The TQM Journal, Available online 18 December 2023
DOI:10.1108/TQM-08-2023-0254

The Analysis of Critical Success Factors for Successful Kaizen Implementation During the COVID-19 Pandemic: A Textile Industry Case Study

Yigit Kazancoglu, Cisem Lafci, Yalcin Berberoglu, Sandeep Jagtap and Cansu Cimitay Celik

Abstract

Design/methodology/approach: This study employs a structured approach to determine critical success factors (CSFs) for successful Kaizen implementation in the textile industry. The Triple Helix Actors structure, comprising business, academia, and government representatives, is utilized to uncover essential insights. Additionally, the Matriced Impacts Croises-multiplication Applique and Classement (MICMAC) analysis and Interpretative Structural Modeling (ISM) techniques are applied to evaluate the influence of CSFs.

Purpose: The primary objective of this research is to determine CSFs that enable textile enterprises to effectively implement Kaizen, a Japanese concept of continuous development, particularly during disruptive situations. The study aims to provide insights into how Kaizen is specifically employed within the textile sector and to offer guidance for addressing future crises.

Findings: The research identifies 17 CSFs for successful Kaizen implementation in the textile industry through a comprehensive literature review and expert input. These factors are organized into a hierarchical structure with 5 distinct levels. Additionally, the application of the MICMAC analysis reveals three clusters of CSFs: linkage, dependent, and independent, highlighting their interdependencies and impact.

Originality/value: Major contribution of this study is understanding how Kaizen can be effectively utilized in the textile industry, especially during disruptive events. The combination of the Triple Helix Actors structure, MICMAC analysis, and ISM provides a unique perspective on the essential factors driving successful Kaizen implementation. The identification of CSFs and their categorization into clusters offer valuable insights for practitioners, policymakers, and academia seeking to enhance the resilience and sustainability of the textile industry.

Keywords: Critical success factors, kaizen, Textile industry, Continuous improvement, Decision making, Total Quality Management.

1. Introduction

The textile sector has long been a pillar of global trade and economic expansion, significantly influencing employment and commercial activity (Farhana et al., 2022). However, a variety of challenges confront the industry, including shifting consumer demands, fierce competition, and disruptive events that can significantly affect operations (Tseng et al., 2022). One such disruptive event that had a significant global impact was the coronavirus disease outbreak (COVID-19). According to Mishra et al. (2023), the coronavirus pandemic recently had a significant impact on global industries and altered market dynamics. Industries, especially the textile industry, have faced severe hurdles because of the epidemic. Production capabilities, consumer needs, and global supply chains (SCs) have all altered. The market has proven resilient in the face of these difficulties, as evidenced by the rising demand for basics like masks, protective clothes, and medical fabrics. In such a scenario, a continuous improvement technique is required to address these complexities, maintain resilience, overcome barriers, and ensure a sustainable future.

Kaizen is a compound word made up of the concepts of "Kai" (change) and "Zen" (for the better) (Singh & Singh, 2009; Palmer, 2001). It is well known that the Japanese philosophy of kaizen, or continuous improvement, is a successful strategy for raising output, cutting waste, and streamlining business operations (Janjić et al., 2020). All employees should be involved in identifying issues, putting improvements into place, and promoting a culture of continuous learning, according to the principles of Kaizen (Deming, 1995). Although Kaizen has been thoroughly researched and applied in many different industries (Brunet & New, 2003), more research is needed, particularly in the perspective of emerging countries textile industries, to better understand its specific application and critical success factors (CSFs) during disruptive times like the COVID-19 outbreak.

The textile industry has been determined as a case study for implementing Kaizen to improve adaptability resulting from the pandemic which has highlighted the value of resilience and adaptation. Despite studies on Kaizen implementation in manufacturing and healthcare, little research has been done on the textile industry. Hence, there is a research gap in the area of how Kaizen is implemented in the textile sector during emergencies like the COVID-19 pandemic, which emphasizes the need for more investigation. The study aims to reveal key factors affecting successful Kaizen implementation in the textile industry, especially during the COVID-19 pandemic. It provides insights and techniques for sustainable growth and development, helping organizations manage challenges by bridging the gap between theoretical understanding and practical. The study's originality and uniqueness stem from its comprehensive analysis of CSFs for effective Kaizen implementation in the textile sector, which examined them from the perspectives of industry, government, and academia, and incorporated the concept of Triple Helix Actors. effectively. By combining these many points of view, this study goes beyond standard research bounds, providing practical recommendations and advice for those who make decisions, addressing the gap between practice and theory, and encouraging textile companies to cope with disruptive circumstances such as the COVID-19 pandemic as a contribution to the existing literature. Understanding the unique CSFs for implementing Kaizen during disruptive periods is necessary because the sector depends on labor-intensive processes and a multinational supply network. The employment and economic growth of emerging economies, as well as the COVID-19 pandemic's emphasis on adaptation and swift change, depend on filling this research deficit. By analyzing the CSFs and Kaizen implementation tactics during such disruptions, this research can provide textile firms with useful guidance on how to better manage upcoming crises. This study focuses on the CSFs for implementing Kaizen in the textile sector during disruptive periods, with a specific emphasis on the COVID-19 outbreak. Insights into the successful application of Kaizen concepts by textile industries are provided via a case study on the developing economy. In order to boost businesses' resilience and adaptability, the study will examine CSFs that facilitate effective Kaizen implementation and offer recommendations for how to adapt or improve Kaizen practices. In accordance, below mentioned RQs were proposed.

