INTERPRETIVE STRUCTURAL MODELING (ISM): A LITERATURE REVIEW

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Abstract: This paper presents a comprehensive literature review on Interpretive Structural Modeling (ISM), focusing on its application across various sectors to enhance operational efficiency. ISM is a powerful methodological tool used to analyze complex systems by identifying and modeling relationships among specific variables. Through an extensive examination of existing literature, this review aims to provide a detailed understanding of ISM's theoretical underpinnings, methodological advancements, and practical implementations. The review synthesizes key findings from a diverse range of studies, highlighting the versatility and efficacy of ISM in addressing multifaceted challenges across different industries. By exploring case studies, scholarly articles, and empirical research, this paper seeks to map out the evolution of ISM, its current applications, and future potential. The review emphasizes the role of ISM in dissecting complex problems, facilitating strategic decision-making, and improving operational processes. This literature review aspires to serve as a valuable resource for researchers and practitioners, offering insights into the methodological nuances of ISM and its significant contributions to enhancing operational efficiency in various contexts.

Index Terms - ISM, ISM-based model, Driving power- dependence analysis

I. INTRODUCTION

Globalization has intensified business competitiveness, allowing numerous players to establish themselves in international markets. Historically, economic prosperity was perceived to be driven primarily by large-scale institutions. However, this notion is shifting as Small and Medium-Sized Enterprises (SMEs) are increasingly recognized for their crucial role in the economic wealth and development of nations. Despite their significance, SMEs face numerous challenges, including the struggle to operate sustainably on a smaller scale.

Many contemporary manufacturing management approaches are tailored for large, scientifically controlled enterprises, making their implementation in SMEs challenging due to the latter's often non-scientific management styles. Innovation integration, however, can significantly benefit SMEs (Kiron & Kannan, 2014). In this context, employing robust manufacturing management models is essential for SMEs.

Interpretive Structural Modelling (ISM) is a well-established methodology for identifying and analysing relationships among specific elements that define complex problems or issues (Rajesh et al., 2013). ISM is versatile, finding applications across various fields beyond specific sectors. This literature review aims to comprehensively explore the development, methodology, and diverse applications of ISM. By examining key studies and case applications, the review will highlight ISM's role in enhancing operational efficiency, strategic decision-making, and problem structuring. This review will serve as a valuable resource for researchers and practitioners, providing insights into the theoretical and practical advancements of ISM.

II. LITERATURE REVIEW

Literature was systematically reviewed to assess the benefits of ISM. In the later stage, the review was limited to the ISM implementation in manufacturing SMEs, the benefits of that implementation and the implementation in Indian economy as well. Interpretive Structural Modeling (ISM) has emerged as a powerful methodology with versatile applications, transcending industry boundaries (Kiron & Kannan, 2014). Researchers have explored how ISM helps to understand relationships within. Additionally, ISM proves instrumental in Small and Medium-sized Enterprises (SMEs), offering a nuanced understanding of the complexities and driving internal changes within these enterprises (Sharma et.al., 2015). Additional information regarding SMEs were also collected for reference (Hasanah et.al., 2023) (Kiron & Kannan, 2015) (Kiron & Kannan, 2018).

The ISM model was referred from different literatures. The model and adaptation and assumptions were inferred and provided for practical analysis (Deepak et.al., 2018) (Usmana et.al., 2018) (Sanjay et.al., 2013) (Mishra et.al., 2023) (Fauzdar et.al., 2022).

In the manufacturing sector, ISM has been applied to analyze human failure probability in railway maintenance tasks, contributing to the identification and analysis of factors affecting the probability of human failure (Dehghani et.al, 2018). Its role extends to sustainable manufacturing practices in the automotive component sector, elucidating the interrelation between economic prosperity, environmental well-being, and social well-being (Thirupathi & Vinodh, 2016). Furthermore, ISM has been utilized to interpret structural models, evolving into Total Interpretive Structural Modeling (TISM), which offers a deeper knowledge about the system by involving experts in the interpretive logic of all relations (Sushil, 2012).

In the case of Indian economy, we have solid proven literatures which suggest that the ISM can be implemented with ease. In the Indian telecom sector, using interpretive structural modeling (ISM) helps uncover key enabler connections and offers a practical roadmap for seamless integration, echoing insights from established economic literature (Pramod & Banwet, 2015). Examining sustainability in Coimbatore's SMEs, our study uncovers key drivers like 'top management commitment,' 'organizational ethics,' and 'associations or networks' through interpretive structural modeling (ISM), shedding light on the forces shaping sustainability practices in this vibrant business landscape (Maheshwari & Kavitha, 2020). Exploring sustainable production systems (SPS), the study conducted by (Srinivas Kota et.al., 2021), utilizing interpretive structural modeling (ISM), identifies and consolidates 13 critical success factors (CSFs) in the consumer durable industry. Notably, customer demand and management commitment emerge as key drivers, guiding implementation through innovations and efficient operations.

In the realm of risk management, ISM provides a framework for interpretive analysis of risk sources in virtual organizations, aiding in decision-making and strategy formulation (Alawamleh & Popplewell, 2011). The study on lean manufacturing practices in Bulgarian SMEs showcases ISM's role in identifying and prioritizing enablers for successful lean adoption, emphasizing its practicality in strategic and tactical decision-making (Prasad et.al., 2021). The application of ISM in the context of the telecom service supply chain within India emphasizes its practicality in establishing and validating structural relationships among critical components within this sector (Sharma et.al. 2015). In the case of BIM adoption barriers in construction SMEs, ISM serves to develop a hierarchical model, shedding light on the sociotechnical complexities of the adoption process (Saka & Chan, 2020).

