African Journal of Applied Research
Vol. 11, No. 1 (2025), pp.388-407
http://www.ajaronline.com
https://doi.org/10.26437/ajar.v11i1.
Received: July 5, 2024
Peer reviewed: October 8, 2024
Revised: November 28, 2024
Published: January 2025

STUDY FOR IDENTIFICATION AND CLASSIFICATION OF ADVANCED MANUFACTURING TECHNOLOGY IMPLEMENTATION DRIVERS IN SMALL AND MEDIUM ENTERPRISES

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ABSTRACT
Purpose: The primary objective of this study is to assess the factors that have the most significant impact on SMEs' adoption rate of Advanced Manufacturing Technologies (AMT).
Design/Methodology/Approach: An interpretive structural modelling (ISM) approach was applied to assess drivers for AMT adoption. Data was gathered from literature and supplemented by expert opinions from academics and professionals. The identified drivers were ranked and classified through the ISM framework, and their reliability and influence were examined using the Matrice d'impacts croisés multiplication appliquée á un classment (MICMAC) analysis.
Findings: The ISM analysis revealed that government policy support and customer/buyer pressure are primary drivers for AMT adoption in SMEs. These drivers form the foundational factors influencing the successful implementation of AMTs and enabling SMEs to develop strategic, priority-based business plans.
Research Limitation: The study is limited to SME environments, which may restrict its applicability to larger firms.
Practical Implication: Emphasising government support and responding to buyer pressure can guide SMEs in integrating AMTs more effectively.
Social Implication: Successful AMT implementation in SMEs can promote job creation, local economic growth, and sustainable manufacturing practices, benefiting society by enhancing regional competitiveness and innovation.
Originality/Value: This study provides a structured framework for understanding AMT adoption drivers in SMEs, incorporating ISM and MICMAC analyses to bridge a gap in the literature.

Keywords: *Adoption. advanced manufacturing technologies. interpretive. modelling. structural*

ISSN: 2408-7920

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INTRODUCTION

Despite differences in national income, manufacturing remains one of the world's most dynamic economic areas. The varied nature of manufacturing means that it is always on the lookout for new ways to optimise processes and create value (Jezierski et al., 2016; Visnjic Kastalli & Van Looy, 2013). Interestingly, only 15% of companies use those cutting-edge procedures, even though 85% of sophisticated manufacturing technologies are acknowledged worldwide Baur et al., 2020).

Nearly half of those who took the survey see AMTs as a way to boost manufacturing's potential for future innovation and growth(Obal & Ng Outl, 2018) (Bhise et al., 2023). By reducing the manufacture of faulty goods while increasing the output of commodities and speeding up the production process, AMTs in manufacturing systems significantly improve an organisation's competitiveness. Furthermore, AMTs offer numerous advantages to manufacturing organisations, including enhanced flexibility, reduced costs, shorter lead times, and increased quality.

Small and Medium Enterprises (SMEs) rule the manufacturing sector in India and are significant economic drivers. Half of India's industrial output and 40% of its exports come from Small and Medium Enterprises (SMEs), which employ 106 million people (Ministry of Statistics and Programme Implementation, 2015). Thus, for India's economic vitality and the long-term production of growth and employment opportunities, it is of paramount necessity that these SMEs undergo industrial modernisation (Ministry of Micro, 2017). However, new technology presents internal and external obstacles for these medium and small businesses.

Just as in the United States, Europe, China, and Japan, Medium and Small Enterprises (SMEs) are the backbone of India's manufacturing sectors. While large corporations excel at streamlining operations at scale but are sluggish to embrace new technologies, medium and small businesses (SMEs) have far more room to manoeuvre when it comes to catering to specific customer needs and embracing technological advancements (Obal & Ng Outl, 2018). Due to their limited resources, Small and Medium Enterprises (SMEs) should thoroughly evaluate the implementation process before investing in AMT. Despite widespread recognition of AMTs' technical capabilities, academics and practitioners remain divided on how best to put them into practice. This is because aspects that contribute to or detract from AMT deployment remain largely unexamined. We need to find out what motivates medium and small firms to use innovative manufacturing technologies so that they can spread faster.

LITERATURE REVIEW

According to prior research, the top five benefits of manufacturing technology implementation are as follows: (i) reduced throughput time; (ii) reduced work-in-process (WIP) inventory; (iii) improved part/product quality; (iv) faster response times to customer orders; and (v) reduced travel

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distances/time (Barzegar et al., 2018). Medium and small enterprises need to boost production, remain competitive in price, and enhance product quality, which were the reasons examined in another study. To stay competitive, owner-managers philosophies or attitudes about AMT are also considered essential implementation drivers (Bey et al., 2013a). In their study, (Darbanhosseiniamirkhiz & Wan Ismail, 2012) investigated three important elements that motivate the adoption of AMT. (1) External pressures, supplier support, and financial resources are all part of the environmental context. (2) The organisation's backdrop includes management, HR policies and procedures, manufacturing strategy, and company culture. Thirdly, the technological setting comprises the benefits and the technology itself.

