



Factors affecting repurposing operations in Micro Small and Medium Enterprises during Covid-19 emergency

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Abstract

Micro, Small and Medium Enterprises (MSME) sector plays a substantial role in the overall economic development and employment generation of a country. The Covid-19 pandemic has impacted adversely, and it is inevitably necessary to consider the influence of the pandemic on MSME, which will assist the policymakers in helping in the repurposing operations of the sector. Because of its size, scale of operations, and availability of financial resources, the MSMEs sector has been one of the most susceptible sectors post-Covid-19. Many academics have explored the constraints to MSMEs' development in the past, but limited research has been done using Total Interpretive Structural Modelling (TISM) technique for the factors impacting MSMEs' repurposing operations during the Covid-19 emergency. This research seeks to "identify," "analyze," and "categorize" the elements impacting MSMEs' repurposing operations during the Covid-19 pandemic. Literature review and experts' comment from various MSMEs resulted in identification of 7 enablers. The TISM and MICMAC approach was employed in this study. The findings shows that occupational health and safety, logistics, and government rules and regulations are the key factors affecting repurposing operations in MSMEs during the Covid-19 emergency. This research helps the top-executives of MSME to look into the factors affecting repurposing operations in MSMEs during the Covid-19 emergency. This research examines factors affecting repurposing operations in MSMEs during the Covid-19 emergency. It is the first study to analyze the factors affecting the repurposing operations in MSME during the Covid-19 using TISM technique.

Keywords Repurposing operations · Micro Small and Medium Enterprises · Covid-19 emergency · Repurposing MSMEs · Repurposing production · Total Interpretive Structural Modelling

1 Introduction

Micro, Small and Medium Enterprises (MSME) sector plays a prominent role in the overall economic activity and employment generation of a nation. According to the

Directorate General of Commercial Intelligence and Statistics (DGCIS) data of the year 2019–20, the MSME sector in India comprises a massive network of 63 million components and employs about 110 million individuals. The sector contributed 29% to overall Gross Domestic Product (GDP) in 2019 and 48.56% of total exports during 2017–18 (Tripathi 2020). This implied that Indian MSMEs are exposed to greater global integration and supply chains. The MSME sector, being the nation's growth engine, accounts for 33.4 percent of India's industrial output. The sector's prominence for the socio-economic development of the economy increased with the government's new mission of reaching a \$5 trillion economy by 2025 (India Brand Equity Formation 2020).

MSMEs serve as auxiliary units to big enterprises, and this sector makes a significant contribution to society (Sharma and Kharub 2015; Virmani et al. 2020). MSME's globalization is projected to accelerate as the global economy becomes more interconnected, owing to continuing reductions in government-imposed obstacles

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and technological advancement (Hausman 2005). Since 1991, the trend of globalization and liberalization of market changes has produced both problems and possibilities. The market is rapidly developing and fiercely competitive in today's industry (Sharma and Kharub 2015). Since Indian Small and Medium Enterprises (SMEs) are in a moment of change, there is a need for continual development through International Organization for Standardization (ISO) accreditation (Sedani and Lakhe 2011). To be successful, small businesses must recognize and appreciate different types of capital, including human, financial, and social capital. The firm's long-term competitive advantage is dependent on its value generation process. The fundamental argument for supporting companies to innovate is that it will lead to improved economic growth in terms of increased growth, employment opportunities, and incomes. Organizations that can constantly construct new critical assets cheaper and faster than their competitors will gain long-term competitive advantages. The MSME sector being the backbone of the Indian economy, has adversely got affected by Covid-19. It is inevitably necessary to study the impact of the pandemic on MSME, which will assist the policymakers in helping in the repurposing operations of the sector. In addition to this, the nature and level of problems faced by the manufacturing MSMEs should also be analyzed. As a result, it's crucial to comprehend and research the factors affecting MSMEs' repurposing activities during the Covid-19 pandemic. Many academics have explored the constraints to MSMEs' development in the past (Aur lio de Oliveira et al. 2012; Adeola 2016; Mehrotra et al. 2020; Veselovsk  2020; Singh 2020; Virmani et al. 2020; Sharma and Kharub 2015; Fumo and Jabbour 2011), but limited research has been done using Total Interpretive Structural Modelling (TISM) technique for the factors impacting MSMEs' repurposing operations during the Covid-19 emergency. This research seeks to "identify," "analyze," and "categorize" the elements impacting MSMEs' repurposing operations during the Covid-19 pandemic. The following four research questions are formulated to develop the framework, notably in MSMEs: (a) What are the factors affecting the repurposing operations in MSMEs during the Covid-19? (b) How do the factors affecting MSMEs repurposing operations during covid-19 influence one another? (c) Which factors depend on other factors, and which factors drive others? (d) Can the priority of each of these factors be measured?

Significant impacting factors are discovered in this study, and a theoretical model is developed that contributes to repurposing operations in MSMEs. Using Total Interpretive Structural Modelling (TISM) approach to analysis of factors impacting repurposing operations in MSMEs fills this research gap.

The next section is the literature review. Section 3 discusses the methodology which is followed by results in

Sect. 4. TISM validation depicts in Sect. 5. Section 6 is devoted for discussions and the theoretical and practical implications of this study. Conclusion is discussed in Sect. 7.

2 Literature review

Virmani et al. (2020) identified various hurdles that hinder MSMEs from implementing sustainable manufacturing methods. Sharma and Kharub (2015) recall and examine the major roadblocks that hinder the growth of MSMEs. The links between obstacles and various performance metrics are investigated using both quantitative and qualitative research methods. Fumo and Jabbour (2011) highlighted the key hurdles that micro and small businesses face and their consequences for the support programs accessible. Ahmed and Sur (2021) identified and analysed the characteristics that influence rural MSMEs by adopting digital banking services during demonetization and Covid-19. Sarkar (2020) examined the current state of Indian MSMEs, the key problems they face, and how the Government's actions to resuscitate MSME companies might help the whole economy during and after the Covid-19. Deshmukh and Haleem (2020) examined Indian Manufacturing firms from a variety of perspectives, including industry groups, qualified teams, academic institutions, and industry, to address the problem of improving industrial efficiency. Alekseev et al. (2020) assessed the consequences of the initial phases of the Covid-19 pandemic on small companies by analyzing the survey of managers, owners, and workers of small firms. Adeola (2016) proposed that all the external environments, such as technological, economic, natural, demographic, legal, political, socio-cultural, financial, global, competitive, and social have a noteworthy impact on the SMEs' performance. There also exists a strong relationship between the external environment and SMEs. Mehrotra et al. (2020) stated that the fall in demand substantially reduced the income for the enterprises. The paper demonstrates the existence of a huge demand and supply gap in the market. To cope with the uncertain situation, MSMEs reduced the volume and variety of goods, which helped to cut costs. Aur lio de Oliveira et al. (2012) highlighted that the resources are allocated by utilizing the available resource to the maximum extent, which is typically reliant on the project selection type, size of the project (small, medium, and large), technical updates, period, and research and development. Tallon and Pinsonneault (2011) discovered the need for resource stability to defend and react to fluctuations in the manufacturing environment rapidly. Resources are crucial to support key competencies in an innovative business marketplace. The spread of resources is possible if company has the ability to protect key competencies, enabling consistent performance in the short term and the potential for long-term agility.

Veselovská (2020) stated that the biggest problem enterprises faced when Covid-19 hit was disruptions in the supply chain. The troubles in the supply chain impact competitiveness, economic growth, and job creation. This affected the medium-scale businesses whose supply chain is spread across borders through different regions or countries. Most companies have realized their supply chain vulnerability and started to diversify. Nendissa et al. (2020) in their study, explored the pattern of price movements, disparities, and instabilities in the price during Covid-19 pandemic in markets. To mitigate the impact of Covid-19, enterprises adopted different conventional solutions. One of the most important strategies is to reduce the price of goods and services. But, due to higher demand, supply shortages, and other pandemic-related expenditures instigate them to increase during Covid-19. Most MSMEs are severely affected, facing several issues financially, reducing sales and profit (Shafi et al. 2020). Amid any economic emergency, businesses confront a cash-flow deficiency; subsequently enterprises formulate strategies to overcome such shortages. Considering the severity of the virus, laying off employees and shutdown of many businesses were already expected (Bartik et al. 2020). As a result of lower market volumes and production capacities, the enterprises were financially affected. The other impacts on the financial sector are solvency, liquidity, profitability, non-performance (Singh 2020). On the health aspect, the outbreak of Covid-19 led to critical health issues indicated by a lack of health facilities and infrastructures. Secondly, there is an issue in providing Covid-19 detectors, such as Polymerase Chain Reaction (PCR) provided by the Government (Djalante et al. 2020). Viscusi (1979) stated that occupational health and safety regulations play a major role in businesses proportional to poor working conditions that do not meet the norms and guidelines.

