain has become an increasingly important consideration for government officials, as well as for other business partners and stakeholders, in order to ensure its long-term success (including customers). Businesses are expected to consider not only their own financial interests, but also the interests of their customers and the environment when developing their products and services.

Due to suppliers' unethical behaviour, which puts the supply chain and their products at risk of social and economic liability, supply chain sustainability was introduced. Every industry is adopting environmentally friendly practises (Kumar and Rahman, 2015; Seuring and Muller, 2008; Kumar and Rahman, 2015).

Organizations can better fulfil their social and environmental obligations when they implement an environmentally and socially responsible supply chain management strategy. Because of the benefits that supply chain sustainability can bring to a company's bottom line and because of external pressures, more and more businesses are committing to sustainability.

Environmental issues have received more attention in the literature on sustainable supply chain management than social aspects like diversity, equity, and human well-being as well as quality of life issues like working conditions, community relations, and working conditions for women (Mani et al., 2016). (SSCM).

In order to effectively manage supply chain changes, organisations will face a variety of challenges and obstacles. Product quality changes, operational difficulties and supply chain disruptions all result from the implementation of sustainability in the supply chain (Lee and Klassen, 2008).

There are many obstacles to overcome before sustainable practises can be implemented. It is possible that the organization's transformation will be hindered by a lack of commitment from top management, resistance from employees, or other factors.

Employees, the lack of new technology, materials, and processes, and the prohibitive cost of implementation are among the factors that contribute to a company's inability to innovate. The perception of these barriers shifts from organisation to organisation and industry to industry. As a result, barriers have different effects and influences depending on the industry (Diabat et al., 2013).

Understanding the interrelationships between these barriers is essential to overcoming them. It's possible that some barriers will drive and influence others, while others will be driven and influenced by others.

There are studies on supply chain barriers to long-term sustainability that can be found in the literature. Lack of awareness about reverse logistics and the lack of commitment from top management were found to be two of the biggest obstacles to reverse logistics in automobile industries, according to Ravi and Shankar (2005). It was found that in the apparel industry using DEMATEL, Zhu et al. (2012) investigated the barriers of ecofriendly apparel production.

Using stakeholder theory, Govindan and Bouzon (2018) identified 37 drivers and 36 barriers to reverse logistics. A study by Majumdar and Sinha (2019) framed contextual relationships among twelve barriers of the green textile and apparel supply chain and found complexity of green process and system design to have the greatest driving power.

There are a number of factors that need to be taken into consideration when implementing a sustainable supply chain in different industrial sectors (Govindan et al., 2014). As can be seen from existing literature, there are still some unresolved issues with implementing sustainability in India's electronics industry.

In the last decade, the use and production of electronic goods in India has grown tremendously. One of India's fastest-growing industries is electronics. Electronics is one of the fastest-growing industries in terms of production, consumption, and export (Dimitrakakis et al., 2009). The environmental impact of this industry is much more important to take into account.

In the coming years, Asian manufacturers will face significant social and environmental challenges (Mangla et al., 2017). Research on the Indian electronics industry supply chain has been prompted by this finding.

Because of this, the electronics industry's supply chain faced several challenges that were discovered after conducting a literature review. Using the responses of three industry experts and an academic expert to questionnaires, eleven barriers specific to India's electronics industry have been identified.

The relationship matrix was constructed with the help of expert opinion and a review of relevant literature. By employing interpretive structural modelling (ISM) methodology, it was discovered that barriers had both driving and driving powers. There are numerous ways to use ISM to investigate the interrelationships between various aspects of a variety of organisations. It is possible to create structures for the complications caused by various factors.

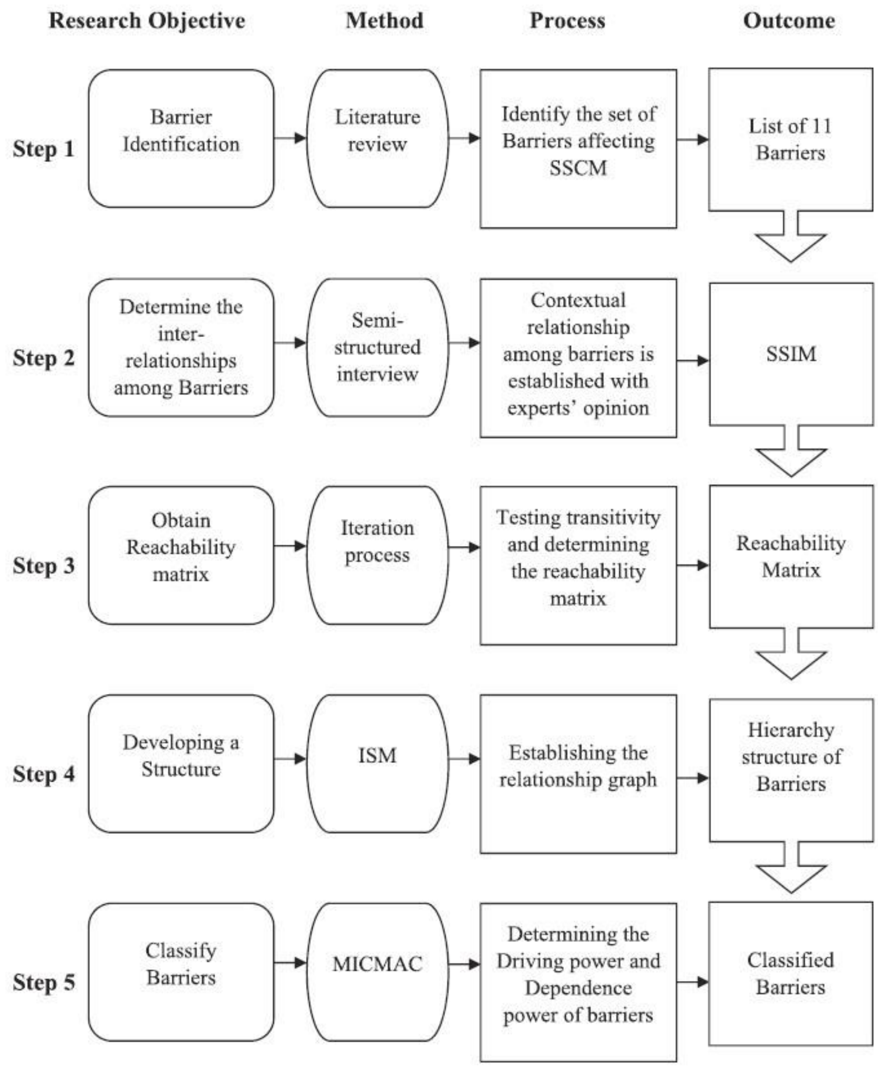

Fig. 1. Research flow.

The ISM model (Jharkharia and Shankar, 2005). Fig. 1 depicts the research flow in this study.

Barriers to long-term viability in the Indian electronics industry were examined in this study. An ISM model establishes the interrelationships among barriers, and the implications of this research for management are discussed. Using this investigation, businesses can gain a comprehensive understanding of how the various barriers interrelate, allowing them to implement sustainability initiatives in the workplace. Prioritizing barriers can help companies decide how best to allocate resources in order to meet their long-term sustainability targets. The functional aspects of the barriers are categorised and classified as independent, dependent, and linkage variables to better understand the functional aspects.

Because of the shorter product life cycle, rising consumption patterns, energy efficiency, and other disposal issues associated with the electronic industry, businesses can implement sustainability measures tailored to their needs.

Stage-wise elimination of barriers is possible depending on the severity of their impact. Using this research, the Indian electronic industry can lessen the obstacles it faces as it transitions to a more sustainable supply chain.

Objective

For this study, the following are the goals:

In the context of the Indian electronics industry, identify the obstacles to implementing a sustainable supply chain.

Determine the interrelationships between barriers and find their driving and driving power through a structured model.

The following is a breakdown of the structure of this paper. Section 2 discusses the literature on SSCM and its challenges. Section 3 explains the research methodology employed in this study. Section 4 presents the study's findings. Section 5 focuses on the implications of the study, followed by Section 6's conclusions and future research plans.

Literature review

In this section, you'll find information on SSCM and the challenges it faces in India's electronics industry.

- This section focuses on the Indian electronic industry's sustainable supply chain management

There is a growing concern about the social, environmental, and economic impacts of supply chains as a result of the growing focus on sustainability (Carter and Rogers, 2008; Carter and Easton, 2011). Brundtland Report, published in 1987, defines sustainability as progress that meets present needs without jeopardising future generations' ability to meet their own needs themselves.

The Triple Bottom Line (TBL) refers to the three pillars of sustainability: economic, social, and environmental. Businesses are under increasing pressure to ensure that their products and processes are environmentally and socially responsible (Kleindorfer et al., 2005). Operations, procurement, engineering, and logistics all play a role in implementing a sustainable supply chain.