The literature shows that these aspects have been extensively researched for industrialised nations and big businesses. However, research on AMT adoption in underdeveloped nations like India has been scant, especially for SMEs. Consequently, Indian SMEs were the focus of the current investigation.

We identify the drivers by reviewing the literature and calibrating them with the opinions of academics and professionals in the field. The ISM technique is used for analysis to prioritise and comprehend the interrelationships among the discovered AMT drivers. In addition, driving-dependency (MICMAC) analysis is used to investigate the drivers' driving and reliance strengths. We anticipate that the driver-dependence relationship matrix will allow us to evaluate the driver that has the most impact on the adoption of AMT. The relationship can also provide important information regarding the drivers' relative relevance and interdependencies. Proactively, this could help decision-makers and practitioners cope with these difficulties.

Advanced manufacturing technologies (AMTs) are computer-based systems that can quickly adapt to changes in design and production. AMT can solve almost all manufacturing problems and is a revolutionary technology. Administrative technologies, which can be used for planning and controlling activities, design/engineering technologies, and manufacturing technologies are the three main categories of advanced manufacturing technologies used by industries (Dean et al., 1992; Zammuto & O’Connor, 2018).

The precise definition of AMT is a collection of computer-based technologies that include things like CAD, CNC, DNC, robotics, FMS, ASRS, AMHS, AGV, barcoding, RP, MRP, SPC, ERP, ABC, and OA (Beaumont et al., 2002).AMTS in manufacturing systems greatly improve an organisation's competitiveness by drastically reducing the manufacture of faulty goods while simultaneously increasing the output of goods and speeding up the production process.

In addition to improving quality, lead times, pricing, and flexibility, AMTs offer many other benefits to manufacturing firms (Bhise et al., 2022). Early studies have demonstrated AMT's

ISSN: 2408-7920

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capacity to enhance the expansion of Small and Medium Enterprises (SMEs) that stand to gain from the strategic deployment of these technologies.

METHODOLOGY

This study employed multiple methods to investigate the factors motivating small and medium enterprises (SMEs) to adopt Advanced Manufacturing Technologies (AMT).

First, a comprehensive literature analysis was conducted to identify key elements influencing AMT adoption. Second, a structured questionnaire survey was administered to gain a general understanding of AMT implementation practices within the Indian SME sector.

The survey data were analysed using SPSS software (version 20.0) through two approaches: an initial analysis focusing on broad categories and a Pearson correlation test to explore the relationship between corporate performance, competitiveness, and the business environment. Third, interpretive structural modelling (ISM) was utilised to represent the intricate contextual relationships among critical drivers of AMT adoption, aiming to identify and prioritise the most influential factors.

The ISM method provided a hierarchical structure to manage the complexity of these variables. Fourth, the Matrice d'impacts croisés multiplication appliquée á un classment (MICMAC) analysis was conducted to rigorously examine each driver's scope in the AMT implementation process. This analysis categorised variables based on their driving and dependency powers, emphasising the significance of indirect interrelationships within the system. By combining these methods, the study provides a structured framework for understanding and evaluating the factors that motivate SMEs to adopt AMT.

Identification of Advanced manufacturing technology drivers

Here are fourteen AMT drivers shown in Table 1 that have been compiled from a literature review and calibrated by professionals in the field and academics:

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Table 1: Fourteen AMT drivers