Rajan (2020) stated that the government had involved itself in formulating short-term and medium-term strategies to revive the sector and economy. In terms of credit guarantee, the government issued Rs. 20,000 crores to Credit Guarantee Fund Trust for Micro and Small Enterprises (CGTMSE). Sridhar (2020) highlighted how the economy's supply-side had been interrupted with the shutdown of all economic activities due to total lockdown. Besides raw materials, with large reverse migration, labor supply is a major concern. Unni (2020) suggested that labor cost is not an imperative element of total costs, apart from labor-intensive industries. Some states have suspended labor laws, believing that it will help the industries revive after lockdown. Sahu et al. (2021) applied behavioral reasoning theory to offer a behavioral reasoning viewpoint on adopting

lean manufacturing practices from the standpoint of MSME employees. Table 1 summarises the findings of the literature review.

The above analysis of the literature forms the basis for the following three main objectives of this paper:

1. To identify the factors affecting repurposing operations in MSMEs during the Covid-19 emergency
2. To investigate the interrelationships among the identified affecting factors
3. To categorize the factors based on dependence and driving power by using MICMAC analysis and rank the factors

2.1 Factors identification

The literature review captures the factors affecting MSMEs repurposing operations as a result of Covid-19, and main impediments are highlighted based on experts' opinions. The significant factors are mentioned following:

2.1.1 Derived demand

The desire or requirement to manufacture a certain intermediate item or component is referred to as "derived demand". This component accounts for the demand for intermediate goods that arises from the demand for finished goods in repurposing activities. A lack of demand is one of the most serious issues confronting American small business owners, managers, and employees during the times of Covid-19 (Aleksseev et al. 2020). In addition, manufacturing enterprises and firms with a low percentage of in-person reported a lack of demand. As a result, their ability to operate is significantly hampered, resulting in serious financial difficulties. According to Mehrotra et al. (2020), the drop in demand significantly reduced the income of the enterprise. According to their findings, 73 percent of businesses were experiencing a decrease in customer footfall. The drop in customer footfall was consistent across firms, regardless of whether they were owned by men or women. They acknowledged that the market already has a significant demand and supply discrepancy. To cope with the uncertain scenario, MSMEs reduced the amount and diversity of items, which aided in cost-cutting. During the Covid-19 tragedy, MSMEs were hurt the worst by demand shocks for repurposing operations.

2.1.2 Resource availability

Resource availability includes raw materials, intermediate goods, and parts, as well as labor, capital, and equipment.

Table 1 Synthesis of literature review

Sl. No	Reference	Aim/Objective	Dimension
1	Deshmukh and Haleem (2020)	To examine Indian Manufacturing firms from various perspectives, including expert team industry groups, academic institutions, and industry, to address the issue of improving industrial efficiency	1. Industry 4.0 2. Covid-19 3. Manufacturing
2	Alekseev et al. (2020)	To assess the consequences of the initial phases of the Covid-19 on small companies by analysing the survey of small firms' managers, owners, and workers	1. Covid-19 2. Small Businesses 3. Derived demand
3	Adeola (2016)	To propose all the external environments, such as technological, economic, natural, demographic, legal, political, socio-cultural, financial, global, competitive, and social, have a significant impact on the organizational performance of SMEs. There also exists a strong relationship between the External Environment and SMEs	1. External business environment 2. Organizational performance 3. Small and Medium-Scale Enterprise
4	Mehrotra et al. (2020)	To address the issue that there is a huge demand and supply gap in the market	1. Covid-19 impact 2. MSMEs 3. Derived demand
5	Aur�lio de Oliveira et al. (2012)	To highlight that the allocation of resource is made by utilizing the available resource to the maximum extent, typically reliant on the project type, selection, size of the project (small, medium, and large), technical updates, time period, and research and development (R&D)	1. Forecasting 2. Organizational Agility 3. Resource availability
6	Tallon and Pinsonneault (2011)	To explore the need for resource stability, to defend and react to variations in the manufacturing environment quickly	1. Organization Agility 2. Resource availability 3. Strategic Information Technology Alignment
7	Veselovsk� (2020)	To state that the biggest problem enterprises faced when Covid-19 hit was disruptions in the supply chain	1. Supply chain disruption 2. Covid-19
8	Nendissa et al. (2020)	To explore the pattern of price movements, disparities, and instabilities in the price during covid-19 in traditional markets	1. Covid-19 2. Disparity 3. Price fluctuation
9	Shafi et al. (2020)	To analyze the impression of the Covid-19 pandemic on the firms and to offer plan to assist MSMEs in decreasing the losses and surviving in the turbulent environment	1. Covid-19 2. Crisis 3. Business Survival 4. Financial fragility
10	Bartik et al. (2020)	To explore the effect of the Covid-19 on small businesses	1. Covid-19 2. Small businesses 3. Financial fragility
11	Singh (2020)	The impact of Covid-19 induced a triple crisis on MSMEs, which are significant drivers of the Indian economy	1. MSME Sector 2. Covid-19 pandemic 3. Supply shock 4. Demand shock
12	Djalante et al. (2020)	To give thorough analysis and reporting of Indonesia's current Covid-19 responses	1. Covid-19 2. Health 3. Resilience
13	Viscusi (1979)	To give a conceptual assessment of the potential impacts of regulation and examine the drivers of safety and health investments	1. Occupational health and safety and Health 2. Regulation
14	Unni (2020)	To suggest that labor cost is not an imperative element of total costs, excluding labor-intensive industries. Some states have suspended labor laws, believing that it will help the industries revive after lockdown	1. Covid-19 2. Government rules and regulations

Table 1 (continued)

Sl. No	Reference	Aim/Objective	Dimension
15	Ahmed and Sur (2021)	To identify and analyze the characteristics that influence rural MSMEs by adopting digital banking services during demonetization and Covid-19	1. MSMEs 2. Cashless economy 3. Demonetization 4. Covid-19
16	Sarkar (2020)	To examine the current state of Indian MSMEs, the key problems they face, and how the Government's actions to resuscitate MSME companies might help the whole economy during and after the Covid-19	1. Economic downturn 2. MSMEs 3. Government initiatives and financial support
17	Sahu et al. (2021)	To identify the determinants and barriers of implementing lean in MSMEs	1. Lean Manufacturing 2. Adoption 3. Barriers 4. MSMEs
18	Virmani et al. (2020)	To identify various hurdles that hinder MSMEs from implementing sustainable manufacturing methods	1. Sustainable Manufacturing 2. MSMEs 3. Barriers
19	Sharma and Kharub (2015)	To recall and examine the major roadblocks that hinder the growth of MSMEs. The link between obstacles and various performance metrics is investigated using both quantitative and qualitative research methods	1. MSME 2. Barriers 3. Quantitative 4. Qualitative
20	Fumo and Jabbour (2011)	To provide light on the key hurdles faced by micro and small businesses and their consequences for the support programs accessible	1. Micro and Small Businesses 2. Barriers

According to Aurélio de Oliveira et al. (2012), resource allocation is determined by maximizing the use of existing resources, which is typically determined by the type of project chosen, project size (small, medium, and large), technological upgrades, time, and research and development. By transforming productive work environments, the information system plays a vital role in exploring resources and promoting agility (Seo and La Paz 2008). Tallon and Pinsonneault (2011) looked into the importance of resource stability in order to safeguard and adapt to changes in the manufacturing environment quickly. In a new company market, resources are critical for supporting core competencies. The resource is distributed based on the company's ability to protect critical skills, allowing for consistent short-term performance while also allowing for long-term flexibility. Resource availability problems include challenges obtaining crucial raw materials, components, and intermediate products, and pandemic-related manpower (labor migration) and capital implications, all of which impede MSME repurposing operations.

2.1.3 Logistics

The inbound and outward flow of items from the manufacturing MSMEs to the end consumer, or the management of the entire supply chain, is referred to as logistics. The epidemic of Covid-19 has a direct impact on the logistical operations of businesses that deal with the movement, storage, and flow of goods. Logistics organizations, as a vital part of

value chains, regardless of cross-border boundaries, assist businesses in getting their products delivered to customers. According to Veselovská (2020), the largest challenge firms encountered when Covid-19 hit was disruptions in the supply chain. Supply chain interruptions have an influence on competitiveness, economic growth, and job creation. This primarily impacted medium-sized enterprises whose supply chains are scattered across multiple regions or nations. Most companies have recognized the vulnerability of their supply networks and are now looking to diversify. Logistics concerns affect repurposing initiatives by causing logistical and transportation issues for commodities and components. Delays in delivery are regarded as serious difficulties.