The concept of sustainability is now a part of many government policies and business plans. Safety, good governance, and supply chain risk mitigation are all part of a sustainable supply chain. Reduce the amount of energy and water used, increase the amount of renewable energy used, and lessen the amount of hazardous waste generated (Rauer and Kaufmann, 2015; Jayant and Azhar, 2014).
Organizations in the supply chain collaborate to achieve social, environmental, and economic goals while also taking into account the needs of customers and stakeholders through the use of supply chain management (SSCM), as defined by Seuring and Muller (2008) There are many steps that can be taken to integrate sustainability into the supply chain rather than focusing on only the economic benefits (Namagembe et al., 2019).

In the long run, these steps will lead to increased productivity and a better company image. This will lead to an increase in the company's economic performance. For the same reason, the sustainable supply chain has been of interest to academics and industry executives (Sarkis et al., 2011).

- The Indian electronics industry in a nutshell

One of the world's most important and fastest-growing industries is electronics (Wath et al., 2010). In light of the ever-increasing prevalence of electronic devices and the resulting problems with their disposal, the industry has found itself under increased legislative and public pressure to implement sustainable practises. This industry has a high rate of innovation and R&D activities.

Because of this, the use of physical resources in the electronics industry is on the rise (Chancerel et al., 2009; Yin et al., 2014). The rate at which resources are being depleted is greater than the planet's capacity to handle it (Sheoran & Kumar, 2020). In 2019, Asia as a whole generated 24.9 Mt of e-waste, with India coming in second with 3230 kt (Forti et al., 2020).

The United States Department for Agriculture Economic Research Service – USDA predicts that India will become the third-largest economy in the world by 2020.
The government of India has implemented policies such as "Digital India," "Atmanirbhar Bharat," and "Make in India" in an effort to boost domestic production.

Economic growth, demand for new technology, and urbanisation have all helped the electronics industry in the country. Complex regulations, procedures, and infrastructure facilities are among the issues it is dealing with (Singh et al., 2018). On the other hand, the measures needed to limit the environmental impact of the electronics industry's rapid expansion are still lacking (Hankammer and Steiner, 2015). The E-Waste Management Rules, 2016 in India are designed to contain electronic waste.

However, the implementation is being hampered by issues with sustainability awareness, recycling facilities, and incorrect data. In this study, the obstacles to implementing a sustainable supply chain in the Indian electronics industry are analysed.
SSCM implementation is hindered by a number of factors.

There have been studies on SSCM barriers and enablers, according to the literature. Sustainable business practises in IT companies were examined by Seidel et al. (2010) to see what makes it easier or more difficult for companies to implement them. According to Faisal (2010), framing the enablers is an effective way to introduce SSCM. Studying the drivers of green supply chain implementation was done by Diabat and Govindan (2011). For plastic manufacturing companies in India, Luthra et al. (2016) analysed fifteen barriers to sustainability adoption.

SSCM and supplier development research has made use of the context of barriers. An impediment to accessing sustainability in the supply chain is what we mean by a "barrier" in this study.

A company's efforts to implement sustainable practises are hindered by these factors. The obstacles to implementing a sustainable supply chain in the electronics industry have been narrowed down from a review of the literature and the opinions of industry experts. Experts were consulted and brainstormed with in order to identify the most critical obstacles for the Indian industrial sector.

Fig. 2 shows eleven barriers to a sustainable supply chain, which we have narrowed down in our research. The barriers were analysed using experts' knowledge of SSCM and the electronics industry to identify their functional characteristics.
The barriers were then classified through a series of group brainstorming sessions. There were numerous references to prior studies (Govindan and Hasanagic, 2018; Majumdar and Sinha 2019, Gupta et al, 2020) in the process. Policy, Human Resources and Technology were grouped into three categories for ease of management during the implementation phase.

Table 1 provides a brief description of each barrier, along with a list of relevant literature references, for each category.
The following paragraphs go into greater detail about the obstacles that SSCM faces.

- Top management's lack of commitment

Sustainability can only be achieved if the company's top management is willing to provide resources and support new ideas.

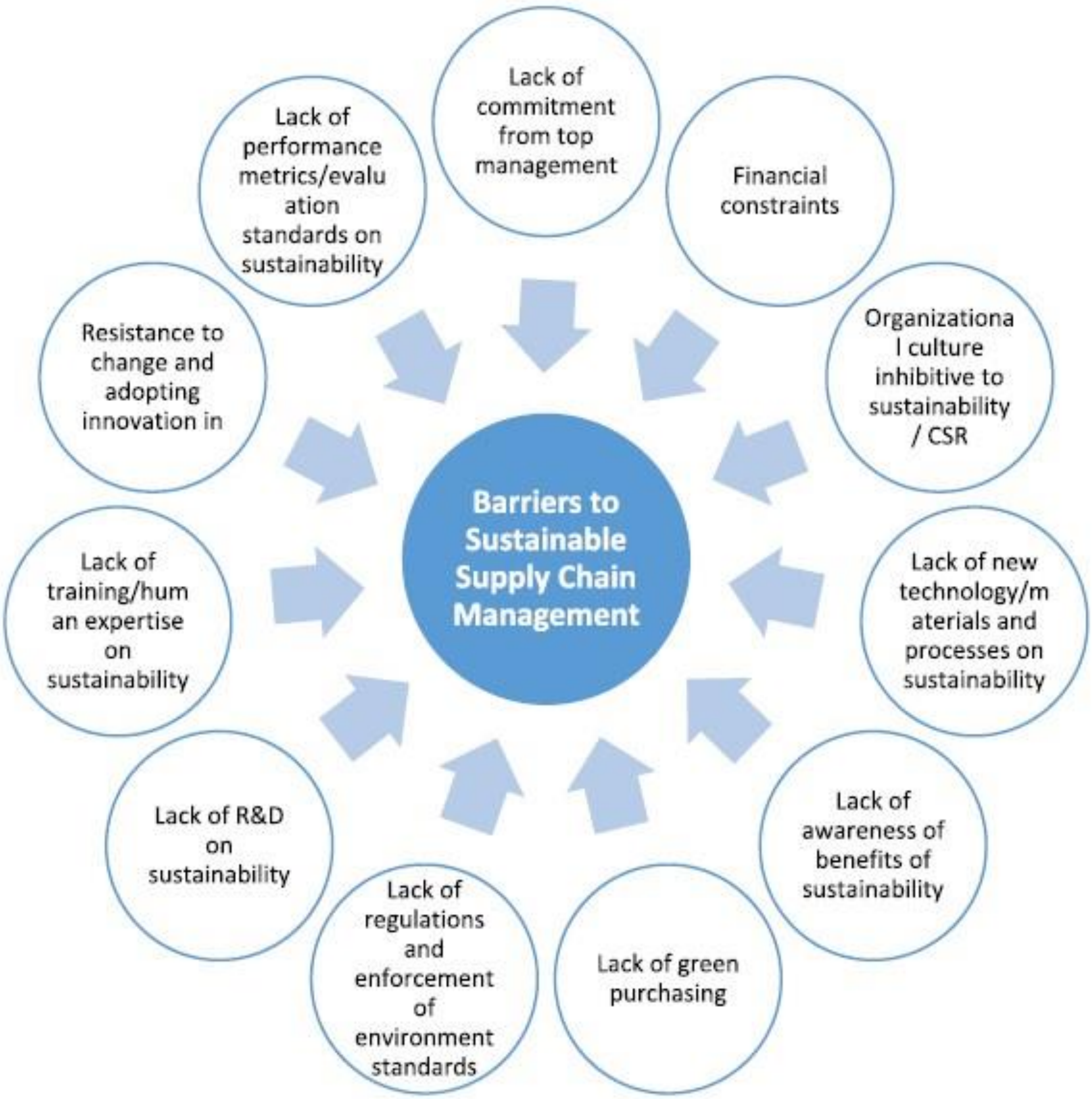

Fig. 2. Barriers in implementation of a Sustainable supply chain.

The policy-making process, training initiatives, and technological advancements are all influenced by senior management (Luthra et al., 2013). SSCM's sustainability strategy is hampered by a lack of top-level support (Giunipero et al., 2012; Turker and Altuntas, 2014). To achieve supply chain sustainability, the company's leadership must be able to provide a mandate, incentives, and education.

In order to achieve long-term viability, top management must set clear objectives and develop a strategy.

SSCM implementation can be disrupted if short-term and long-term goals are not aligned (Walker and Jones, 2012). Top management can ensure that financial goals do not completely override the company's environmental and social responsibilities.

- Constraints of resources

An investment in new systems is required to implement sustainable practises in the supply chain. SSCM requires financial assistance, and a dearth of funds is a significant obstacle (Hervani et al., 2005; AlKhidir and Zailani, 2009). Sustainable infrastructure often necessitates a large initial investment, but the case can be made that these expenses will be recouped over time. Sustainable projects and manufacturing practises are hindered by the lack of funds needed to carry them out.

The costs of environmentally-friendly packaging and other processes can be prohibitive. Costs are also associated with recycling, product collection, and hazardous waste disposal. Organizational culture that hinders long-term success a lack of innovation in terms of new technologies, materials, and methods.