S. No.	AMT Driver	Literature Relevance
1	Enabling government policies	(Barzegar et al., 2018; Darbanhosseiniamirkhiz & Wan Ismail, 2012; Stornelli et al., 2021; Bhise et al., 2022)
2	Buyer/customer pressure	(Lee & Drake, 2010; Malik et al., 2016; Stornelli et al., 2021)
3	Effective information flow	(Cheng & Bateman, 2008; Govindan et al., 2014; Idrissia et al., 2012; Irani & Love, 2000; Lanz et al., 2013)
4	Strengthening margins	(Moyano-Fuentes et al., 2016; Sohal et al., 2001)
5	Current technologies becoming obsolete	(Moyano-Fuentes et al., 2016; Stornelli et al., 2021; Bhise et al., 2022)
6	Integration of manufacturing activities of the organization	(Borges & Tan, 2017; Cheng & Bateman, 2008; Ilyukhin et al., 2001; Kotha & Swamidass, 2000; Unnikrishnan et al., 2015)
7	Enhancing the operational performance	(Borges & Tan, 2017; Dean et al., 1992; Kotha & Swamidass, 2000; Marri et al., 2006; Nyori & Ogola, 2015; Raymond & St-Pierre, 2005; Zammuto & O'Connor, 2018)
8	Order qualifier/Order winner	(Bey et al., 2013b; Joung et al., 2013a)
9	To be a part of industry 4.0 revolution	(Batrancea et al., 2018a; Mrugalska & Wyrwicka, 2017)
10	Managerial realization	(Bey et al., 2013b; Dean et al., 1992; Kotha & Swamidass, 2000; Stornelli et al., 2021; Zammuto & O'Connor, 2018)
11	Cost savings	(Erbay & Yıldırım, 2019; Marri et al., 2006; Stornelli et al., 2021; V. Bhise et al., 2022)
12	Enhancing productivity	(Erbay & Yıldırım, 2019; Kotha & Swamidass, 2000; Marri et al., 2006; Stornelli et al., 2021; Bhise et al., 2022)

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13	Gaining a competitive advantage	(Erbay & Yıldırım, 2019; Kotha & Swamidass, 2000; Marri et al., 2006; Sangwan et al., 2014; Stornelli et al., 2021; Bhise et al., 2022)
14	Achieving sustainability	(Joung et al., 2013b; Niaki et al., 2019; Oncioiu et al., 2018; Zhu et al., 2015)

ISM Methodology

John N. Warfield founded ISM (Warfield, 1974), who worked at the Battelle Memorial Institute between 1971 and 1973. Learning with ISM is an engaging experience. The technique is both interpretative and structural; the former assesses whether and how things are related using group judgment, whereas the latter extracts an overall structure from the complex set of items based on the relationship.

Because a diagraph model shows the general structure and the particular relationships, it can be considered modelling. When dealing with large systems, the ISM approach can assist in putting order and direction among the many interdependent parts (Warfield, 1974).

An issue in any complex situation under discussion may be related to various things. Compared to the scenario as a whole, the interconnections between the elements—both direct and indirect—do a far better job of capturing its essence. This leads ISM to understand how people generally perceive these connections. Since its introduction, many authors and researchers have relied heavily on this method to clarify the complex interdependencies underlying the issues they are examining. Supplier selection, sustainable supply chain practices, lean manufacturing, customer-centricity, the Internet of Things in smart cities, knowledge management in the automotive industry, and many more fields have recently used this technique to explain relationships. (Batrancea et al., 2018b; Oncioiu et al., 2018; Warfield, 1974). The flow diagram for constructing the based model of the drivers is presented in Figure 1.

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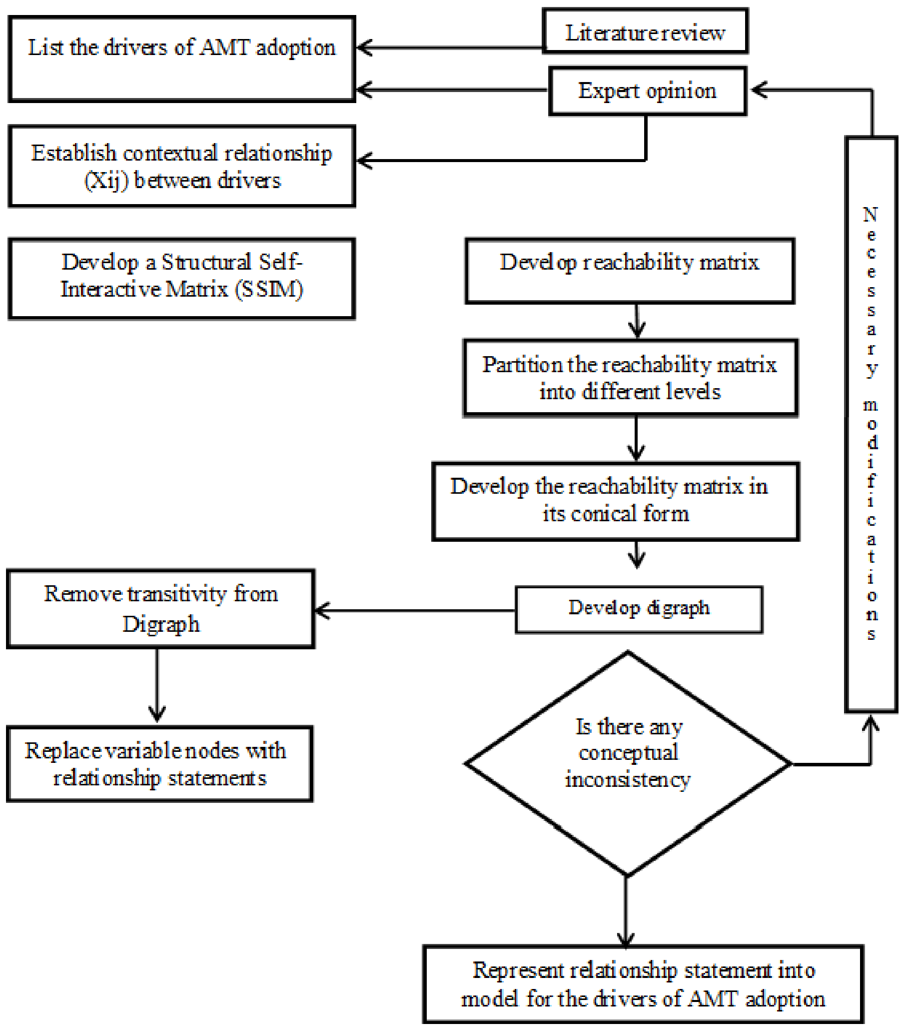