2.1.4 Price responsiveness

The ability of a firm to respond to increases in raw material costs is referred to as price responsiveness. Nendissa et al. (2020) investigated the pattern of price movements, discrepancies, and variations in traditional markets because of the Covid-19 epidemic. To reduce the impact of Covid-19, businesses used a variety of traditional methods. Reduction in prices for goods and services is one of the most essential measures. During Covid-19, firms are expected to increase prices because of supply constraints, increased demand, and other pandemic-related expenses. Business clients and customers, on the other hand, have been renegotiating lower rates, postponing payments, and cancelling purchases. During initial phase of Covid-19, the price of raw materials such

as copper, pump stamping, and metal rose by 15% to 25%. Despite increasing production during the Covid shutdown, the price has dropped by 45 percent. With local suppliers raising prices of raw material, MSMEs are unable to pass on this additional burden to OEMs, who rely solely on pre-agreed rates. As a result, how businesses react to price changes in raw materials and components is critical in repurposing MSMEs' operations.

2.1.5 Financial fragility

Financial fragility refers to a financial system's vulnerability to a financial crisis. Working capital or cash flow is the amount of money available for an MSME's day-to-day operations. Cash flow limitations, financial options, and support from outside sources such as banks and the government are all part of this consideration. The majority of MSMEs have been adversely impacted, and they are dealing with a variety of financial challenges, including decreased sales and profits (Shafi et al. 2020). During any economic downturn, businesses confront a cash-flow shortage. As a result, businesses start to formulate strategies for overcoming the cash-flow constraint. Laying off personnel, cutting staff salaries, and partially closing down the business are all strategies used by businesses to save costs and control cash flow volatility. Given the severity of the epidemic, layoffs and the closure of many firms were already foreseen (Bartik et al. 2020). The firms suffered financial losses as a result of decreasing market volumes and manufacturing capacities. Other effects on the financial sector include solvency, liquidity, profitability, and non-performing loans (Singh 2020).

2.1.6 Occupational health and safety

Occupational health and safety refer to practices aimed largely at safeguarding MSMEs' employees from workplace accidents, injuries, and exposure to hazardous substances. This component of the investigation looks into the patterns of worker sickness and injury during the Covid-19 pandemic. In terms of health, the Covid-19 outbreak resulted in significant health difficulties, as evidenced by a shortage of health services and infrastructure. Second, there is a problem with the government's provision of Covid-19 detectors, such as polymerase chain reaction (Djalante et al. 2020). For the majority of time, health issues are the primary concerns. On the supply side, the rigorous lockdowns and quarantines as a part of epidemic protection measures resulted in a reduction in capacity utilization. Social distancing measures have resulted in a decline or even a complete stoppage of economic activity, particularly among those working in the

informal sector. Furthermore, many job terminations may have increased unemployment rates, affecting the poverty level in the town. MSMEs experience difficulties in paying wages and granting sick leave to the workers who are affected by Covid-19. Many businesses and governments from around the world have established cooperation channels to devise measures to deal with the outbreak. According to Viscusi (1979), occupational health and safety regulations have a significant impact on enterprises and are proportionate to the presence of inadequate working conditions that do not satisfy the standards and recommendations. High fine amounts would encourage businesses to concentrate on providing high-quality jobs.

2.1.7 Government rules and regulation

Government rules and regulations refer to the policies and guidelines established by the government to control the operational activity of MSMEs. According to Rajan (2020), the government has invested in several short- and medium-term plans to revitalize the sector and the economy. In terms of credit guarantees, the Indian government contributed Rs. 20,000 crores to the Credit Guarantee Fund Trust for Micro and Small Enterprises. Sridhar (2020) emphasized how the supply side of the economy has been impacted by the complete shutdown of all commercial activity. Aside from raw materials, a major worry with large reverse migration is labor supply. Unni (2020) proposed that except in labor-intensive businesses, labor expenses are not a significant component of total costs. Some states have temporarily suspended labor regulations in the hope that it will help industries reopen once the lockdown is lifted. These restrictions on imports and exports, as well as regional insecurity and a prolonged shutdown, all have an impact on MSMEs' repurposing operations.

2.2 Literature review on ISM/TISM

Warfield (1976) has originally developed a methodology called Interpretive Structural Modelling (ISM) for resolving structuring complex problems, and in the present world, it is used in various fields (Vasanthakumar et al. 2016; Cherrafi et al. 2017; Gardas et al. 2017; Raut et al. 2018). ISM is a theory-building approach to analyze the interrelationship between the factors based on experts' opinions and develop the hierarchical model (Ramesh and Vinodh 2021). Clarification of the connection is restricted to the direction and contextual relationship among factors; hence the relations need to be understood to explain the way experts conceptualize or describe guided relationships (Sushil 2012). Hence,

when combined with the interpretive matrix, ISM guides the development of the TISM methodology and framework (Menon and Suresh 2019). TISM provides the interpretations between the pair of factors and it is an advanced qualitative modelling approach (Dubey et al. 2015). Ramiya and Suresh (2021) applied the TISM approach to analyze the interrelationships among lean-sustainable maintenance. They considered eleven major factors for the analysis and found that top management, auxiliary parts management, and energy proficiency are the key factors for lean-sustainable maintenance. Mathivathanan et al. (2021) used the TISM approach to analyze the affecting factors in the adoption process of blockchain in the supply chain. Agarwal and Seth (2021) analyzed the interrelationship of supply chain resilience affecting factors for automotive organizations using TISM. Suguna et al. (2021) applied TISM to examine the last mile delivery factors' interrelationships during Covid-19 emergency. Chillayil et al. (2021) studied the energy auditing behavioral factors' interrelationships using TISM. Wankhede and Vinodh (2021) applied TISM for analyzing the intermediate factors of preservative manufacturing and industry 4.0. Suresh et al. (2021) analyzed the agility interrelationships aspects in Covid-19 care hospitals using TISM. Sreenivasan and Suresh (2021) applied TISM to analyze the sourcing risk in startups in Covid-19 emergency. Patil and Suresh (2019) have applied TISM to offer a classified structure for identifying moving enablers and reliant enablers and to provide an enabler's order of control on the workers' agility in the IoT technical projects.

3 Methodology

3.1 Sampling design and data collection

The prime concentration of the current research is on impacting the repurposing of MSMEs operations during the Covid-19 emergency. A closed-ended questionnaire is prepared to catch the impact of all the major factors found in concerning one another, which implies pair-wise comparisons of the factors. Expert opinions regarding the identified factors, interrelationships of MSMEs were considered while revising the questionnaire. After finalizing the questionnaire, scheduled interviews were carried out. The ultimate survey was carried out among the experts who were belonging to MSMEs operations during the Covid-19 emergency. Invitations for a face-to-face interview were sent to 31 members belonging to the decision-makers of operations in MSMEs.

In total, 27 members acknowledged the invitation and 25 members were cross-examined. The respondents were from different designations such as managers, supervisors, and proprietors in several MSMEs in India. Each interview was scheduled for 45 min. The initial 15 min were used to clarify the study and elaborate the explanations of the seven major factors and the remaining 30 min were productively used to receive the feedback from respondents for the questions asked and to note it in the essential format.

3.2 Research methodology

The ISM approach transforms systems' imprecise, poorly stated mental models into measurable, well-defined models (Warfield 1976). The interpretation of the links is limited to the direction of impact, i.e., describing the "how" of the elements' influence. This explanation, on the other hand, does not explain the "why" of the elements' contextual connection. To summarise, ISM only contributes to the formation of ideas by providing answers to the questions "what" and "how." It does not explain the causation of links, hence it does not address the question "why." Yadav and Sushil (2014) established an interpretative as a management tool that provides an absolute interpretation of the structural model; pair-wise factor interactions, to overcome the constraints of the ISM. Jena et al. (2017) define TISM as a combination of the ISM structural model and an interpretative matrix. Because practitioners' perspectives dictate not only "how" but also "why" the criteria are related in a certain way, the interpretative matrix in TISM provides an overall interpretation. As a consequence, TISM facilitates the transition of imprecisely specified models into organized and clear models that answer the "what," "how," and "why" concerns, as well as their implementation in practise. In this study, TISM approach is adopted to recognize the interrelationship between the factors that affect MSMEs' repurposing operations during the Covid-19 emergency. Figure 1 displays the flowchart of the steps involved in the TISM methodology of the proposed model. The following are the steps adopted (Vaishnavi et al. 2019a) to successfully apply the TISM model:

1. **Factors Identification:** The first step was to categorize the major factors that affect MSMEs repurposing operations during the Covid 19 emergency. This was identified through literature review and taking experts' opinion on the same. The major factors that affecting MSMEs repurposing operations are listed in Table 2.