Environmental degradation has been blamed in part on a dearth of cutting-edge technology (Wang et al., 2016; Mittal and Sangwan, 2014). To reduce pollution and waste in the manufacturing process, industries must be aware of new developments and use cleaner technologies (Mudgal et al., 2010). Introducing or changing technology, processes, or materials necessitates a shift in the allocation of funds.
However, it has been discovered that in the long run, this could be advantageous. To have a greater impact on the environment, businesses must improve their processes and make technological advancements.

Insufficient knowledge of the advantages of sustainability
Organizations are more concerned with the short-term costs of implementing sustainability in their supply chains than with the long-term benefits. Low environmental literacy and a lack of knowledge about environmental management practises act as barriers (Herren and Hadley, 2010).

An important impediment to the implementation of reverse logistics operations is a general lack of knowledge about the concept (Ravi and Shankar, 2005). Companies aren't encouraged by a lack of public awareness of the benefits of sustainability. Pressure from society can encourage companies to improve their environmental performance by highlighting the need to do so.

Green purchasing is not being done enough.

Green purchasing is the practise of making purchases that have a lower impact on the environment and human beings than their counterparts in the market. In addition to the more traditional criteria of price, quality, and delivery time, green purchasing also considers the long-term effects of the inputs it purchases.

A study published in 2008 by Kannan et al. Firms' low adoption and green purchasing practises have received only a limited amount of investigation (Hsu and Hu, 2008; Srivastava, 2007). Because of the higher initial costs and the absence of any standard guidelines, organisations rarely make use of green purchasing.

- The lack of environmental regulations and enforcement.

Governing bodies are essential to ensuring that legislation is implemented effectively in countries. SSCM is thwarted by a lack of regulation and policies that are friendly to the environment (AlKhidir and Zailani, 2009; Zhu et al., 2012; Ghazilla et al., 2015). Designing policies that promote long-term development requires a high level of compliance and enforcement.

A country's regulations and policies provide a framework for compliance and performance, but they differ across countries, requiring companies to spend more time and money on compliance. Lack of government support for environmentally friendly manufacturing practises is another roadblock, in addition to rules (Prakash and Barua, 2015; Govindan et al., 2013). Tax subsidies, incentives, and other forms of financial compensation can be used to ensure compliance with regulations.

Lack of research on environmental sustainability

Sustainability research and development in industry can improve safety and environmental contribution by reducing energy use and waste. Natural resources are in short supply. As a result, industries must conduct research and development to ensure that all resources are utilised to their full potential.

In order to achieve sustainability, systems must be designed to reduce energy and resource consumption (Russel, 2017; Perron, 2005). The implementation of sustainable R&D may be slowed by a lack of resources allocated by organisations.

- A scarcity of sustainability-related education and training

Because SSCM relies heavily on trained and knowledgeable personnel, human factors like insufficient training and staff shortages pose a significant challenge.

(Bohdanowicz and colleagues, 2011) To incorporate social and environmental practises into an organisation, a certain level of expertise is needed.

Instead of using other methods to influence their suppliers, companies should focus on training them. Educating supply chain partners about sustainable practises can help green supply chain management be more successful (Zabbi et al., 2013; Kumar et al., 2013). It also aids suppliers in learning about the industry's sustainability standards. Eco-literacy programmes are an important strategy for implementing sustainability in the workplace. (Luthra and colleagues, 2013; Govindan and colleagues, 2014) Training is essential in the electronics industry for processes like recycling (Wath et al., 2010; Yeh and Xu, 2013).

- Sustainability innovation and resistance to change

Sustainable supply chain implementation is hampered by an unwillingness to adapt and adopt new ideas (Gaziulusoy et al., 2013). The aversion to change is a major roadblock to new ideas. When implementing a new strategy, it is necessary to change the existing culture, attitudes, and structures.

A lack of trust and uncertainty also exists during the transition period. At the same time, benefits must be communicated to consumers, and they must come to terms with change. There is a general apprehension about changing systems and a lack of desire to learn new ones. Many environmental problems can be solved through innovation, but it is often met with resistance (Acciaro et al., 2014).

There are no sustainability performance metrics or evaluation standards in place.

A measurement system is essential in any industry in order to determine the system's efficiency. Sustainability implementation is hindered by a lack of expertise in assessing and gauging the social and environmental impact (Cetinkaya et al., 2011). The monitoring
Sustainability can be difficult to measure. Companies aren't sure how to measure environmental performance because of a lack of guidance on environmental standards (Shaw et al., 2010). Common sustainability metrics must be developed based on evaluation criteria and indicators.

In addition to economics, sustainability should be taken into consideration when evaluating accounting reports. There is a major flaw in traditional accounting methods because they fail to take into account the environmental and social consequences. An investigation was conducted in 2011 by El Saadany et al.

- Other industries' studies of barriers

Literature shows that the barriers and their impact vary depending on industry and region. Ravi and Shankar examined the interactions between 11 barriers to reverse logistics in the automotive industry (2005). Costs for environmentally friendly packaging, complex design to reduce resource and energy consumption, and a lack of clarity regarding sustainability are critical for SSCM implementation, according to Al Zaabi et al. (2013) in a study of the fastener manufacturing industry.

According to the responses of industrial participants in Tamilnadu, India, and the Analytical Hierarchy Process (AHP) method, the most significant barrier to implementing green supply chain management is the technology category barrier (Govindan et al., 2014).

Exactly what is the barrier? Green supply chain management (GSCM) adoption has been slowed down by the difficulty of measuring and monitoring suppliers' environmental practises. Lack of green initiatives, lack of corporate social responsibility, and a lack of management commitment and leadership are all factors that have a high driving power in the Indian oil and gas sector according to Raut and colleagues (2018).

A study by Moktadir et al. (2018) found that the lack of awareness of local customers in green products and the lack of commitment from top management had a high causal effect in the Bangladesh leather industry. According to Narayanan et al. (2019), the barriers to Kerala's rubber products manufacturing industry have been identified and prioritised. SSCM implementation in this industry has been hampered by a lack of government initiatives and a benchmark for sustainability measurement.

Organizational culture was identified as the most significant barrier to sustainable public procurement in Brazil by Delmonico et al. (2018). The lack of support from commercial banks, corruption, and a lack of environmental awareness were found to be the most significant impediments to a sustainable supply chain in the Indian marble and stone industry by Soni et al. (2020).

Gap in the research

It has become increasingly important to implement sustainability in supply chains in developing countries because pollution levels are rising as a result of rapid industrialization (Namagembe et al., 2019).

Research shows that incorporating sustainability into the supply chain can have a positive impact, but organisations are reluctant to do so because of the many obstacles they face. SSCM implementation presents a number of challenges for electronic companies, and dealing with them all at once is difficult (Ghadge et al., 2017). Electronic waste, hazardous chemicals, recycling processes, transportation, and other factors all contribute to the sustainability issues that plague the electronics industry's supply chain.

In developing countries, there are few studies on sustainable supply chain management practises (Ahmed and Najmi, 2018).

An insufficient amount of research has been done on how to implement sustainability in the supply chain of Indian electronics companies. It is therefore necessary to investigate the challenges of setting up a long-term supply chain in the Indian electronics industry. In order to understand the interrelationship between barriers in a structured manner, the research will provide recommendations on how to remove them.

The third and final step in the process is the method

Diagraphs can be used to structure and present the specific relationship between related elements in Interpretive Structural Modeling (ISM). ISM has been used to analyse green value chains, total quality management, and reverse logistics as a modelling method
(Mangla et al., 2018). In situations where there are a number of variables that have an ambiguous relationship to one another, the application of method is useful in transforming them into an understandable and structured form (Raut et al., 2019).

This method, unlike others in the MCDM toolkit, does not require a high level of dominance to examine the interrelationships between variables Analytical Hierarchy Process (AHP) differs from ISM in that it ignores interactions and indirect effects. It is difficult to remove all possible cluster interactions from the Analytical Network Process (ANP) (Wu, 2008).

Alternative methods such as Decision making trial and evaluation laboratory (DEMATEL) and social network analysis (SNA) do not prioritise factors other than establishing connections in a complex system. This method does (Abuzeinab et al., 2017). Because it combines computational, theoretical, and conceptual capabilities, the ISM method is used to frame the diagram (Narayanan et al., 2019).

The ISM method is a powerful tool that uses a smaller amount of data to uncover the complex web of interactions and relationships between variables (Panigrahi & Sahu, 2018). It is not necessary for ISM to have access to quantitative data. A model is created by arranging a number of variables that have a direct impact on the system.

Using ISM, students can learn about the interrelationships between variables in an interactive way (Bouzon et al., 2015). Figure 3 depicts the steps in the ISM methodology.