RQ1: What are the CSFs that facilitate effective Kaizen implementation within the textile industry during disruptive times like the COVID-19 pandemic?

RQ2: Which CSFs have significance from the perspectives of industry, government, and academia to help textile organizations implement Kaizen principles successfully?

For businesses looking to successfully navigate disruptive situations like the COVID-19 pandemic, examining the CSFs that support efficient Kaizen implementation within the textile industry is crucial. Understanding these elements can help decision-makers maximize the advantages of Kaizen implementation during disruptions and gain insight into the CSFs. As a result, to properly explore the relevant aspects from the viewpoints of industry, academia, and the government, this study combined Triple Helix Actors while examining the CSFs. This case study provides insightful guidance for textile businesses applying Kaizen in challenging circumstances like the COVID-19 pandemic. It offers advice on overcoming obstacles and constraints, empowering companies to manage competitive, resilient, and long-term growth. Hence, the research employs interpretive structural modeling (ISM) and Matriced Impacts Croises-multiplication Applique and Classement (MICMAC) analysis as methodologies to investigate the identified CSFs from the literature review, aiming to uncover and emphasize their significance.

The reason why we have integrated the Triple Helix Actors into our study is because these actors each provide a variety of resources, skills, and viewpoints, which together produce results that are advantageous to both parties. To boost innovation, it specifically promotes the development of stronger partnerships between academics, the industry, and the government (Razak & White, 2015). The three key players in the triple helix—business, academia, and government—are essential for societal development, economic expansion, and innovation. For financial stability, leadership commitment, and operational expertise, industry engagement is crucial. Kaizen principles need scholarly investigation, instruction, and knowledge sharing. The federal government's assistance to these players in the triple helix is crucial for fostering cooperation, encouraging innovation and economic growth, and creating the right conditions for the implementation of kaizen.

Because, a supportive legislative and regulatory environment, collaborative opportunities, and the development of an environment that encourages continual improvement are all important functions of the government. Thereby, this research offers insightful remarks and suggestions for each actor to increase their engagement by taking into account the distinctive contributions of industry, academia, and government within the triple helix players (see Figure 1 below).

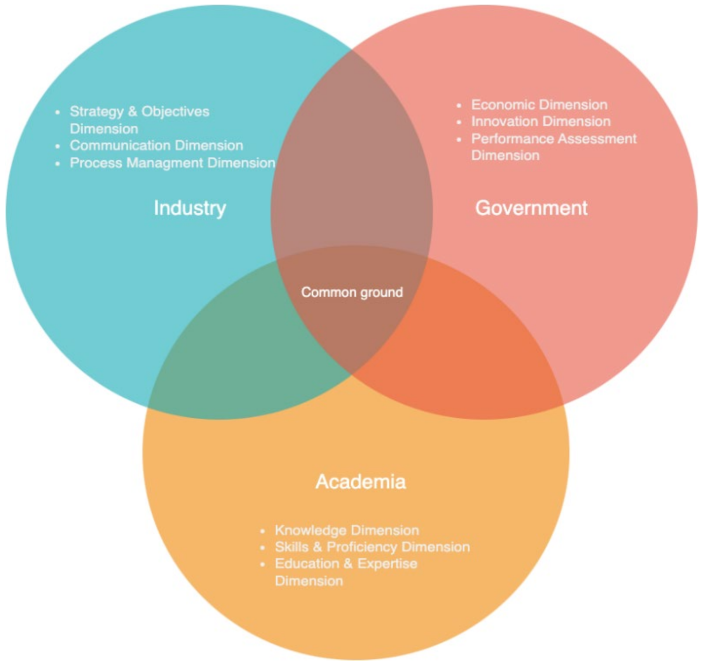

Figure 1 CSFs for Kaizen Implementation Under Triple Helix Actors Perspective (Figure by Authors)

The study's structure is as follows: in section 2, comprehensive information about the Kaizen philosophy and a literature review of Kaizen implementations and CSFs in the textile industry have been examined. In section 3, the conceptual framework of the study was presented by identifying the CSFs. Then, the methodology of the study has been described along with its steps in section 4. In addition, case implementations and the analysis's findings have been presented in section 5. Section 6 contains discussion of the findings and implications. Lastly, the study concluded in the 7th section.