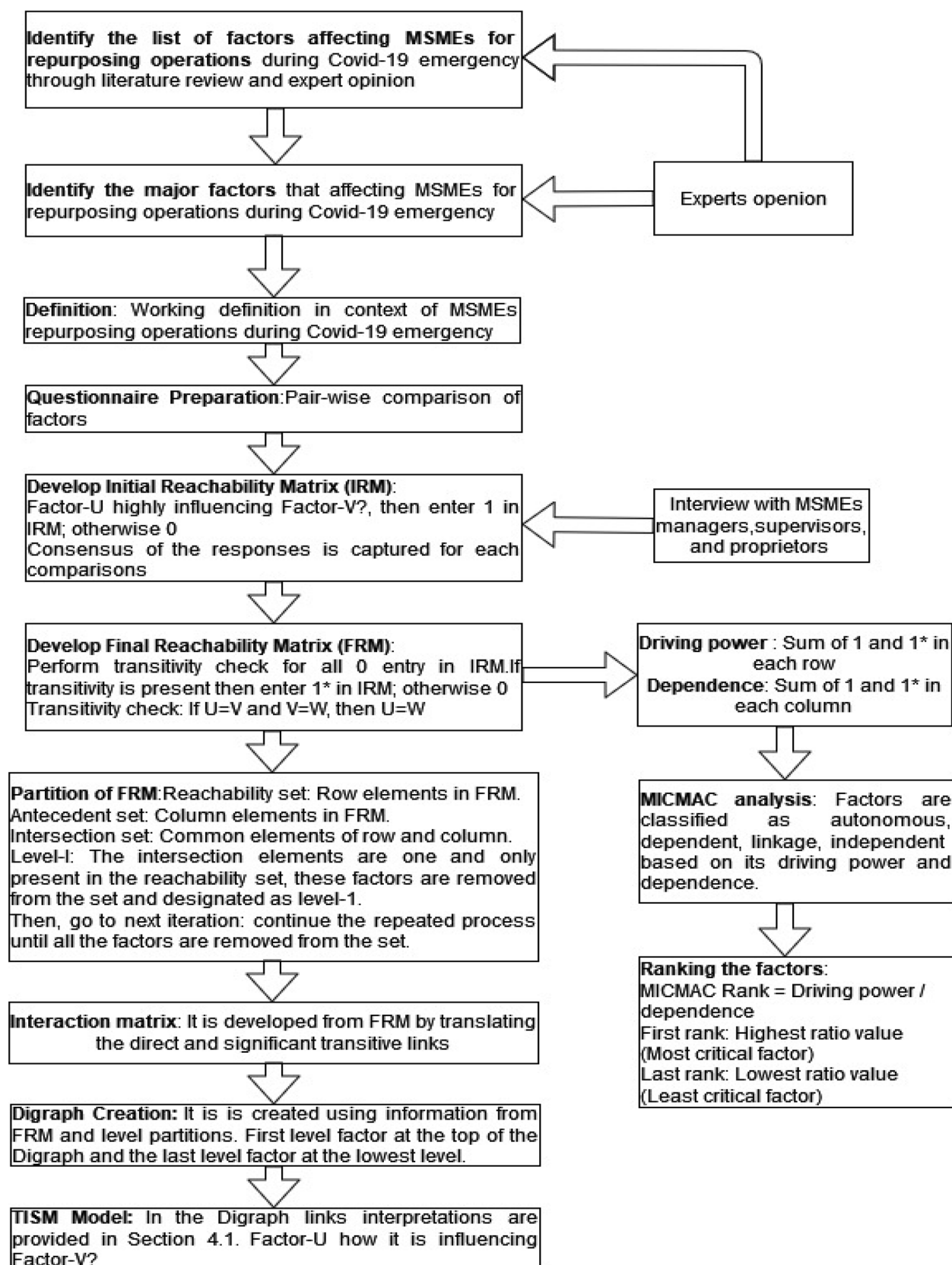


Fig. 1 The flow of TISM for MSMEs' repurposing operations during Covid 19 emergency

Table 2 Identified major factors affecting MSMEs repurposing operations

B. No	Factors	References
B1	Derived demand (B1)	Mehrotra et al. (2020); Alekseev et al. (2020)
B2	Resource availability (B2)	Aurélio de Oliveira et al. (2012); Seo and La Paz (2008); Tallon and Pinsonneault (2011)
B3	Logistics (B3)	Veselovská (2020)
B4	Price responsiveness (B4)	Nendissa et al. (2020)
B5	Financial fragility (B5)	Shafi et al. (2020); Bartik et al. (2020); Singh (2020)
B6	Occupational health and safety (B6)	Djalante et al. (2020); Viscusi (1979)
B7	Government rules and regulations (B7)	Rajan (2020); Sridhar (2020); Unni (2020)

- Establishing the relationship between factors:** To arrive at the Initial Reachability Matrix (IRM), contextual relationships between the factors have to be established. For this study, 25 responses have been collected from the respondents which included managers, supervisors, and proprietors from MSMEs in India. The arrival of IRM procedure is given in Fig. 1 and IRM for factors that affecting MSMEs repurposing operations are captured in Table 3.
- Interpreting the relationship between the factors:** How factor-U influences factor-V (Vaishnavi and Suresh 2020).
- Checking the transitivity by developing the Final Reachability Matrix (FRM):** The FRM has been derived through transitivity check (Lakshmi Priyadarsini et al. 2020). The arrival of FRM from IRM procedures are shown in Fig. 1 and FRM for factors that affecting MSMEs repurposing operations are captured in Table 4.
- Dividing the FRM factors into levels:** The partition reachability matrix is derived from FRM (Menon and Suresh 2021a).
- Interaction matrix design:** The significant transitive links are identified through experts' opinion and direct links are depicted in Table 5.

- Creating the digraph and the TISM model:** It is created by using level partitions and interaction matrix (Vaishnavi et al. 2019b). Figure 2 depicts the TISM model, while Sect. 4.1 discusses the explanations for the direct and important transitive connections.

4 Results

4.1 Interpretation of TISM Di-graph

Figure 2 signifies the graphical representation of TISM analysis of the factors having an impact on the MSMEs' repurposing operation during Covid-19 emergency.

4.1.1 Level IV: Level four has one factor, which is factor 6

Occupational health and safety (B6) impact resource availability (B2): The health, safety, and welfare of the employees are some important factors that affected the availability of manpower, materials, and machines. Widespread closure and spread of the Covid-19 have affected the well-being of the workers and resulted in significant unavailability of labor,

Table 3 IRM for factors affecting MSMEs repurposing operations

	B1	B2	B3	B4	B5	B6	B7
B1	1	1	0	0	1	0	0
B2	1	1	0	1	0	0	0
B3	0	1	1	0	1	0	1
B4	0	0	0	1	0	0	0
B5	0	0	0	0	1	0	0
B6	0	1	1	0	1	1	1
B7	1	1	1	0	1	0	1

Table 4 FRM for factors affecting MSMEs repurposing operations

	B1	B2	B3	B4	B5	B6	B7	Driving Power
B1	1	1	0	1*	1	0	0	4
B2	1	1	0	1	1*	0	0	4
B3	1*	1	1	1*	1	0	1	6
B4	0	0	0	1	0	0	0	1
B5	0	0	0	0	1	0	0	1
B6	1*	1	1	1*	1	1	1	7
B7	1	1	1	1*	1	0	1	6
Dependence	5	5	3	6	6	1	3	

* represents transitive links

raw materials and components. As a result of containment measures, MSMEs addressed this issue by reducing the production capacity.

Occupational health and safety (B6) affect logistics (B3): Factory workers' health condition strongly affects the activity of transporting goods from one place to another. The Covid-19 spread protective measurements like lockdown and border restriction affected the movement of goods, raw materials, and components. Shortage of drivers due to the spread of the virus was addressed by many enterprises.

Occupational health and safety (B6) affect financial fragility (B5): The health condition of the workers has a significant impact on the cash flow of the organization. The biggest problem that the MSMEs face during the Covid-19 is a cashflow shortage. When the workers' and employees' health and safety were disturbed by the novel coronavirus, the MSME's especially micro-enterprises started facing issues in their day-to-day expenses.

Occupational health and safety (B6) affect the government rules and regulation (B7): Restrictions posed by the government in the containment areas are mainly dependent on the number of cases in the respective region. The central government has taken steps to curtail the increasingly spreading coronavirus. The impact of framing stringent

rules and regulations concerning social distancing, lockdown, and border restrictions have controlled the spread of the infection.

4.1.2 Level III: Level three has two factors, which are factors 3 and 7

Logistics (B3) affects derived demand (B1): The movement of goods and services affects the demand for goods and services. The demand for luxury goods was deflated because people were more concerned about meeting their basic needs such as groceries, medical items, medicines, vegetables, etc. The cross-border restrictions have significantly affected the availability of the products which in turn led to the decreased demand. During the pandemic, MSMEs suffer from a reduction in the demand for the orders. They also emphasized to match the reduction in the demand and constraints in the production, they reduced their production of components, goods and services.