- Development of an interpretive structural model

Four experts from the electronics industry were consulted in this study in order to identify the contextual relationship between the barriers to sustainable supply chain implementation in the electronics industry. According to the literature, the number of samples for ISM does not have to be too large (Shen et al., 2016) and can be as few as two experts (Ravi and Shankar, 2005). For this reason, we chose to use four experts.
Three experts from industry and one from academia were consulted to get a wide range of viewpoints. The three industrial experts all had at least 15–20 years of experience in the electronics industry, and they all held positions of responsibility at the executive level. On the green purchasing and quality assurance fronts, they've been actively involved in implementing sustainable practises.

These professionals have been working in the electronics industry's supply chain for over a decade and are well-versed in sustainability issues.
An associate professor with more than 15 years of experience in sustainable supply chain management is the academic expert.

System influences are identified and prioritised in step one of this process.
In this study, the obstacles to implementing a sustainable supply chain were discovered through a literature review of relevant studies. The Indian electronics industry's supply chain has been identified and categorised as having eleven barriers to the implementation of sustainability in the supply chain.

Table 1 illustrates these obstacles.
The contextual relationship between these factors is determined in step two.
In the context of ISM, the expert's opinion is used to determine the relationship between variables. Management techniques such as the nominal technique, brainstorming, and others are used to develop expert opinion. These barriers were linked together using a focused group discussion method.

This is the third step in the process of creating a structural self-interaction matrix For each factor, a Structural Self-Interaction Matrix (SSIM) is created to establish a pair-wise relationship.

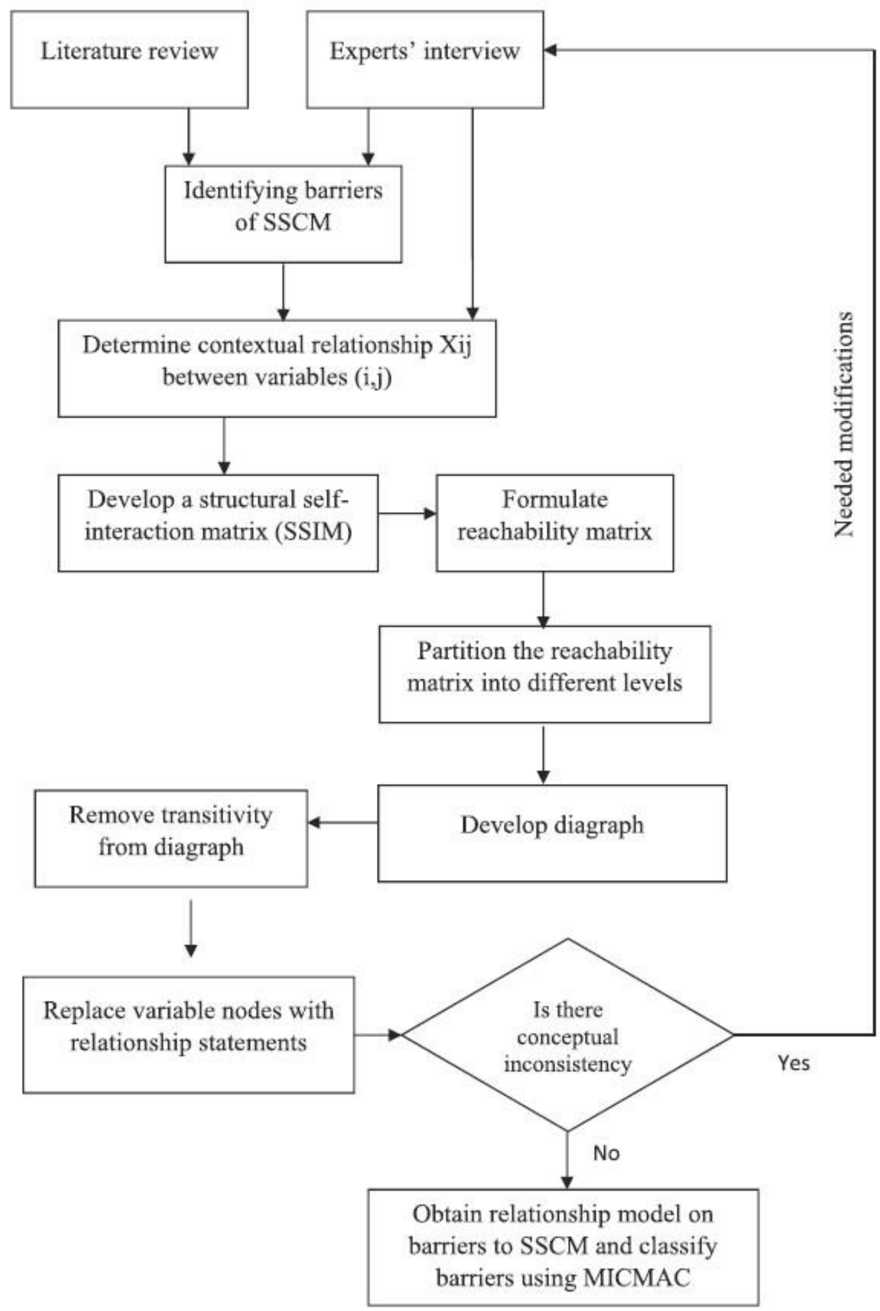

Fig. 3. Flow diagram for ISM method.

A "leads to" type of relationship is used to analyse the barriers to sustainable supply chain variables. You can establish the context of a relationship this way: one variable leads to another. The relationship between two variables, say I and j, is worked out by examining the relationship between variables I and j in context. ISM uses four symbols to represent the relationship between variables I and j: The letters V, X, A, and O stand for these concepts. They can be used in a variety of ways, depending on how barrier I and j help or hinder each other.

Variable I leads to variable j in a forward relationship.
Reverse correlation: A relation in which one variable leads to the other and vice versa is A. And Variables I and j are not related to each other, and there is no correlation between them.

Table 2 shows the SSIM for the obstacles to implementing a sustainable supply chain. A reduction in the effects of Barrier 10 can be achieved through the use of Barrier 9. The symbol V in the SSIM table represents this connection.
As a result, there is less resistance to change and innovation in sustainability because of a lack of human expertise. A new system is met with resistance that can be overcome through education and counselling. As a result, employees' resistance to change and adoption of innovation will be alleviated by symbol V, which depicts lack of training.

Barriers 4 and 10 help each other out. Symbol X in the SSIM table depicts this relationship. The absence of new sustainable technologies, materials, and processes will be caused by a lack of openness to change and innovation. Innovation adoption will be hindered by a lack of new technology/materials and processes.

The SSIM matrix shows that Barrier 2 and Barrier 11 are not related to each other. The financial obstacles Because there is no correlation between constraints and a lack of performance metrics/evaluation standards, the O is marked.
SSIM establishes the contextual relationships for each of the 11 sustainability implementation barriers (Table 2) that were discovered.

The reachability matrix is now complete.

SSIM is used to create the Reachability matrix by verifying the matrix's transitivity. Basically, if a factor P has a relationship with Q and Q has a relationship with R, then P also has a relationship with R.

SSIM data is transformed into a binary matrix, consisting of the values 1 and 0, using a set of rules. The initial reachability matrix is the name given to this matrix, and

Table 2
Structural self-interaction matrix (SSIM).

Barriers	11	10	9	8	7	6	5	4	3	2
1. Lack of commitment from top management	V	O	V	V	A	V	A	V	V	V
2. Financial Constraints	O	V	V	V	O	V	A	V	X	
3. Organizational culture inhibitive to sustainability/CSR	V	V	V	V	O	V	A	V		
4. Lack of new technology/materials and processes on sustainability	V	X	O	A	A	A	A			
5. Lack of awareness of benefits of sustainability	V	V	V	V	V	V				
6. Lack of green purchasing	V	O	V	X	A					
7. Lack of regulations and enforcement of environment standards	V	V	V	V						
8. Lack of R&D on sustainability	V	V	X							
9. Lack of training/human expertise on sustainability	V	V								
10. Resistance to change and adopting innovation in sustainability	V									
11. Lack of performance metrics/evaluation standards on sustainability										

V, A, X, and O are all replaced by either 1 or 0 in this example. The switch has been made. in accordance with Table 3's conditions

For example SSIM (i,j) entry (V, j) can be explained in Table 3 if (i,j) is I j)

A reachability matrix entry for (i,j) becomes one and (i,j) is zero (j, i)

1 becomes 0. Furthermore, if the value of A is found at (i,j) in an SSIM, then the value of B is found (i, j)

No entry is made in the reachability matrix; only one is made in the (j/i) entry.

So on and so forth. Initial reachability is achieved by making substitutions as described above.

Table 4 shows the matrix as shown

To ensure that the initial reachability matrix is free of transitive errors, it must be examined.

Variable-to-variable connections that may exist. As an illustration, in Table 4

There are two barriers here: one influences the other. Therefore,
barrier 9 can be inferred to have an effect on barrier 6 and the rest of the system In the final reachability matrix, the relation is changed from 0 to 1.

The final usability

Table 5 displays the matrix after transitivity checks have been performed. Involved in Table 5 shows the barrier's power and dependence.