Figure 1: Steps to construct ISM based model of the drivers

SSIM of AMT adoption drivers

Determining the basis of the contextual link among the factors of AMT adoption procedures required consulting with specialists from academia and industry. We utilise a 'leads to' contextual connection type to study the drivers' interactions. "Favourable company image" results from "better quality," for instance. Similarly, the variables' contextual linkages are established. The presence of a relationship between any two variables (i and j) and the direction of that link are questioned, bearing in mind the contextual relationship for each variable. To show the direction of the link among the variables (i and j), four symbols are used:

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- V: Variable i will ease variable j, according to V.
- A: I will make variable j easier to deal with.
- X: I and j will work together to make both variables easier.
- O: I and j are unrelated variables, according to O.

Table 2 shows the 14 variables considered drivers, and the SSIM is built for each of them based on the contextual correlations.

Table 2: SSIM of AMT adoption drivers

S. No.	**Factor**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
1	Enabling government policies	V	V	V	V	V	V	V	V	V	V	V	V	X	-
2	Buyer/customer pressure	V	V	V	V	V	V	V	V	V	V	V	V	-	
3	Effective information flow	V	V	V	V	A	V	V	V	X	A	V	-		
4	Strengthening margins	X	A	A	A	A	X	A	A	A	A	-			
5	Current technologies are becoming obsolete	V	V	V	V	V	V	V	V	V	-				
6	Integration of manufacturing activities of the organisation	V	V	V	V	A	V	V	V	-					
7	Enhancing the operational performance	V	V	V	V	A	V	V	-						
8	Order qualifier/Order winner	V	X	A	X	A	V	-							
9	To be a part of Industry 4.0 revolution	X	A	A	A	A	-								
10	Managerial realisation	V	V	V	V	-									
11	Cost savings	V	X	A	-										
12	Enhancing productivity	V	V	-											
13	Gaining a competitive advantage	V	-												
14	Achieving sustainability	-													

Reachability matrix of AMT adoption drivers

One must grasp transitivity and reachability well to create a reachability matrix using SSIM. These are two of the most important concepts in ISM methodology.

ISSN: 2408-7920

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RM is prepared by converting entries of the SSIM (Table 2) into 1's and 0's based on the following rule:

(i-j) entry	(i to j) relation	(j to i) relation
V	1	0
A	0	1
X	1	1
O	0	0

Table 3 displays the results of identifying the initial RM for the AMT drivers and then adding the transitivities to create the final RM. Also displayed in this table are the driving forces and dependent variables for each. A variable's driving power is equal to the sum of all the variables it may contribute to, including itself, and its dependence is equal to the sum of all the variables it may contribute to.

Table 3: The AMT drivers' reachability matrix

S. No.	**Factor**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**DP**
1	Enabling government policies	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
2	Buyer/customer pressure	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
3	Effective information flow	0	0	1	1	0	1	1	1	1	0	1	1	1	1	10
4	Strengthening margins	0	0	0	1	0	0	0	0	1	0	0	0	0	1	3
5	Current technologies are becoming obsolete	0	0	1	1	1	1	1	1	1	1	1	1	1	1	12
6	Integration of manufacturing activities of the organisation	0	0	1	1	0	1	1	1	1	0	1	1	1	1	10
7	Enhancing the operational performance	0	0	0	1	0	0	1	1	1	0	1	1	1	1	8
8	Order qualifier/Order winner	0	0	0	1	0	0	0	1	1	0	1	0	1	1	6
9	To be a part of Industry 4.0 revolution	0	0	0	1	0	0	0	0	1	0	0	0	0	1	3
10	Managerial realisation	0	0	1	1	0	1	1	1	1	1	1	1	1	1	11
11	Cost savings	0	0	0	1	0	0	0	1	1	0	1	0	1	1	6