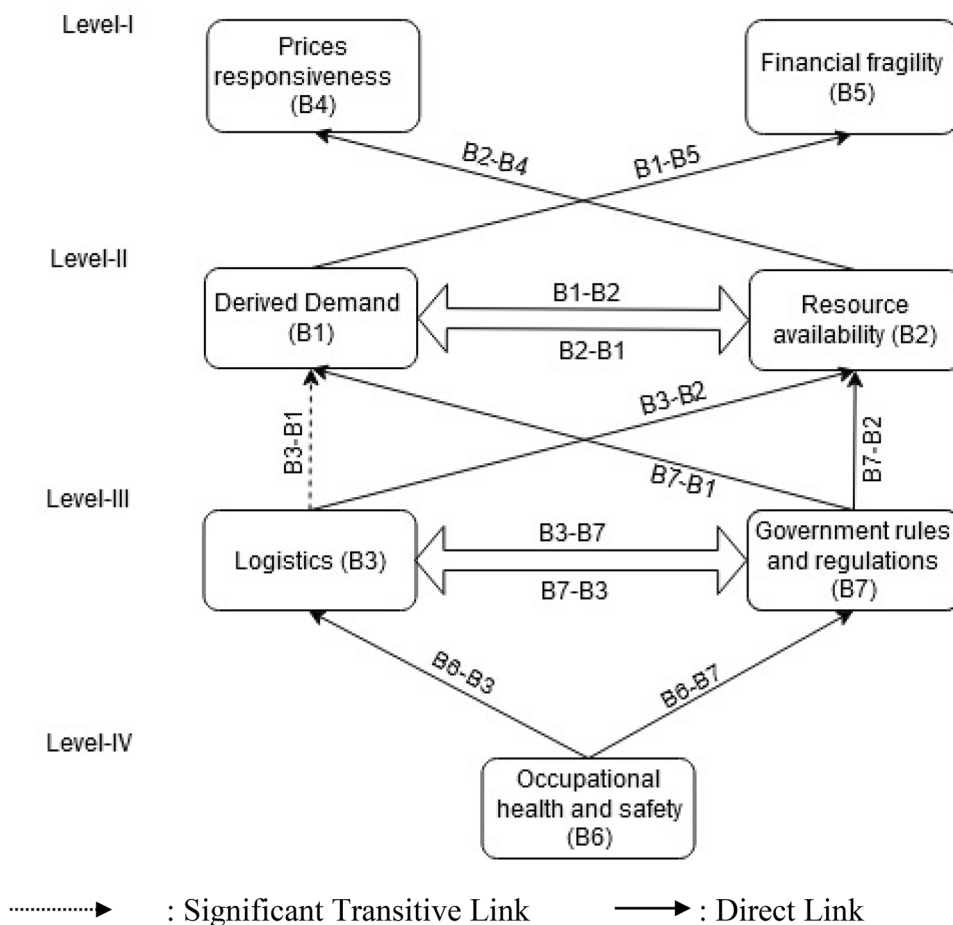
Logistics (B3) affects resource availability (B2): Movement, storage and transportation of goods, raw materials and components, were deeply affected by the Covid-19 pandemic. Border closure and the lockdown have an impact on restraining the transport capabilities, thereby affecting the

Table 5 Interaction matrix

	B1	B2	B3	B4	B5	B6	B7
B1	1	1	0	0	1	0	0
B2	1	1	0	1	0	0	0
B3	1*	1	1	0	1	0	1
B4	0	0	0	1	0	0	0
B5	0	0	0	0	1	0	0
B6	0	1	1	0	1	1	1
B7	1	1	1	0	1	0	1

* represents significant transitive links

Fig. 2 TISM model for factors affecting MSMEs repurposing operations



availability of raw materials, intermediate goods and parts, labor force, capital and equipment.

Logistics (B3) affects financial fragility (B5): Accessibility to the market is one of the crucial factors for the growth of Enterprises. Generally, MSMEs in India follow the brick-and-mortar model, which was restricted during the Covid-19 times. Some of the micro enterprises were adversely affected since there was nil operation and the businesses were experiencing a shortage in cash flow.

Logistics (B3) affects government rules and regulations (B7): The unrestricted phase in the initial stages of the pandemic has increased the spread of the virus at a very high rate. Sensing the increasing cases, government and health officials felt that a complete lockdown is essential to restrict infections contained clusters which helps in avoiding the community transmission.

Government rules and regulation (B7) affect derived demand (B1): Some of the stringent policies and rules brought by the government led to nil operation in most of the MSMEs. On the other hand, consumers were more concerned about essential goods than non-essential goods. In turn, the propensity to consume drastically reduced as a result of income loss.

Government rules and regulation (B7) affect resource availability (B2): As a result of lockdown, skilled migrant labors have relocated to their home towns and villages, which led to a lack of workforce in the enterprises. On the other hand, the enterprises face problems in the procurement of raw materials mainly because of the restrictions about logistics and social distancing. Protocols such as social distancing at the factory and warehouse were introduced to ensure the safety and health of the workers.

Government rules and regulation (B7) affect logistics (B3): The first and foremost step taken by the government to combat the spread is border closures and travel restrictions. These restrictions affected the MSMEs in transporting their goods and services from one area to another.

Government rules and regulation (B7) affect financial fragility (B5): Deliberate measures to combat the spread of the virus by the government have created maximum heat in the MSMEs especially due to liquidity crunch. Even though the spread of the virus plays a major role, government restrictions and policies have created operational difficulties in enterprises.

4.1.3 Level II: Level two have two factors, which are factors 1 and 2

Derived demand (B1) affects resource availability (B2): Reduced demand has indirectly affected availability of resources such as labor, capital and other materials. When enterprises had no production for the more than a month, lay-offs and clearance of the stocks were the primary steps taken by the MSMEs to survive the hard-hit pandemic. Idle resources were removed from the system.

Derived demand (B1) affects the financial fragility (B5): Generally, MSMEs suffer from delayed payments and also suffer from liquidity crunch to meet the Covid-19 crisis. MSMEs projected that the lack of financial support from the banking sector and government as the main reason for the struggle. The financing gap has widened with the massive demand constraint, despite the efforts taken by the government and Reserve Bank of India like lending and financing.

Resource availability (B2) affects the derived demand (B1): During Covid 19 pandemic, the non-availability of resources viz. labor, capital and other materials directly affect the desired production level.

Resource availability (B2) affects the price responsiveness (B4): As raw material prices rise due to unavailability; the product prices may increase slightly.

4.1.4 Level I: Level one has two factors, which are factor 4 and factor 5

Fluctuations in the prices of resources are affected by lack of resource availability, restrictions in logistics, health and safety of the workers and also rules and regulations framed by the government to combat the spread of the coronavirus. Derived demand, logistics, occupational health and safety, and government rules and regulation are the factors that affect the level one factor financial fragility. Cash crunch was one of the significant challenges that the MSMEs were facing during the Covid-19 emergency.

Table 7 MICMAC rank for factors affecting MSMEs' repurposing operations

Factor	Driving power	Dependence	Driving power / Dependence	MICMAC rank
B1	4	5	0.8	3
B2	4	5	0.8	3
B3	6	3	2	2
B4	1	6	0.166	4
B5	1	6	0.166	4
B6	7	1	7	1
B7	6	3	2	2

4.2 MICMAC analysis

MICMAC encompasses the classification of the identified factors into four classes (Suresh et al., 2019a, b) which is shown in Table 6.

As per the MICMAC analysis, the factors influencing MSMEs' repurposing operations during Covid-19 emergency are ranked (Suresh and Nathan 2020) in Table 7.

Figure 3 depicts the MICMAC graph. Table 6 displays the ranking of the factors affecting MSMEs' repurposing operations during the Covid-19 emergency. According to the ranking, occupational health and safety (B6), logistics (B3), and government rules and regulations (B7) are the key factors. Price responsiveness (B4) and financial fragility (B5) are the factors that are ranked fourth in the MICMAC analysis ranking.

5 TISM validation

The TISM validation has been performed using a one-tailed one-sample t-test (Yadav and Sushil 2014). For this validation, a total of 15 respondents with not less than 3.5 years of experience were nominated to further verify the interrelationship between the direct and significant

Table 6 Factor's classification using MICMAC

Class	Factor's classification	Driving power	Dependence	Factor
Class-I	Autonomous	Weak	Weak	• None
Class-II	Dependent	Weak	Strong	• Price responsiveness (B4) • Financial fragility (B5)
Class-III	Linkage	Strong	Strong	• Derived demand (B1) • Resource availability (B2)
Class-IV	Driving	Strong	Weak	• Occupational health and safety (B6) • Logistics (B3) • Government rules and regulations (B7)

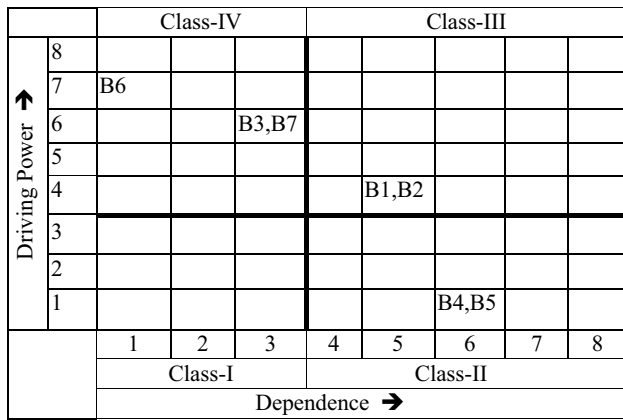


Fig. 3 MICMAC graph

factors, and quantitative analysis was performed. From the interaction matrix, a total of 16 direct and significant transitive links were considered for this validation. The five-point scale (0–4) is used to capture the responses viz. ‘no relationship’, ‘low impact’, ‘moderate impact’, ‘high impact’, and ‘very high impact’.