From the total barriers, the driving force of a particular barrier can be determined.

supports the achievement of one's goals, including the obstacle that is being overcome. The While dependence refers to all the obstacles that are preventing something from being accomplished,and includes itself in that. The values for driving and dependence in comparison to each other MICMAC analysis, which classifies data, will make use of power. Separating autonomous, dependent, and linkage barriers into four categories independent.

The fifth step. The final reachability matrix is partitioned into levels. levels of complexity.

Using the final reachability matrix, the reachability and antecedent set can be determined from Warfield (1974) discovered a way to overcome each obstacle. The set of reachability tools includes:

that which can be predicted and the outcomes it helps to produce. An earlier set of data
is made up of variables that contribute to the goal of the variable. The All variables are included in the set that is the intersection of these sets.

After deciphering the problem Removed from the rest of the variables, top-level variable Level I is characterised by a dearth of performance metrics and evaluation, as can be seen in Table 6.

Standards for environmental protection (Barrier 11). Barrier 11 is a Level I barrier because it is located at the bottom of the staircase which will be placed on top of the ISM pyramid.

Iteration 2 will see the intersection of reachability set and once more.

The antecedent set is identified. According to Iteration 2, which can be seen in Table 7, Variables 4 and 10 contain evidence of secondary motivation. Because of this, they will occupies second level and is removed in subsequent updates.

This Variables are eliminated at each level of the process. Onwards and upwards!

until each variable's values are known. How many barriers are in place determines the outcome.

Where they fall on the ISM scale Building the digraph is made easier by these levels and the final ISM model.

The obstacles, as well as the means by which they can be overcome,

There is a list of the antecedent set, intersection set, and barrier levels.

Tables 6–12 are included.

The sixth and final step. Construction of an ISM model based on a diagram relational matrix and eliminating the transitive arrows links. Factorial conversion transforms the diagraph into an ISM model.

nodes that link to text The presence of is tested in the ISM model that was generated.

The changes are made if necessary to correct any conceptual discrepancies.

It should be removed.

It is possible to construct a structural model using the final reachability matrix. To An arrow is drawn to show the relationship between two barriers, I and j.

A digraph is the graph formed by connecting points I and j Finally, the digraph has been completed. as depicted in Fig. as an ISM model 4.

According to Fig. 4 the fact that sustainability's advantages are not widely known.

Because it's at the bottom, (Barrier 5) indicates that it has a significant impact.

Table 3
Rules for initial reachability matrix formulation.

	Substitution in Reachability matrix	
Value of (*i, j*) in SSIM	(*i, j*) entry	(*j, i*) entry
V	1	0
A	0	1
X	1	1
O	0	0

It's all about the framework. There are seven levels to this model's eleven barriers. Barrier 5 is at level 7, while Barrier 7 is at level 6, due to a lack of public awareness of the advantages of sustainability. This shows that regulations and enforcement of sustainability are influenced by lack of knowledge about sustainability (Barrier 5). (Barrier 7).

Barrier 11 (lack of sustainability performance metrics/evaluation standards) is at the very top of the diagram, at level I.

Results

There are seven levels of barriers to the supply chain of electronics industries depicted in Fig. 4 and their relationship is shown. To put it another way, upper-level barriers are influenced by lower-level barriers Because it exerts the greatest influence at level 7, the lowest in the ISM model, a lack of knowledge about sustainability's advantages (Barrier 5) is a significant impediment. Organizations in business, non-profits, and governments all have a role to play in raising public awareness about the many advantages of sustainability. Researchers found that the greatest obstacle to implementing green supply chain management (GSCM) in South Indian automobile industries was a lack of environmental awareness among suppliers (Mathishagan et al., 2013). Lack of recycling awareness and a lack of policies and regulations are the root causes of e-waste problems, according to Kumar and Dixit (2018). Efforts to raise public awareness of the importance of environmental sustainability and its benefits to society should be a priority.

The lack of environmental standards regulation and enforcement is the next major obstacle, which is found at level 6. (Barrier7). Due to a lack of public awareness, the enforcement of environmental standards is reduced. There will only be strict enforcement and regulation if people are aware of the benefits. Concerned citizens should raise this issue with government and businesses should follow through with stringent regulations and enforcement. Electronics industries appear to have a low tolerance for regulations and policies, even though they have a significant impact (Ravi and Shankar, 2014). Environmentally friendly recycling infrastructure should be improved as well as regulations governing how electronic waste should be disposed of. There should be an expansion of programmes like extended producer responsibility (EPR). According to Mitra and Datta (2014), the regulatory framework and environmental sustainability awareness were both lacking in Indian manufacturing industries, making GSCM adoption difficult. It was found that the most important barrier to sustainable consumption and production in India is 'Government support and policies'.

Top management's lack of commitment is at level 5 due to the aforementioned roadblocks. When top management (Barrier 1) feels that there is a lack of regulation and enforcement, they become less committed. Top management's unwillingness to commit to a sustainable supply chain strategy in the absence of stringent regulations is consistent with Majumdar and Sinha (2019). In the implementation of green supply chain management practises in Indian mining industries, top management commitment is the most important behavioural factor (Muduli et al., 2013). In the derived ISM Fig. 4, this can be seen at level 4.

The lack of top management commitment to sustainability/CSR (Barrier 2) and

organisational culture (Barrier 3) at level 4 are affected by financial constraints (Barrier 2) and organisational culture (Barrier 3). (Barrier1). A company's top management allocates the funds needed to implement sustainability. The culture of an organisation and its obligation to corporate social responsibilities are influenced by the attitude of its top management.

Thus CSR/Sustainability efforts are hindered by a lack of commitment from top management (B1) (B3).

Investing in the disposal and recycling processes is a necessity.

In today's fast-paced world of product design and short-lived electronics, it's difficult to keep up.

Table 4
Initial reachability matrix.

Barriers	1	2	3	4	5	6	7	8	9	10	11
1. Lack of commitment from top management	1	`1	1	1	0	1	0	1	1	0	1
2. Financial Constraints	0	1	1	1	0	1	0	1	1	1	0
3. Organizational culture inhibitive to sustainability/CSR	0	1	1	1	0	1	0	1	1	1	1
4. Lack of new technology/materials and processes on sustainability	0	0	0	1	0	0	0	0	0	1	1
5. Lack of awareness of benefits of sustainability	1	1	1	1	1	1	1	1	1	1	1
6. Lack of green purchasing	0	0	0	1	0	1	0	1	1	0	1
7. Lack of regulations and enforcement of environment standards	1	0	0	1	0	1	1	1	1	1	1
8. Lack of R&D on sustainability	0	0	0	1	0	1	0	1	1	1	1
9. Lack of training/human expertise on sustainability	0	0	0	0	0	0	0	1	1	1	1
10. Resistance to change and adopting innovation in sustainability	0	0	0	1	0	0	0	0	0	1	1
11. Lack of performance metrics/evaluation standards on sustainability	0	0	0	0	0	0	0	0	0	0	1

Table 5
Final reachability matrix.

Barriers	1	2	3	4	5	6	7	8	9	10	11	Driver Power
1. Lack of commitment from top management	1	1	1	1	0	1	0	1	1	1	1	**9**
2. Financial Constraints	0	1	1	1	0	1	0	1	1	1	1	**8**
3. Organizational culture inhibitive to sustainability/CSR	0	1	1	1	0	1	0	1	1	1	1	**8**
4. Lack of new technology/materials and processes on sustainability	0	0	0	1	0	0	0	0	0	1	1	**3**
5. Lack of awareness of benefits of sustainability	1	1	1	1	1	1	1	1	1	1	1	**11**
6. Lack of green purchasing	0	0	0	1	0	1	0	1	1	1	1	**6**
7. Lack of regulations and enforcement of environment standards	1	1	1	1	0	1	1	1	1	1	1	**10**
8. Lack of R&D on sustainability	0	0	0	1	0	1	0	1	1	1	1	**6**
9. Lack of training/human expertise on sustainability	0	0	0	1	0	1	0	1	1	1	1	**6**
10. Resistance to change and adopting innovation in sustainability	0	0	0	1	0	0	0	0	0	1	1	**3**
11. Lack of performance metrics/evaluation standards on sustainability	0	0	0	0	0	0	0	0	0	0	1	**1**
Dependence power	**3**	**5**	**5**	**10**	**1**	**8**	**2**	**8**	**8**	**10**	**11**	

As a result, the allocation of resources to different areas is a challenge. In order to alleviate the financial burden, it is necessary to develop new technologies and optimization methods. Better solutions can be found through projects in which industry and academia work together. When it comes to sustainability, it's important to incorporate it into your company's overall culture. In order to achieve sustainability, it is important to have a strong organisational culture that encourages participation and new ways of thinking (Muduli et al., 2013). Financial constraints (Barrier 2) and an organisational culture that is hostile to sustainability/CSR (Barrier 3) lead to a lack of green purchasing (Barrier 6), a lack of R&D on sustainability (Barrier 8), and a lack of training/human expertise on sustainability (Barrier 9). (Barrier3).