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S. No.	Factor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	DP
12	Enhancing productivity	0	0	0	1	0	0	0	1	1	0	1	1	1	1	7
13	Gaining a competitive advantage	0	0	0	1	0	0	0	1	1	0	1	0	1	1	6
14	Achieving sustainability	0	0	0	1	0	0	0	0	1	0	0	0	0	1	3
	Dependence	2	2	6	14	3	6	7	11	14	4	11	8	11	14	113

Level partitions of reachability matrix of AMT drivers

The final reachability matrix determines each factor's antecedent set and reachability. The set of items an element can help achieve is called the reachability set. In contrast, the antecedent set is the collection of elements that an element can assist in accomplishing. After that, we find the intersection of these sets for every element.

The highest-level element in the ISM hierarchy is the one for which the sets of reachability and intersection are identical. Attaining any level below the top-level element of the hierarchy would be futile. Finding the top-level element is the first step in separating it from the others. Then, the subsequent level of elements is located using the identical procedure.

Building the diagraph and ultimate model relies on these recognised levels. Achieving sustainability, being a part of the Industry 4.0 revolution, and strengthening margins are all located at level I, as shown in Table 4. Consequently, they would occupy the highest rank inside the ISM hierarchy. The levels of each variable are determined by repeating this process. After seven rounds of iteration, the values of the variables were determined and displayed in Table 4. Both the digraph and the final ISM model rely on the specified levels.

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Table 4: Iteration results of the level division of the AMT adoption drivers' reachability matrix

S/N	Factors	Reachability set	Antecedent set	Intersection	Level
1	Enabling government policies	1,2,3,4,5,6,7,8,9,10,11,12,13,14	1,2	1,2	
2	Buyer/customer pressure	1,2,3,4,5,6,7,8,9,10,11,12,13,14	1,2	1,2	
3	Effective information flow	3,4,6,7,8,9,11,12,13,14	1,2,3,5,6,10	3,6	
4	Strengthening margins	4,9,14	1,2,3,4,5,6,7,8,9,10,11,12,13,14	4,9,14	
5	Current technologies becoming obsolete	3,4,5,6,7,8,9,10,11,12,13,14	1,2,5	5	
6	Integration of manufacturing activities of the organization	3,4,6,7,8,9,11,12,13,14	1,2,3,5,6,10	3,6	
7	Enhancing the operational performance	4,7,8,9,11,12,13,14	1,2,3,5,6,7,10	7	
8	Order qualifier/Order winner	4,8,9,11,13,14	1,2,3,5,6,7,8,10,11, 12,13	8,11,13	
9	To be a part of industry 4.0 revolution	4,9,14	1,2,3,4,5,6,7,8,9,10,11,12,13,14	4,9,14	
10	Managerial realization	3,4,6,7,8,9,10,11,12,13,14	1,2,5,10	10	
11	Cost savings	4,8,9,11,13,14	1,2,3,5,6,7,8,10,11,12,13	8,11,13	
12	Enhancing productivity	4,8,9,11,12,13,14	1,2,3,5,6,7,10,12	12	
13	Gaining a competitive advantage	4,8,9,11,13,14	1,2,3,5,6,7,8,10,11,12,13	8,11,13	
14	Achieving sustainability	4,9,14	1,2,3,4,5,6,7,8,9,10,11,12,13,14	4,9,14	I

ISSN: 2408-7920

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Table 5: Iteration result II–VIII of the AMT adoption drivers' reachability matrix level partitioning

S/N	Factors	Reachability set	Antecedent set	Intersection	Level
1	Enabling government policies	1,2	1,2	1,2	VIII
2	Buyer/customer pressure	1,2	1,2	1,2	VIII
3	Effective information flow	3,6	1,2,3,5,6,10	3,6	V
4	Strengthening margins	4,9,14	1,2,3,4,5,6,7,8,9, 10,11,12,13,14	4,9,14	I
5	Current technologies are becoming obsolete	5	1,2,5	5	VII
6	Integration of manufacturing activities of the organisation	3,6	1,2,3,5,6,10	3,6	V
7	Enhancing the operational performance	7	1,2,3,5,6,7,10	7	IV
8	Order qualifier/Order winner	8,11,13	1,2,3,5,6,7,8,10, 12	8,11,13	II
9	To be a part of Industry 4.0 revolution	4,9,14	1,2,3,4,5,6,7,8,9, 10,11,12,13,14	4,9,14	I
10	Managerial realisation	10	1,2,10	10	VI
11	Cost savings	8,11,13	1,2,3,5,6,7,10,11, 12	8,11,13	II
12	Enhancing productivity	12	1,2,3,5,6,7,10,12	12	III
13	Gaining a competitive advantage	8,11,13	1,2,3,5,6,7,10,12, 13	8,11,13	II
14	Achieving sustainability	4,9,14	1,2,3,4,5,6,7,8,9, 10,11,12,13,14	4,9,14	I