2. Background

This study focuses on how Kaizen is used in the textile industry, emphasizing how important it is to improve operational efficiency and competitiveness. Industry-wide challenges make Kaizen principles and practices essential to maintaining innovation, adaptability, and competitive advantage. By applying Kaizen, textile companies can improve their production processes, reduce waste, streamline operations, and react quickly to market changes. Relevant studies including research articles, case studies, and industry reports were thoroughly reviewed to identify CSFs for the purpose of effective execution. This section tries to identify critical factors influencing successful implementation and provide analysis and insights to help textile organizations apply Kaizen principles for sustainable growth and development.

2.1. Kaizen Philosophy

Japanese philosophy and methodology known as "kaizen" emphasizes constant change for the better. According to Rochmawati (2013), kaizen places special focus on two key ideas: the philosophy of continuous improvement and how it connects to the tools and methods utilized in quality improvement to meet customer expectations. Finding and removing waste, enhancing quality, and optimizing processes, involve everyone in an organization, from top management to frontline staff. Instead of focusing on radical transformations, kaizen emphasizes small, gradual changes that have a significant long-term impact. It encourages a culture of cooperation, involvement, and process ownership. Thereby, the goal of Kaizen is to promote continuous improvement across all areas of an organization with a focus on reducing waste, enhancing quality, increasing productivity, and empowering staff. Gemba Walk, PDCA (Plan-Do-Check-Act) Cycle, 5S Methodology, and Value Stream Mapping (VSM) are just a few of the Kaizen techniques and applications.

Kaizen is a philosophy and methodology that emphasizes empowerment, continuous change, and change for the better. To support initiatives for continuous improvement, it makes use of a variety of techniques and tools, including the PDCA Cycle, 5S Methodology, Gemba Walk, and VSM. Kaizen seeks to increase effectiveness, quality, and productivity within a company by locating and eliminating waste.

The origins of Kaizen rely on General Douglas MacArthur reconstruction of Japan's economy following World War II based on free markets, concentrating on democratizing market reform initiatives and employee involvement, which gave rise to Kaizen (Soltero & Waldrip, 2002). The Kaizen event, a systematic continuous improvement effort comprising a cross-functional team to address a particular work area and achieve defined goals in a limited amount of time (often one week or less), is becoming more and more popular in lean manufacturing (Farris et al., 2009; 2008). Moreover, Kaizen refers to ongoing improvement at work that involves both managers and employees (Suárez-Barraza et al., 2011). According to Masaki Imai's definition in "Kaizen, the Key to Success" from 1994, which calls for continual improvement in one's personal, home, social, and professional life, the concept of Kaizen is the key to an organization's success in ensuring competitiveness Vieira et al., (2012). Kaizen places a strong emphasis on continual improvement and believes that management should be responsible for upholding and raising working standards (Alvarado-Ramírez et al., 2018; Wittenberg, 1994).

Many business owners and competitive managers who were keen to implement approaches that would support the fiercely competitive climate in which they operated adopted the Kaizen mindset García et al., (2013). Tools like Poka Yoke, JIT, Kanban, and Kaizen are used in lean manufacturing optimization, which is essential for businesses to maintain a competitive advantage and optimize operations (Rivera-Mojica & Rivera-Mojica, 2014).

Although the use of Kaizen has been extensively researched and recognized as a strong tool for continuous improvement in many industries (Al Smadi, 2009), including manufacturing and services, there is a noticeable research gap regarding its application and CSFs within the textile industry during disruptive times like the COVID-19 pandemic, particularly in emerging economies. The majority of the literature on the implementation of Kaizen in the textile industry concentrates on stable business environments, removing obstacles during disruptive events in developed economies, and ignoring emerging economies where the textile industry plays a significant role in economic development and faces specific opportunities and challenges.