Barrier4 is on level 6 above the lack of green purchasing (Barrier6) and of R&D on sustainability (Barrier3), which are the two most important barriers to sustainability (Barrier8). R&D and green purchasing help to alleviate new developments in technology, materials, and processes related to sustainability. Sustainability (Barrier10) resistance is alleviated by the lack of R&D (Barrier8) and training/expertise (Barrier8) on sustainability. (Barrier10) on the same level 6.) (Barrier9).

Lack of R&D was found to be an important impediment to the adoption of green production practises in Small and Medium Enterprises (SMEs) (Ghazilla et al., 2015). The lack of performance metrics/evaluation standards on sustainability (Barrier11) is therefore placed at the top of Fig. 4 because of the lack of new technology/materials/processes and innovation adoption. Technology barriers are found to be in the top five, six, and seven levels, indicating that other barriers are the primary influence on technology barriers.

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Table 6
Iteration 1.

Barrier	Reachability set	Antecedent set	Intersection set	Level
1	1, 2, 3, 4, 6, 8, 9, 10, 11	1, 5, 7	1	
2	2, 3, 4, 6, 8, 9, 10, 11	1, 2, 3, 5, 7	2, 3	
3	2, 3, 4, 6, 8, 9, 10, 11	1, 2, 3, 5, 7	2, 3	
4	4, 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	4,10	
5	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	5	5	
6	4, 6, 8, 9, 10, 11	1, 2, 3, 5, 6, 7, 8, 9	6, 8, 9	
7	1, 2, 3, 4, 6, 7, 8, 9, 10, 11	5, 7	7	
8	4, 6, 8, 9, 10, 11	1, 2, 3, 5, 6, 7, 8, 9	6, 8, 9	
9	4, 6, 8, 9, 10, 11	1, 2, 3, 5, 6, 7, 8, 9	6, 8, 9	
10	4, 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	4, 10	
11	11	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	11	I

Table 7
Iteration 2.

Barrier	Reachability set	Antecedent set	Intersection set	Level
1	1, 2, 3, 4, 6, 8, 9, 10	1, 5, 7	1	
2	2, 3, 4, 6, 8, 9, 10	1, 2, 3, 5, 7	2, 3	
3	2, 3, 4, 6, 8, 9, 10	1, 2, 3, 5, 7	2, 3	
4	4, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	4,10	II
5	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	5	5	
6	4, 6, 8, 9, 10	1, 2, 3, 5, 6, 7, 8, 9	6, 8, 9	
7	1, 2, 3, 4, 6, 7, 8, 9, 10	5, 7	7	
8	4, 6, 8, 9, 10	1, 2, 3, 5, 6, 7, 8, 9	6, 8, 9	
9	4, 6, 8, 9, 10	1, 2, 3, 5, 6, 7, 8, 9	6, 8, 9	
10	4, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	4, 10	II

Table 8
Iteration 3.

Barrier	Reachability set	Antecedent set	Intersection set	Level
1	1, 2, 3, 6, 8, 9	1, 5, 7	1	
2	2, 3, 6, 8, 9	1, 2, 3, 5, 7	2, 3	
3	2, 3, 6, 8, 9	1, 2, 3, 5, 7	2, 3	
5	1, 2, 3, 5, 6, 7, 8, 9	5	5	
6	6, 8, 9	1, 2, 3, 5, 6, 7, 8, 9	6, 8, 9	III
7	1, 2, 3, 6, 7, 8, 9	5, 7	7	
8	6, 8, 9	1, 2, 3, 5, 6, 7, 8, 9	6, 8, 9	III
9	6, 8, 9	1, 2, 3, 5, 6, 7, 8, 9	6, 8, 9	III

Table 9
Iteration 4.

Barrier	Reachability set	Antecedent set	Intersection set	Level
1	1, 2, 3	1, 5, 7	1	
2	2, 3	1, 2, 3, 5, 7	2, 3	IV
3	2, 3	1, 2, 3, 5, 7	2, 3	IV
5	1, 2, 3, 5, 7	5	5	
7	1, 2, 3, 7	5, 7	7	

4th analysis: MICMAC

For the MICMAC analysis, the driver and dependent variables' strengths and weaknesses are determined by multiplying the MICMAC matrix by cross-impact multiplications (applied to classification). Autonomous, dependent, linkage, and independent are the four categories of variables (Fig. 5).

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Table 10
Iteration 5.

Barrier	Reachability set	Antecedent set	Intersection set	Level
1	1	1, 5, 7	1	V
5	1, 5, 7	5	5	
7	1, 7	5, 7	7	

Table 11
Iteration 6.

Barrier	Reachability set	Antecedent set	Intersection set	Level
5	5, 7	5	5	
7	7	5, 7	7	VI

Table 12
Iteration 7.

Barrier	Reachability set	Antecedent set	Intersection set	Level
5	5	5	5	VII

The variables in the first quadrant, referred to as "autonomous," have low driving and dependence powers. It is possible that some of these variables have strong and significant connections to the structure. The variables in Quadrant 2 have a weak driving force but a strong dependence. Quadrant 3 has a lot of power and a lot of dependability. With a lot of traction, but not solely dependent on it, the "independents" occupy quadrant four. Each of these barriers has a direct effect on the driving force, which is shown in Table 5. The presence of a 1 in any of the columns or rows of this table denotes a dependency or driving force. Barriers' driving power and dependence power are shown in Figure 5. When it comes to corporate social responsibility (Barrier 3), for example, Table 5 shows that it has a driving power of 8 and a dependence power of 5. Consequently, Figure 5 places it in the fourth quadrant. The driving and dependent power of each of the eleven barriers is depicted in Fig. 5 in the same way.

MICMAC analysis shows that there are no obstacles in the autonomous quadrant, as shown in Figure 5. Because of this, the research takes into account any and all possible obstacles to the electronics industry's sustainability. Barrier11, Barrier4, and Barrier4 are all in the dependent quadrant (Barrier10), which has a high dependence power but a low driving power, due to the absence of sustainability performance metrics and evaluation standards, new technology, materials, and processes, and resistance to sustainability change and innovation. The high dependence power has other barriers, but they are not guiding those other barriers. There is a lack of green purchasing, sustainability R&D, and sustainability training/human expertise at barriers 6, 8, and 9 in the linkage quadrant. On the people around them, and on themselves, actions in this quadrant have a direct impact (Yadav and Barve, 2015).

Lack of knowledge about the benefits (Barrier 5), lack of environmental regulations and enforcement (Barrier 7), and lack of top-level commitment (Barrier 8) are some of the barriers to sustainability/CSR (Barrier1). We must overcome these obstacles before the electronics industry can become more environmentally friendly. Sustainability implementation has been shown in the literature to depend heavily on government regulations and enforcement, as well as top-level management commitment and awareness.

It is necessary to place more emphasis on their significance.