RESULT AND DISCUSSION

Formation of ISM-based model of AMT drivers

The structural model is generated using the final reachability matrix, and the digraph is then drawn. Figure 2 shows the ultimate result of converting the digraph into the Interpretive Structural Model, which is achieved by removing the transitivity stated in the ISM technique. Given their position at the bottom of the ISM hierarchy, "enabling government policies" and "buyer/customer pressure" are key motivators for AMT adoption among Indian SMEs. The fact that the least important drivers—achieving sustainability, being a member of the Industry 4.0 revolution, and strengthening margins—appeared at the top of the hierarchy suggests as much. Taking care of the variables lower on the hierarchy will allow us to raise the top-level variable to a better position.

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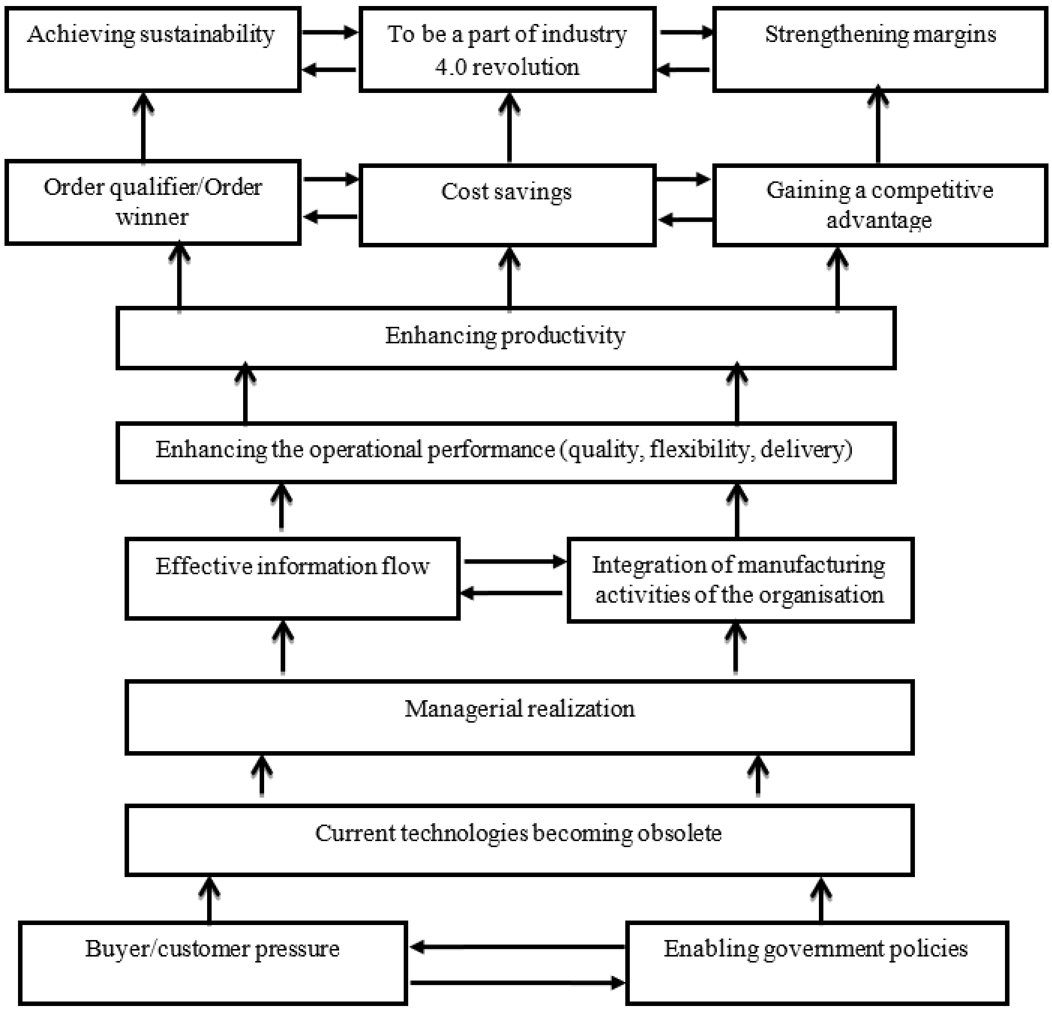

Figure 2: Model-based on ISM for AMT adoption drivers

MICMAC analysis of AMT drivers

Matrice d'impacts croisés multiplication appliquée á un classment (MICMAC) for short, is a technique employed in data analysis. The MICMAC study examines the variables' dependencies and driving power (DP). Figure 3 shows the investigation results, which grouped the AMT drivers previously mentioned into four categories. The first group comprises 'Autonomous variables' with low DP and no dependence. These variables do not belong anywhere and have weak connections to the system they are a part of.