The proposed hypotheses are as follows (Menon and Suresh 2021b):

H0 (null hypothesis): There is no significant difference between the observed mean and the specified mean concerning the opinion of current experts.

H1 (alternate hypothesis): There is a positive significant difference between the observed mean and the specified mean concerning the opinion of current experts.

i.e., *H0*: mean (observed) – mean (specified) = 0

H1: mean (observed) – mean (specified) > 0

Here, degree of freedom = 15–1 = 14

The “hypothetical mean value” was set as 2.5 and Microsoft Excel is used for this computation. Based on the sample statistics and t-values, the results of hypotheses tested are shown in Table 8. At a 5% significance level, all those links that had a value less than 0.025 (significance value for a one-tailed test) were accepted, and other links were rejected (Suguna et al. 2021). In these 16 pair of links, majority of links were accepted except one direct link, i.e., B7-B5.

6 Discussions

MSMEs are currently facing a global shutdown/production crisis due to the Covid-19 pandemic (Kumar 2020). The economic and societal impression of the Covid-19 pandemic will be catastrophic in the long run unless MSMEs develop an appropriate repurposing strategy to restore operations and put the production target back on track to fulfil the customers' demand (Tripathy and Bisoyi 2021). The repurposing and reshaping of MSMEs operations would be dangerous to prepare before the next wave of mutant forms of the Covid-19 pandemic. MSMEs' repurposing has many implications from the government regulatory authority and the operational systems of the Covid-19 pandemic. MSMEs are usually required to repurpose their operations to achieve full functionality in the Covid-19 emergency. However, it is a process associated with many more challenges from a

Table 8 t-test results for TISM validation

SI No	Factors in Interaction Matrix		Mean	Std Dev	1-Tail t-Value	Significance (1-tailed)	Accept/Reject
	Factor-1	Factor-2					
B1/B2	Derived demand	Resource availability	2.866	0.516	2.75	0.0078	Accept
B1/B5	Derived demand	Financial fragility	2.8	0.414	2.806	0.0070	Accept
B2/B1	Resource availability	Derived demand	2.933	0.457	3.666	0.0012	Accept
B2/B4	Resource availability	Prices responsiveness	2.866	0.352	4.036	0.0006	Accept
B3/B1	Logistics	Derived demand	2.8	0.414	2.806	0.0070	Accept
B3/B2	Logistics	Resource availability	3.533	0.639	6.254	0.0000	Accept
B3/B5	Logistics	Financial fragility	3	0.654	2.958	0.0051	Accept
B3/B7	Logistics	Government rules and regulations	3.2	0.862	3.145	0.0035	Accept
B6/B2	Occupational health and safety	Resource availability	2.933	0.593	2.827	0.0067	Accept
B6/B3	Occupational health and safety	Logistics	3.066	0.457	4.795	0.0001	Accept
B6/B5	Occupational health and safety	Financial fragility	3	0.654	2.958	0.0051	Accept
B6/B7	Occupational health and safety	Government rules and regulations	3.2	0.414	6.548	0.0000	Accept
B7/B1	Government rules and regulations	Derived demand	2.866	0.516	2.75	0.0078	Accept
B7/B2	Government rules and regulations	Resource availability	3.733	0.457	10.435	0.0000	Accept
B7/B3	Government rules and regulations	Logistics	3.733	0.457	10.435	0.0000	Accept
B7/B5	Government rules and regulations	Financial fragility	2.733	0.593	1.522	0.0750	Reject

regulatory, operational/technical, and workforce perspective. According to the MICMAC analysis, occupational health and safety, logistics, government rules, and regulations were the key drivers in repurposing operations of MSMEs during the Covid-19 emergency. Close cooperation between different stakeholders is required to leverage and strategically plan for potential repurposing activities during the Covid-19 emergency (Sultana et al. 2020). The Covid-19 eruption has come in a new era, with many nations attempting to successfully control the outbreaks and protect their manufacturing and service organizations with limited resources (Her 2020).

Despite Covid-19 emergency disruptions in the workplace and outside, the safety and health climate are positively associated with employees' well-being. It is more critical than ever for MSMEs to focus on the employees' safety and health by creating a robust occupational safety and health environment. Total labor health provides a complete and accessible way for MSMEs employers to create a particularly strong health and safety climate (Brown et al. 2021). The moment order control on transport operations during the Covid-19 emergency affected MSMEs (Singh et al. 2021). MSMEs struggle to ship and deliver their products when transportation activities are banned or temporarily closed due to the pandemic (Montoya-Torres et al. 2021). Also, MSMEs had to bear the extra cost and other taxes for the storage space of their goods (Mitreęa and Choi 2021). Due to poor logistics and moment order control for MSMEs during the Covid-19 pandemic, the increased cost may be limited to an additional 5% of their total production cost (Ratnasingam et al. 2020). Government authorities enforce the mandatory rules and regulations to MSMEs during the Covid-19 emergency. Even during outbreaks, MSMEs would be subject to the penalties of these terms for violations (Bai et al. 2021). MSMEs are responding to the economic consequences of Covid-19 in a variety of ways. Half of the assessed MSMEs have lowered their output of products and services to match demand decreases and production restrictions. Occupational health and safety training, as well as logistics continuity planning, are critical to assisting firms in surviving the pandemic. These services, however, must be supplemented by robust government intervention. With cash flow being a primary concern, businesses want quick access to short-term funding, utility payment postponement, and social security contribution delay. The appropriate policies are critical to the survival of MSMEs. Despite the considerable challenges that MSMEs face, the government's reaction to the Covid-19 pandemic can help foster a good, resilient, and sustainable future for MSMEs worldwide. The subsequent sub-sections discuss on the practical and theoretical implications of the study.

6.1 Implications

Covid-19 is a global emergency. It is life-threatening in the absence of precise drugs because it frequently mutates in various forms and affects people worldwide. The Covid-19 pandemic has transformed the MSMEs' routine operations and growth worldwide, and the impact is inevitable. In this situation, the existing model can categorize the factors that can be operated, the connection factors, that help MSMEs repurposing operations. The Covid-19 emergency has disrupted the majority of MSMEs operations structure worldwide, and its impact is inevitable.

The key factors are categorized by high driving and low dependence power. This high driving power enables these factors as independent, strong and influential in driving the repurposing of MSMEs operations. These factors are also crucial in activating the factors with a low driving power. In this study, occupational health and safety, logistics, government rules, and regulations are the enablers with high driving and low dependence power. An alteration in the factors with high driving power can impact the dependent factors. In the Covid-19 pandemic, occupational health, and safety have been instrumental in accelerating the repurposing operations of the MSMEs sector. The MSMEs need to master their coordination skills with suppliers and customers during the Covid-19 emergency. The logistics and distribution activities are highly unstable regarding the government's decision on cross-border transport (Suguna et al. 2021). Furthermore, MSMEs need to strengthen existing logistics partners rather than looking for new collaborators (Mitreęa and Choi 2021). MSMEs were left with no option but to react to the Covid-19 emergency by repurposing their operations, redesigning logistics and distributions plans, and reskilling coordination for achieving seamless production. The study also pointed out the role of government rules and regulations in driving the repurposing of MSMEs operations. The government regulatory authorities and Covid-19 policymakers can play a vital role in formulating policies and employees' safety initiatives in industries that aid MSMEs in adopting the policy for their repurposing operations. The MSMEs' top management needs to formulate repurposing strategies and practices that build agility to achieve defined goals during the Covid-19 emergency.

Apart from the independent and dependent enablers, the TISM model has two linkage enablers: derived demand and resource availability. Linkage factors occupy the middle level in the TISM model, which means that they act as a mediator between the independent and dependent factors. The high dependence of these factors makes them sensitive to changes in the repurposing operations. Resource availability and derived demand of linkage factors can enhance the MSMEs' agility. The factors low in driving power and

dependence are called autonomous factors. As they are low on driving power and dependence, they usually stay disconnected in the system and are not important. This study has no self-directed factors, which displays that all the identified factors are significant and can drive repurposing operations in MSMEs. Apart from the direct links, the model also has one significant transitive link that can indirectly impact repurposing operations in MSMEs. In addition to direct links, the framework also has one link that can directly impact achieving repurposing operations in MSMEs (Table 4). Understanding the direct and transitive links will help MSMEs adopt a repurposing strategy to improve their processes and practices during the Covid-19 emergency.