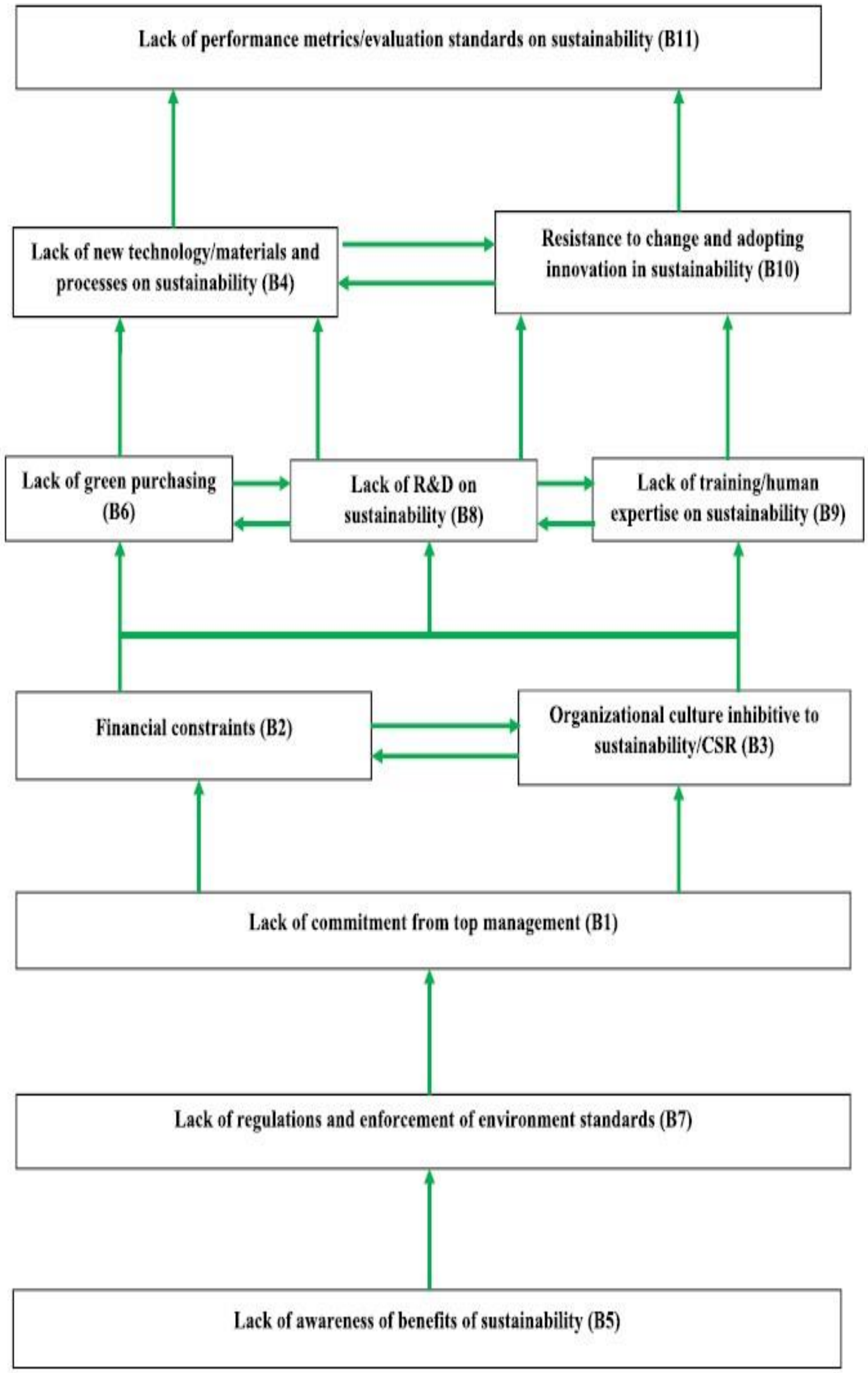

Fig. 4. ISM-based model for the barriers in implementation sustainable supply chain.

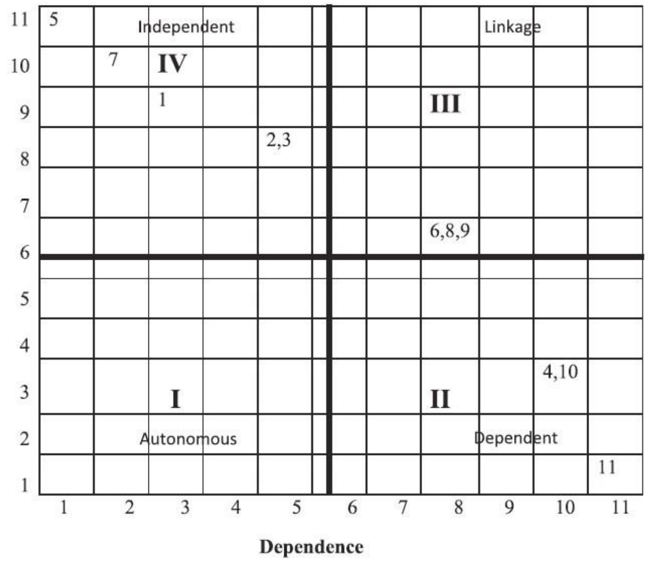

Fig. 5. Driving power and dependence diagram.

In Figure 6, MICMAC results show the barrier category's position in the rankings. A large number of policy barriers are found to be in the independent quadrant, which indicates that policy barriers exert a significant influence on the system It is therefore imperative that governments and organisations develop and strengthen policies related to these areas in order to remove obstacles to the implementation of a sustainable supply chain management. Focusing on specific policy areas will go a long way toward overcoming the other challenges. As a result, managing these crucial barriers helps control the system as a whole. It's true that the ISM model developed for the electronic industry can be applied to other industries. 5. Management implications

There is a wide range of practical and academic applications for this study's findings. The paper examines sustainable supply chains and discusses various obstacles and solutions to their implementation. When industries try to implement SSCM, it shows the relationship between the challenges they face.

So, managers can now better understand how the barriers to sustainability implementation in Indian electronics industries affect them individually and collectively, thanks to this classification. They know which barriers need immediate attention and how their actions will impact other barriers. Researchers have discovered the driving and driving powers, along with their dependence or independence on other obstacles. Administrators must put in place strong policies and regulations to ensure the long-term viability of the organisation. Enforcing these rules should take precedence over other priorities. The ISM was born.

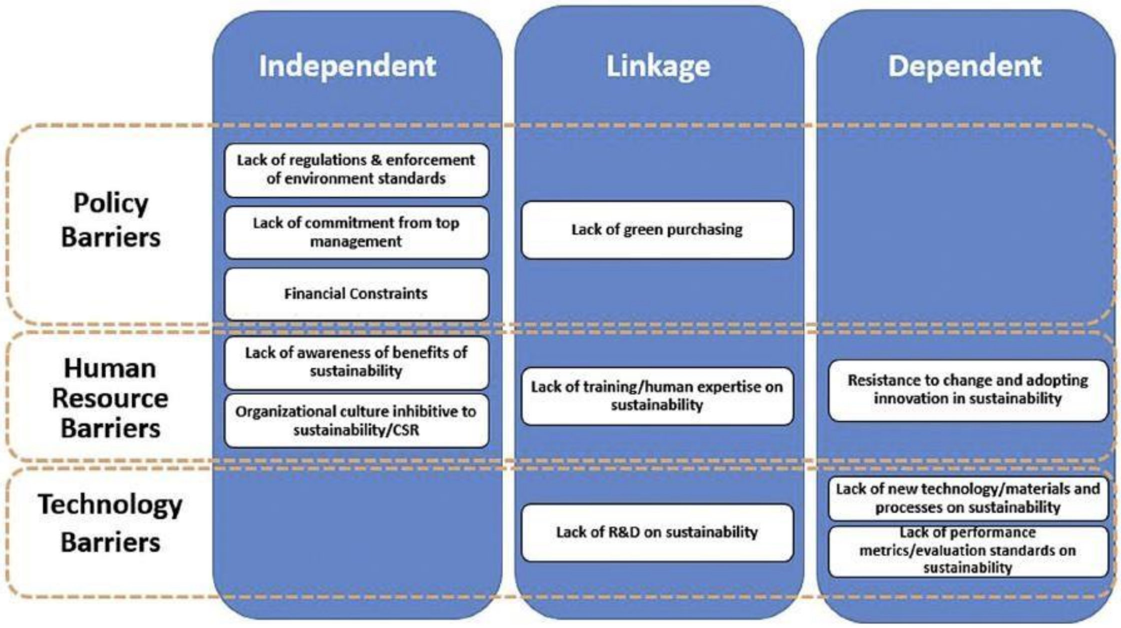

Fig. 6. MICMAC analysis classified to Barrier categories.

model can help managers to devise strategies and develop solutions in tackling barriers to successfully implement a sustainable supply chain.

Conclusion

As a result, sustainable supply chains are now a top priority for businesses all over the world. In order to stay in business, companies must take into account both their customers and the environment.

Despite the pressures, the companies are moving towards sustainability...........

Moreover, they benefit greatly from a sustainable supply chain.

Worldwide, the electronics industry is booming, especially in Asia.

India. In developing countries, the use of electronic devices is on the rise.

Depletion of physical resources and electronic waste generation.

Because of the unique nature of the industry and its consumption.

It is critical for Indian electronic manufacturers to follow this design pattern.

The supply chain is a critical part of a company's sustainability strategy.

When it comes to implementation, these sectors will have to deal with numerous obstacles.

sustainability. First, the paper identifies the problem.

Barriers to the implementation of a sustainable electronics supply chain industries in the context of India.

Then, a diagram showing the interconnections was created.

The ISM method is used to build one of these barriers.

Interdependence of the barriers and their driving and driven forces

Furthermore, it is clear. Further, MICMAC analysis can be used to evaluate the results.

The independent, linkage, and dependent barriers are established.

With the help of a literature review and four experts, eleven obstacles have been eliminated were found and documented as part of the SSCM implementation.

In light of their specific characteristics that make them useful The barriers were categorised into three groups: Policy, Regulation, and Enforcement.

Human and technological resources to make implementation more efficient phase.

An ISM study found that people aren't aware of what's going on.

Because it has the greatest impact, benefits of sustainability is a major barrier to occupy the lowest position in the ISM hierarchy.

The following is a list of factors that have an effect on the absence of environmental regulations and their enforcement coming in second and third and a lack of support from the company's top executives.

As a result, this is the most important Implementation of an SSCM faces significant challenges.

Lack of knowledge about the advantages of sustainability and a dearth of rules top-level lack of commitment to environmental standards management. Financial and organisational constraints are exacerbated by these barriers.

Culture is a barrier to CSR and sustainability. a lack of interest in purchasing environmentally friendly products lack of sustainability research and development, as well as a dearth of human expertise and knowledge on linkage barriers show that sustainability is driven by the independent in addition to having a direct impact on other barriers higher level of the ISM framework.

All three are hampered by linkage obstacles.

Policy, human resources, and technological barriers are all examples of this.

Technology lack of performance metrics/evaluation is one of the main categories of barriers.

A lack of new technology and materials, as well as strict environmental regulations sustainability processes, resistance to change, and implementation Other barriers to sustainability innovation are also a factor.