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The second cluster, which includes the 'dependent variables,' is characterised by strong dependency and weak DP. The third cluster is very dependent and has an intense DP. These variables are inherently unstable because their changes impact other variables and themselves. In the fourth set, we find the "independent variable" with low dependence and high driving power. Table 3 displays the dependent variable (DP) and the variables upon which it is dependent. Take Table 3 as an example. It shows that drivers 3 and 6, which deal with adequate information flow and integration of the firm's manufacturing activities, have driving powers of 10 and 6, meaning they are positioned in the same place.

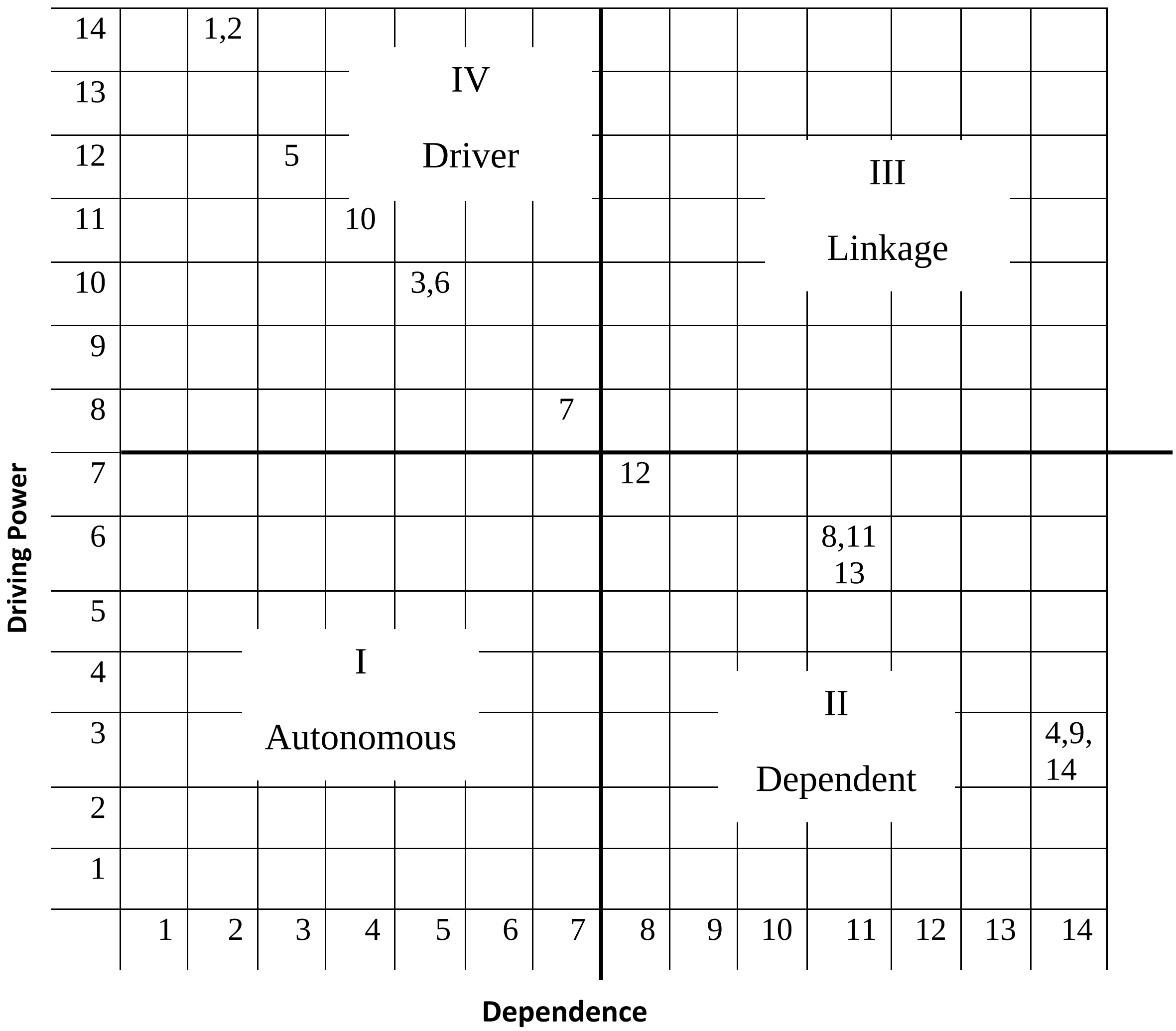

Figure 3: Driving power and dependence diagram of AMT drivers

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http://www.ajaronline.com
https://doi.org/10.26437/ajar.v11i1.
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Peer reviewed: October 8, 2024
Revised: November 28, 2024
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Discussion