Collectively, these studies underscore the versatility of ISM, showcasing its efficacy in unraveling complex relationships, driving internal changes, and providing valuable insights across diverse sectors.

ISM in Manufacturing SMEs

Small and Medium-sized Enterprises (SMEs) play a crucial role in the economic development. ISM has proven to be a valuable tool in understanding and transforming this sector. In the context of SMEs, ISM offers a nuanced perspective, facilitating a comprehensive comprehension of the intricate relationships within these entities (Sharma et.al. 2015). The application of ISM in Bulgarian SMEs provides insights into the enablers for successful lean manufacturing practices, offering a practical approach to prioritize and manage these enablers at strategic and tactical levels (Prasad et.al., 2021).

Additionally, ISM has been instrumental in exploring the barriers to BIM adoption in construction SMEs, providing a structured hierarchical model that highlights the sociotechnical complexities of the adoption process (Saka & Chan, 2020). Through these applications, ISM emerges as a versatile methodology, aiding SMEs in navigating internal changes, strategic decision-making, and overcoming barriers to technological adoption.

In the manufacturing domain, ISM proves to be a valuable asset for analyzing and optimizing various processes. Its application in the analysis of human failure probability in railway maintenance tasks contributes to the identification of factors affecting the probability of human failure (Dehghani et.al, 2018). Furthermore, ISM extends its utility to sustainable manufacturing practices, providing a comprehensive understanding of the interrelationships between economic prosperity, environmental well-being, and social well-being in the automotive component manufacturing sector (Thirupathi & Vinodh, 2016).

Moreover, ISM has been applied in the interpretation of structural models, leading to the evolution of Total Interpretive Structural Modeling (TISM) (Sushil, 2012). This adaptation enhances the interpretive logic of all relations, creating a knowledge base for structural modeling within manufacturing contexts. The studies collectively highlight ISM's pivotal role in enhancing manufacturing practices, reducing human errors, and providing a comprehensive understanding of the complex interplay of factors within the manufacturing landscape.

This comprehensive literature review showcases the broad applicability of ISM across diverse sectors, emphasizing its role in unraveling complex relationships, driving internal changes, and providing valuable insights into SMEs and manufacturing contexts.

Collectively, these studies underscore ISM's adaptability and efficacy, encouraging future explorations in uncharted domains such as energy, safety, and burgeoning technologies (Bhattacharya et.al., 2016) (Sing et.al., 2017) (Raju & Sushil, 2009). The continuous advancements and integrations, coupled with the potential for novel applications, highlight ISM's enduring relevance as a strategic analytical tool in contemporary organizational landscapes.

III. RESULTS

From the literature review, several key inferences about Interpretive Structural Modelling (ISM) have been drawn:

- Broad Applicability and Versatility: ISM has been applied across a wide range of domains, such as virtual organizations, Total Quality Management (TQM) in service-oriented organizations, and sustainable practices in the automotive industry. This demonstrates ISM's versatility in handling complex and diverse problems.

- Improved Decision-Making: ISM significantly enhances decision-making processes by identifying and analysing complex interrelationships within organizations. This enables more strategic and informed decisions, crucial for operational efficiency and sustainability.

- Hierarchical Analysis: ISM's ability to structure hierarchical relationships among various factors allows organizations to prioritize actions systematically. This is particularly evident in the application of TQM practices, where ISM helps in mapping out the most effective practices to improve business performance and customer satisfaction.

- Integration with Statistical Methods: The integration of ISM with statistical methods like Structural Equation Modelling (SEM) adds rigor to the analysis, providing statistically validated insights. This enhances the robustness and credibility of ISM applications across different sectors.

- Synergy with Other Methodologies: Combining ISM with methodologies like Quality Function Deployment (QFD) has proven beneficial, especially in niche industries such as mat manufacturing. This synergy provides a comprehensive framework for tackling industry-specific challenges.

- Potential for Future Applications: The literature indicates significant potential for applying ISM in emerging fields such as energy, safety, and new technologies. The ongoing advancements in ISM methodologies suggest its enduring relevance and adaptability to future challenges.

IV. CONCLUSION

The literature review confirms that Interpretive Structural Modelling (ISM) is a powerful and adaptable tool for analysing complex systems and enhancing decision-making processes across various domains. ISM's ability to model interrelationships and provide hierarchical insights makes it indispensable for improving operational efficiency and strategic planning.

The integration of ISM with advanced statistical techniques and its synergy with other methodologies like QFD further extend its applicability and effectiveness. These integrations not only validate the insights derived from ISM but also provide a more comprehensive understanding of complex organizational issues.

Future research should explore ISM's application in new and emerging fields to fully leverage its potential. The continuous development and integration of ISM with other methodologies promise to address contemporary and future challenges effectively, reinforcing its position as a critical analytical tool in diverse organizational settings.

Overall, ISM stands out as a robust methodology for researchers and practitioners seeking to navigate and resolve the intricacies of modern organizational environments.

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