Programs and activities aimed at promoting a healthy lifestyle have been developed as a result of this work a lack of awareness of the social and environmental impact of electronic goods

Adoption of sustainability at various levels and its benefits to society are strongly recommended. The study found that most of the barriers were in the policy category. are self-sufficient and have a lot of power. It's been proposed that in both the public and private sectors, targeted policies must be implemented made specifically for the electronics industry's needs Make it easier for a sustainable supply chain management to be implemented Like extended producer responsibility (EPR), as well as other programmes.

In the electronics industry, recycling should be encouraged. Managerial strategies to mitigate the impact of the issue have been outlined. barriers. Further academic research could be prompted by this discovery.

in order to break down the roadblocks and formulate policies at different levels, India's electronics industry.

With the help of MICMAC and the ISM model, the electronics industry can benefit to determine which obstacles need to be addressed first and given the most attention during the implementation of supply chain sustainability.

This a framework helps us to see how obstacles are connected and how we can overcome them and the degree to which they are influenced by or dependent upon one another within the system. Of all the difficulties in order to implement sustainability, there are a lot of people involved.

Using a framed model, you can gauge the importance of potential roadblocks.

In this study, the obstacles to implementing a sustainable supply chain were examined.

In the Indian electronics industry, the supply chain is tracked down and studied by

The International System of Modeling. A potential for bias exists when relying on experts' opinions.

And hence in future study, the number of experts can be increased and results compared. The study finds the relationship between factors but
Because of the ISM method, the strength of this relationship is unknown.

This model needs to be statistically validated Structural Equation Modelling (SEM) or other methods can be used to do this.

Classification of MICMAC analysis into Barrier categories is depicted in Figure 6. In Cleaner and Responsible Consumption 3 (2021) 100026, R.R. Menon, V. Ravi

The relationship between additional barriers and their classifications can be studied in future research. Another method of multi-criteria decision-making (MCDM) can be examined for analysis, as can barriers in other industries.
Affidavit of conflict of interest
There are no conflicts of interest or personal relationships that could have appeared to influence the work reported in this paper, according to the authors of this paper.

References

Authors: A. Abuzeinab; M. A. Arif; and M. A. Qadri, 2017. An ISM study found that the construction industry in the UK has significant barriers to MNE green business models. The Journal of Cleaner Production 160: 27–37 (2005).

This study was conducted by Acciaro, Vanelslander, Sys, Ferrari, Roumboutsos and Giuliano, among others. A framework for innovation in environmental sustainability at seaports. Political Science and International Affairs, 41 (5): 480–500.

Ahmed, W., and Najmi, A. A developing country's view of the impact of GSCM on green and economic performance is presented in a framework for development and analysis. International Journal of Environmental Quality 29 (4), 740–758. https://doi.org/10.11 \s08/MEQ-11-2017-0140.

Diabat, A. and Al Zaabi, S. (2013). Al Dhaheri N. and Diabat A. (2013). Barriers to implementing sustainable supply chain management are examined in this study. Journal of Advanced Manufacturing Technology, 68, 895–905, 2001.

T. alKhidir and S. zailani (2009) presented their findings at the annual meeting of the American Society for Microbiology. Increasing environmental sustainability by going green in the supply chain. Environmental Research 3 (3), 246–251.

2018 S. AlSanad. All rights reserved. In Kuwait, there are many obstacles to implementing sustainable cement manufacturing. Journal of Sustainable Development, 7, 317-317. This paper was written by Bhanot, Rao, and Deshmukh in 2017. Analyzing the factors that promote and obstruct sustainable manufacturing through a holistic lens. Clean Production 142, 4412–4439. J. Clean.

Published in: Bohdanowicz (P), Zientara (P), and Novotna (E), 2011 An examination of Hilton's We Care! environmental protection programme in Europe from 2006–2008. Sustainable Tourism, 19 (7), pp. 797–816, in press.

In this paper, the authors present the findings of a study by Bouzon, Govindan, and Rodriguez, all of which were published in the year 2015. Minimizing mineral extraction through ISM-based reverse logistics in Brazil's machinery manufacturing sector. Resour. Politician 46, 27–36.

H.T.S. Caldera, C. Desha, and L. Dawes, 2019. Finding and addressing the factors that make it easier for small, lean businesses to implement sustainable business practises. 575– 590, Journal of Cleaner Production.

the author's full name is Christopher R. Carter and the year is 2011. The evolution of sustainable supply chain management and its prospects for the future. Physical Distribution and Logistic Management, 41(1): 46–62.

As of 2008, Carter, CR, and Rorke, DS, Moving toward a new theory of sustainable supply chain management Phys. Destrib. Logist. Manag. 38 (5), 360–387

Bozkurt Celaynkaya, Robert Cuthbertson Ewer Klaas-Wissing Piotrowicz and Christopher Tyssen 2011. Practical Ideas for Moving Towards Best Practice in Sustainable Supply Chain Management. Science and Business Media Springer.

There is a lot to learn from the work of Chancerel (P), Meskers (CE), Hagelüken (C), and Rotter (VS) in 2009. Preparation of waste electrical and electronic equipment for precious metal extraction. 791–810 in Journal of Industrial Ecology.

Raynor, M.E. ; Christensen, C.M. ; and McDonald R., 2015. What is a disruptive innovation?

The Harvard Business Review, 5 (5). Accessed at https://www.hbr.org/2017/12/17/what-isdisruptive-innovation.html, 2017.

Pereira, S.C.F; Pereira Jabbour de Sousa Jabbour; Renwick DWS; Thome AMP; Thome AMP; Delmonico D; 2018. Evidence from a leading Latin American sustainable supply chain initiative for removing roadblocks to sustainable public procurement in emerging economies. Conservation and Recycling 134: 70–79.

Demirel, P., and Kesidou, E. Ability to meet regulatory, technological, and market demands for eco-innovation with a focus on sustainability 28 (5), 847–857, Bus. Strat.

Environ

It was published in 2011 by Diabat, A., and Govindan, K. An examination of the factors that influence the adoption of environmentally friendly supply chain management practises. 55 (6): 659–667 (Resource Conservation and Recycling).

Diabat, A., Khreishah, A., Kannan, G., Panikar, V., Gunasekaran, A., 2013. Benchmarking third-party logistics implementation's interactions between barriers. Int. Benchmark. 20 (6), 805–824. Abstract: https://doi.org/10.1108/bij-04-2013-0039.

There are a number of authors who have collaborated on this paper: Digalwar, A. Raut, V. S. Yadav and A A Gotmare in the year 2020.

A hybrid ISM-ANP approach to the evaluation of critical constructs for measuring sustainable supply chain practises in lean-agile firms of Indian origin. Transportation and the Environment, 29(3), 1575–1596.

All of the authors of this paper are grateful for the opportunity to present their findings at the 2009 Annual Meeting of the American Chemical Society. Analysis of plastics containing heavy metals and halogens from electronic waste. Waste Management, 29 (10), 2700–2706. Waste Management, 29 (10).

Al-Sadany, A.M.A., Jaber, M., and M. Bonney, 2011 Supply chain environmental performance metrics. Journal of Management Studies, 34 (11): 1202–1221. https://doi.org/10.1108/01 \s409171111178756.

According to the authors of this study: ElTayeb TK; Zailani SS; and Jayaram K; 2010. EMS 14001 certified companies in Malaysia were asked about the factors that influence their use of green purchasing. Manufacturing Technology and Management Journal, 21(2), 206–225.. https://doi.org/10.1108/17410381011014378.

Faisal, M.N., year of publication: 2010. Research on the interactions between the enablers of long-term supply chain sustainability.

Business Process Management Journal, Vol. 16, No. 3, pp. 508–529.

This paper was published in Forti, Balde, Kuehr and Bel in 2020. Quantities, flows, and the circular economy potential of global e-waste in 2020: a report.

A.I. Gaziulusoy, C. Boyle, and R. McDowall, 2013. A business-friendly approach to systemic double-flow scenario innovation. In the journal Clean Production 45, 104–116.

In 2017, A. Ghadge and M. Kaklamanou published a paper in the journal Science

Translational Medicine. The Greek Dairy Supply Chain's Implementation of Environmental Practices. Systems for Industrial Management and Data.

With the help of Sakundarini (N), Abdul-Rashid (SH), Ayub (NS), Olugo (EU), Musa (SN),

2015. Preliminary findings on the drivers and barriers to green manufacturing in Malaysian small and medium-sized enterprises. 658–663

2012, Giunipero, Hooker and Denslow, Giunipero, Hooker and Denslow. There are both positive and negative aspects to sustainable purchasing and supply management. Purch. Supply Management. 18(4), 258–269.

Kumar Govindan and Marc Bouzon When it comes to reverse logistics barriers and drivers, there are many ways to look at the problem. Clean Prod 187, 318–337, J.

Govindan, K., Hasanagic, M., 2018. Circular economy: a supply chain perspective from a systematic review of drivers, barriers, and practises. 278–311 in Int. J. Prod. Res.