The study has contributed to the literature on MSMEs repurposing operations during the Covid-19 emergency. The study has used an alternative research method, the TISM approach to build the prelim qualitative model for repurposing operations factors in MSMEs. According to Whetten (1989), any investigation ought to respond the six fundamental questions; what, how, why, who, when, and where. By applying the TISM method, the study answers the three most basic questions: what, how, and why. The first step in the theory-building process is identifying and defining the variables that constitute the theoretical framework. The identified major repurposing operations factors answer the question *what*, the contextual relationship among the factors answers *how* the factors are related, and the causality behind the established relationship answers the question *why*. The study has contributed by developing a sound theoretical model which would serve as a foundation for further empirical validation.

7 Conclusion

This study evaluates the major factors affecting the MSMEs repurposing operations persistent onset of Covid-19 emergency. However, several studies suggest the challenges MSMEs face during the Covid-19 era (Fitriasari 2020; Grondys et al. 2021). The authors of this paper used an integrated analytical approach to scientifically demonstrate the association between factors and the dependence to take the necessary steps for repurposing MSMEs operations in the Covid-19 emergency. This article identifies seven major factors that affect MSMEs' repurposing operations based on data from literature review and expert opinions. The TISM approach was utilized to analyze the factors affecting the MSMEs repurposing operations and to find their interrelatedness. The factors were graded according to its driving power and dependence, and a hierarchical structure was established in this model. The results discovered that variations in any distinct factor in the study may indirectly or

directly contribute to the repurposing operations of MSMEs in the Covid-19 emergency. According to this model, occupational health and safety, logistics, and government rules and regulations were found to be key factors. These factors were autonomously found to enforce a sturdy impact on the repurposing operations of MSMEs. Logistics, government rules, and regulations factors were the chief driving reasons that led to the derived demand and resource availability due to price responsiveness and financial fragility. The findings guide MSME managers to detect the impressions of gathered interference resulting in repurposing operations of MSMEs. This study may support them to reinforce their repurposing strategies to preserve MSMEs operations during the Covid-19 emergency.

The limitation of this study was constrained to a small sample, which holds generalization difficult, and MSMEs' experts validated the theoretical framework of the repurposing factors. The model was tested using a one-tailed one-sample t-test and found that most of the links were accepted. Only one link was rejected. i.e., government rules and regulations affect financial fragility. For establishing construct validity, an empirical study becomes imperative. This preliminary qualitative validation can be analytically confirmed by broadening the sample size and employing a statistical technique like structural equation modelling (SEM). The model helped in identifying only seven major factors. Studies in the future can explore more factors and sub-factors that are production/service sector-specific. Further, each of the direct and transitive hypothesized relationships established in this paper can be tested empirically with a large sample size and different countries.

Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose. The authors have no conflicts of interest to declare that are relevant to the content of this article. All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript. The authors have no financial or proprietary interests in any material discussed in this article.

References

- Adeola A (2016) Impact of external business environment on organizational performance of small and medium scale enterprises in Osun State, Nigeria. *Scholedge Int J Bus Policy Gov* 3(10):155. <https://doi.org/10.19085/journal.sjbp031002>
- Agarwal N, Seth N (2021) Analysis of supply chain resilience barriers in Indian automotive company using total interpretive structural modelling. *J Adv Manag Res*. <https://doi.org/10.1108/JAMR-08-2020-0190>

- Ahmed S, Sur S (2021) Change in the uses pattern of digital banking services by Indian rural MSMEs during demonetization and Covid-19 pandemic-related restrictions. *Vilakshan-XIMB J Manag.* <https://doi.org/10.1108/XJM-09-2020-0138>
- Alekseev G, Amer S, Gopal M, Kuchler T, Schneider J, Stroebel J, Wernerfelt N (2020) The effects of Covid-19 on U.S. small businesses: Evidence from owners, managers, and employees. *SSRN Electron J.* <https://doi.org/10.2139/ssrn.3692733>
- Aurélio de Oliveira M, Dalla Valentina LVO, Possamai O (2012) Forecasting project performance considering the influence of leadership style on organizational agility. *Int J Product Perform Manag* 61(6):653–671
- Bai C, Quayson M, Sarkis J (2021) COVID-19 Pandemic Digitization Lessons for Sustainable Development of Micro-and Small-Enterprises. *Sustain Prod Consum* 27:1989–2001
- Bartik A, Cullen Z, Bertrand M, Glaeser EL, Luca M, Stanton C (2020) How are small businesses adjusting to COVID-19? Early evidence from a survey. *SSRN Electron J.* <https://doi.org/10.2139/ssrn.3570896>
- Brown CE, Schwatka N, Dexter L, Dally M, Shore E, Tenney L, Newman LS (2021) The Importance of Small Business Safety and Health Climates during COVID-19. *J Occup Environ Med* 63(2):81–88
- Cherrafi A, Elfezazi S, Garza-Reyes JA, Benhida K, Mokhlis A (2017) Barriers in Green Lean implementation: a combined systematic literature review and interpretive structural modelling approach. *Prod Plan Control* 28(10):829–842
- Chillayil J, Suresh M, Viswanathan PK, Kottayil SK (2021) Is imperfect evaluation a deterrent to adoption of energy audit recommendations? *Int J Product Perform Manag.* <https://doi.org/10.1108/IJPPM-05-2020-0236>
- Deshmukh SG, Haleem A (2020) Framework for manufacturing in post-COVID-19 world order: An indian perspective. *Int J Glob Bus Compet* 15(1):49–60. <https://doi.org/10.1007/s42943-020-00009-1>
- Djalante R, Lassa J, Setiamarga D, Sudjatma A, Indrawan M, Haryanto B, Mahfud C, Sinapoy MS, Djalante S, Rafflesia I, Gunawan LA, Surtiari GAK, Warsilah H (2020) Review and analysis of current responses to COVID-19 in Indonesia: Period of January to March 2020. *Prog Disast Sci* 6:100091. <https://doi.org/10.1016/j.pdisas.2020.100091>
- Dubey R, Gunasekaran A, Sushil, Singh T (2015) Building theory of sustainable manufacturing using total interpretive structural modelling. *Int J Syst Sci Oper Logist* 2(4):231–247
- Fitriasari F (2020) How do Small and Medium Enterprise (SME) survive the COVID-19 outbreak?. *Jurnal Inovasi Ekonomi* 5(02):53–62. <https://ejournal.umm.ac.id/index.php/JIKO/article/view/11838/7934>. Accessed date 1 Jul 2021
- Fumo NDG, Jabbour CJC (2011) Barriers faced by MSEs: evidence from Mozambique. *Ind Manag Data Syst* 111(6):849–868
- Gardas BB, Raut RD, Narkhede BE (2017) A state-of-the-art survey of interpretive structural modelling methodologies and applications. *Int J Bus Excell* 11(4):505–560
- Grondys K, Ślusarczyk O, Hussain HI, Androniceanu A (2021) Risk assessment of the SME sector operations during the COVID-19 pandemic. *Int J Environ Res Public Health* 18(8):4183
- Hausman A (2005) Innovativeness among small businesses: Theory and propositions for future research. *Ind Mark Manag* 34(8):773–782
- Her M (2020) Repurposing and reshaping of hospitals during the COVID-19 outbreak in South Korea. *One Health* 10:100137
- IBEF (2020) MSMEs in India – Pad for the next economic leap. <https://www.ibef.org/blogs/msmes-in-india-pad-for-the-next-economic-leap>. Accessed 1 Jul 2021
- Jena J, Sidharth S, Thakur LS, Pathak DK, Pandey VC (2017) Total interpretive structural modeling (TISM): approach and application. *J Adv Manag Res* 14(2):162–181
- Kumar NP (2020) Impact of COVID -19 on MSMEs in India. *Int J Mod Trends Sci Technol* 6(6):76–79. <https://doi.org/10.46501/ijmst060617>
- Lakshmi Priyadarsini S, Suresh M, Huisingh D (2020) What can we learn from previous pandemics to reduce the frequency of emerging infectious diseases like COVID-19? *Glob Transit.* <https://doi.org/10.1016/j.glt.2020.09.003>
- Mathivathanan D, Mathiyazhagan K, Rana NP, Khorana S, Dwivedi YK (2021) Barriers to the adoption of blockchain technology in business supply chains: a total interpretive structural modelling (TISM) approach. *Int J Prod Res* 59(11):3338–3359
- Mehrotra A, Anand A, Gayatri, Nayak M, Srivastava M, Narain N, Mishra S, Sood S (2020) Impact of COVID-19 pandemic on micro, small, and medium enterprises (MSMEs). *Micro Save Consulting.* <https://www.microsave.net/wp-content/uploads/2020/06/Impact-of-COVID-19-pandemic-on-micro-small-and-medium-enterprises-MSMEs-India-report-1.pdf>. Accessed 11 Jul 2021
- Menon S, Suresh M (2019) Total interpretive structural modelling: Evolution and applications. In *International Conference on Innovative Data Communication Technologies and Application* (pp 257–265). Springer, Cham
- Menon S, Suresh M (2021a) Enablers of workforce agility in engineering educational institutions. *J Appl Res High Educ* 13(2):504–539
- Menon S, Suresh M (2021b) Factors influencing organizational agility in higher education. *BIJ* 28(1):307–332
- Mitrega M, Choi TM (2021) How small-and-medium transportation companies handle asymmetric customer relationships under COVID-19 pandemic: A multi-method study. *Transport Res E-Log* 148:102249
- Montoya-Torres JR, Muñoz-Villamizar A, Mejia-Argueta C (2021) Mapping research in logistics and supply chain management during COVID-19 pandemic. *Int J Log Res Appl* 1–21
- Nendissa D, Olviana T, Kapioru C (2020) The impact of the covid-19 pandemic on price disparities and fluctuations of shallots in traditional markets. *Russ J Agric Soc-Econ Sci* 103(7):113–119. <https://doi.org/10.18551/rjoas.2020-07.14>
- Patil M, Suresh M (2019) Modelling the enablers of workforce agility in IoT projects: A TISM approach. *Glob J Flex Syst Manag* 20(2):157–175
- Rajan (2020) PSBs luring MSMEs with pre-approved loans. *Mf or Bank.* <https://mforbank.com/psbs-luring-msmes-with-pre-approved-loans/>. Accessed 1 Jul 2021
- Ramesh P, Vinodh S (2021) Analysis of factors influencing energy consumption of material extrusion-based additive manufacturing using interpretive structural modelling. *Rapid Prototyping Journal* 27(7):1363–1377
- Ramiya S, Suresh M (2021) Factors influencing lean-sustainable maintenance using TISM approach. *Int J Syst Assur Eng Manag.* <https://doi.org/10.1007/s13198-021-01304-7>
- Ratnasingam J, Khoo A, Jegathesan N, Wei LC, Abd Latib H, Thanasegaran G, Amir MA (2020) How are small and medium enterprises in Malaysia’s furniture industry coping with COVID-19 pandemic? Early evidences from a survey and recommendations for policymakers. *BioResources* 15(3):5951–5964
- Raut R, Priyadarshinee P, Jha M, Gardas BB, Kamble S (2018) Modeling the implementation barriers of cloud computing adoption: an interpretive structural modeling. *BIJ* 25(8):2760–2782
- Sahu AK, Padhy RK, Dhir A (2021) Determinants and barriers of implementing lean manufacturing practices in MSMEs: a behavioural reasoning theory perspective. *Prod Plan Control.* <https://doi.org/10.1080/09537287.2020.1857449>
- Sarkar A (2020) Impact of COVID-19 on MSME sector in India. *Jamshedpur Res Rev* 6(43):34–39
- Sedani CM, Lakhe RR (2011) ISO certification and business performance: empirical findings of Indian SMEs. *Int J Bus Excell* 4(6):715–730