Despite the well-known benefits of AMT adoption, AMTs are not widely used by Indian SMEs. The cause could be a lack of understanding of the various influential AMT factors and their interdependence in the implementation framework. Several factors encourage organisations to use AMTs. These factors, known as AMT adoption drivers, also facilitate AMT implementation in organisations. Organisations must first thoroughly understand these drivers and their interrelationships to reap the most benefits from AMT. The current study attempted to assess the effectiveness of various factors that initiate and accelerate AMT implementation in Indian SMEs. The following are some managerial takeaways from this study.

- The relationships between several factors of AMT adoption are examined using the hierarchical model created by the ISM. Decision-makers will find this helpful in determining the hierarchy of activities needed to meet these factors and successfully select and implement AMTs in Indian SMEs.

- Managers can aid in rationalising time and resource constraints by identifying the interrelationships between the drivers.

- It is evident from the driver power and dependence diagram (Figure 4.3) that there are no drivers in 'cluster I,' suggesting that the system is deficient in autonomous drivers. Generally speaking, autonomous variables are considered somewhat unrelated to the system and are also weak drivers and dependents. The other variables in the system are not greatly affected by these factors. Consequently, each of the highlighted drivers is crucial to the launch of AMT. Managers and practitioners should not ignore any of the identified drivers but should instead give careful consideration to each one (Dewangan et al., 2015).

- The drivers' strengthening margins,' 'order winner,' 'cost savings,' 'increasing productivity,' 'gaining a competitive edge,' and 'reaching sustainability' are perceived as weak drivers that rely heavily on other drivers. Although their dependency power is considerable, these drivers' driving capability is weak (Lee & Whang, 2000; Tripathy et al., 2013).

- No driver is present in the third cluster. It can be inferred that all drivers are stable because there are no linking drivers.

- The fourth cluster of drivers is occupied by "enabling government policies," "buyer/customer pressure," "effective information flow," "current technology becoming obsolete," "integration of manufacturing activities of the organisation," "enhancing operational performance," and "managerial realisation,". These drivers are highly dependent but have much driving power.

African Journal of Applied Research
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When choosing and implementing AMTs, managers and decision-makers must consider these drivers (Bloom et al., 2011; Shukla & Shankar, 2022).

- Drivers such as 'achieving sustainability', 'strengthening margins' and 'to be a part of industry 4.0 revolution' occupy the topmost position in the hierarchy of the ISM-based model of the drivers (figure 4.2). These factors represent the desired outcome of AMT adoption and are classified as dependent drivers. Bottom-level drivers should be continuously improved in order to achieve these goals (Bosman et al., 2020; Tripathy et al., 2013).

CONCLUSION

Diverse factors that may encourage AMT implementation among Indian SMEs are investigated in this research. After consulting with specialists and reviewing pertinent literature, these drivers are identified. These drivers were analysed using the ISM technique. Companies often try to mimic the operational tactics of their rivals, which leads them to adopt new technologies too quickly. Sometimes, these choices can have a devastating effect on small firms. In order to speed up AMT adoption and deployment, companies interested in AMT need to understand these elements and how they interact with one another. How the different drivers interact can be better understood with the help of the iterative process that the ISM modelling technique offers. The more powerful drivers are more strategic, whereas the dependent variables focus more on performance and results. Therefore, better outcomes can be achieved by consistently enhancing the driving variables.

This study explores the critical factors driving Advanced Manufacturing Technologies (AMT) adoption in small and medium enterprises (SMEs) using the innovative Interpretive Structural Modeling (ISM) methodology, which organises and clarifies complex interrelationships among variables.

The findings offer practical guidance for SME owners and managers, enabling phased, resource-efficient AMT implementation while providing policymakers with insights to design targeted support initiatives. The ISM-based hierarchical framework prioritises key drivers and uncovers their interdependencies, offering a novel approach to AMT adoption that combines qualitative insights with structured analysis. The study's adaptable model and comprehensive questionnaire pave the way for empirical research and application across various industries and regions. In contrast, future research could enhance these insights through advanced tools like fuzzy-ISM, TISM, or ANP.

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Received: July 5, 2024
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Peer reviewed: October 8, 2024
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