- Seo D, La Paz AI (2008) Exploring the dark side of IS in achieving organizational agility. *Commun ACM* 51(11):136–139. <https://doi.org/10.1145/1400214.1400242>
- Shafi M, Liu J, Ren W (2020) Impact of COVID-19 pandemic on micro, small, and medium-sized Enterprises operating in Pakistan. *Res Glob* 2:100018. <https://doi.org/10.1016/j.resglo.2020.100018>
- Sharma RK, Kharub M (2015) Qualitative and quantitative evaluation of barriers hindering the growth of MSMEs. *Int J Bus Excell* 8(6):724–747
- Singh A (2020) What About India's MSME Sector: COVID-19 Pandemic and Indian MSME Sector Outlook. *SSRN Electron J*. <https://doi.org/10.2139/ssrn.3696778>
- Singh S, Kumar R, Panchal R, Tiwari MK (2021) Impact of COVID-19 on logistics systems and disruptions in food supply chain. *Int J Prod Res* 59(7):1993–2008
- Sreenivasan A, Suresh M (2021) Modeling the enablers of sourcing risks faced by startups in COVID-19 era. *J Glob Oper Strategic Sourcing*. <https://doi.org/10.1108/JGOSS-12-2020-0070>
- Sridhar V (2020) An Empty Package, *Frontline*, June 5. <https://frontline.thehindu.com/cover-story/article31658653.ece>. Accessed 1 Jul 2021
- Suguna M, Shah B, Raj SK, Suresh M (2021) A study on the influential factors of the last mile delivery projects during Covid-19 era. *Oper Manag Res*. <https://doi.org/10.1007/s12063-021-00214-y>
- Sultana J, Crisafulli S, Gabbay F, Lynn E, Shakir S, Trifirò G (2020) Challenges for drug repurposing in the COVID-19 pandemic era. *Front Pharmacol* 11:1657
- Sushil S (2012) Interpreting the interpretive structural model. *Glob J Flex Syst Manag* 13(2):87–106
- Suresh M, Nathan RAR (2020) Readiness for lean procurement in construction projects. *Constr Innov* 20(4):587–608
- Suresh M, Ganesh S, Raman R (2019a) Modelling the factors of agility of humanitarian operations. *Int J Agile Syst Manag* 12(2):108–123
- Suresh M, Mahadevan G, Abhishek RD (2019b) Modelling the factors influencing the service quality in supermarkets. *Int J Syst Assur Eng Manag* 10(6):1474–1486
- Suresh M, Roobaswathiny A, Lakshmi Priyadarsini S (2021) A study on the factors that influence the agility of COVID-19 hospitals. *Int J Healthc Manag* 14(1):290–299
- Tallon PP, Pinsonneault A (2011) Competing perspectives on the link between strategic information technology alignment and organizational agility: Insights from a mediation model. *MIS Q* 35(2):463. <https://doi.org/10.2307/23044052>
- Tripathi A (2020) Covid-19 affect on Micro, Small and Medium Enterprises (MSMEs). *Times of India Blog*. (2020, September 23). <https://timesofindia.indiatimes.com/blogs/agyeya/covid-19-affect-on-micro-small-and-medium-enterprises-msmes/>. Accessed 1 Jul 2021
- Tripathy S, Bisoyi T (2021) Detrimental impact of COVID-19 pandemic on micro, small and medium enterprises in India. *Jharkhand J Dev Manag Stud* 19(1):8651–8660
- Unni J (2020) Impact of COVID-19 on Informal Economy: The Revival. *Indian J Labour Econ* 63(S1):113–118. <https://doi.org/10.1007/s41027-020-00265-y>
- Vaishnavi V, Suresh M (2020) Modelling of readiness factors for the implementation of Lean Six Sigma in healthcare organizations. *Int J Lean Six Sigma*. <https://doi.org/10.1108/IJLSS-12-2017-0146>
- Vaishnavi V, Suresh M, Dutta P (2019a) A study on the influence of factors associated with organizational readiness for change in healthcare organizations using TISM. *BIJ* 26(4):1290–1313
- Vaishnavi V, Suresh M, Dutta P (2019b) Modelling the readiness factors for agility in healthcare organization: a TISM approach. *BIJ* 26(7):2372–2400
- Vasanthakumar C, Vinodh S, Ramesh K (2016) Application of interpretive structural modelling for analysis of factors influencing lean remanufacturing practices. *Int J Prod Res* 54(24):7439–7452
- Veselovská L (2020) Supply chain disruptions in the context of early stages of the global COVID-19 outbreak. *Probl Perspect Manag* 18(2):490–500. [https://doi.org/10.21511/ppm.18\(2\).2020.40](https://doi.org/10.21511/ppm.18(2).2020.40)
- Virmani N, Bera S, Kumar R (2020) Identification and testing of barriers to sustainable manufacturing in the automobile industry: a focus on Indian MSMEs. *Benchmarking: An International Journal* 28(3):857–880
- Viscusi WK (1979) The impact of occupational safety and health regulation. *Bell J Econ* 10(1):117. <https://doi.org/10.2307/3003322>
- Wankhede VA, Vinodh S (2021) Application of total interpretive structural modeling for analyzing factors of additive manufacturing and industry 4.0 integration. *Rapid Prototyp J* 27(8):1591–1608
- Warfield JN (1976) Implication structures for system interconnection matrices. *IEEE Trans Syst Man Cybern* (1):18–24
- Whetten DA (1989) What constitutes a theoretical contribution? *Acad Manag Review* 14(4):490–495
- Yadav N, Sushil (2014) Total interpretive structural modelling (TISM) of strategic performance management for Indian telecom service providers. *Int J Product Perform Manag* 63(4):421–445

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