Overproduction, waiting times, transportation, overprocessing, inventory, motion, and defects are the seven types of waste in processes that Kaizen seeks to identify and eliminate. These wastes can result in rising costs, declining productivity, and decreasing efficiency. With increasing industrialization and growing textile industries, kaizen implementation is challenging for emerging economies, especially during disruptive times like the COVID-19 epidemic. New health and safety rules are put into place, customer demand changes, and SCs are affected. To stay competitive and resilient, textile firms must overcome these difficulties while pursuing continuous improvement (Köksal et al., 2017). To boost production and resilience in the face of disruptive events, the textile industry has to adopt contemporary approaches like Quality 4.0 and Kaizen concepts. The goal of Quality 4.0 (or Q4.0) was to equip the quality function and profession to take the lead in utilizing I4.0 technologies to continuously provide high-quality products (Chiarini & Kumar, 2022; Sony, et al., 2020; Jacob, 2017). By providing real-time quality monitoring, resource optimization, and quick bottleneck detection, this integration can assist the industry in overcoming obstacles and adjusting to shifting customer needs.

2.2. Kaizen Philosophy Literature for the Textile Sector

Under this section, general perspective related to the textile and apparel industry in terms of Kaizen and related lean management techniques during Covid-19 pandemic-related issues were presented by citing examples from the literature, they made their points. For instance, through a lens of global business risk management, Sumarliah et al., (2021) investigated the epidemics' extensive and complicated impacts on SCs' in worldwide apparel firms.

The manufacturing of clothes is increasingly using techniques like Kaizen and lean manufacturing. Janjić et al., (2020) pinpointed crucial success elements for kaizen implementation in transition and emerging economies, which is advantageous for businesses in these regions. It offered insights from both the views of engineers and economics. Malsinghe et al., (2022) also determined six CSFs for sustainable supply chain (SSCs) by analyzing operational excellence frameworks of sustainable SCs in Sri Lankan industrial production system (clothing, paper and paper goods, rubber, and plastic items, etc.) throughout the epidemic. The purpose of Quddus & Ahsan, (2014) in their study was to demonstrate the impact of kaizen on the apparel industry to minimize Work in Progress (WIP) and improve the working environment in order to boost productivity.. Rajpoot et al., (2021) discussed how to integrate waste analysis and waste reduction approaches like Kaizen in the clothing business. The advantages of visualizing risks, adapting, and enduring them over time are highlighted by Zighan & Ruel's (2023) examination of SMEs' resilience via continuous improvement. Moreover, Kapuria et al., (2017) studied the underlying factors that contribute to sewing errors in the Bangladeshi textile sector and continuously enhanced the Kaizen (continuous improvement) system's ability to reduce errors.

Lean manufacturing concentrated on waste removal through ongoing improvement in the textile sector in south India. Radar diagrams are used to illustrate how poka-yoke, 5S (sort, set up order, shine, standardize, and sustain), VSM, Kanban, Kaizen, and visual controls are used for enhancing operations (Saleeshya et al., 2012). Hoque et al., (2023) examined how buyers and suppliers contribute to the implementation and maintenance of lean in clothing supplier factories, particularly during the pandemic. The study also explored the critical roles that suppliers and customers play in sustaining lean methods and overcoming obstacles. The current condition, dangers, and risk mitigation strategies of the fashion SCs are examined in the study by McMaster et al., (2020), and it is found that lean management is shown to be beneficial for reducing costs and waste, but it is constrained by SC transparency and rising demand volatility. Another research by Omotayo et al., (2018) studied Kaizen in construction is a lean production paradigm that focuses on improving stakeholder relationships, increasing profitability, and delivering projects to satisfied clients. Silva et al., (2011) determined the conditions that would be necessary for the Sri Lankan garment industry to adopt lean manufacturing ideas, with a particular emphasis on the best implementation strategies, difficulties, and advantages. Based on a literature analysis, Prasad et al., (2020) explored the appropriate application of lean concepts in the textile industry. Additionally, Adikorley et al. (2017), conducted an examination about the success of Lean Six Sigma projects within the textile sector. The research involved analyzing the implementations of these projects and assessing their economic impact on a specific textile company. Besides, Bhat et al., (2021) intended to reinforce government programs by exploring the difficulties, lessons gained, and management consequences of adopting the competitiveness of Lean Six Sigma in India's micro, small, and medium enterprises (MSME). In addition, Wickramasinghe & Wickramasinghe, (2016) presented empirical evidence on the impact of continuous improvement on shop-floor employee work productivity and investigated how CI affected work performance and how Lean duration relates to it in textile and apparel companies. By creating a model to evaluate the level of industry preparedness for the effective implementation of Lean Six Sigma (LSS), the paper intended to advance knowledge of industry readiness (Abbes et al., 2022). Netland, (2016) analyzed how, despite agreement on what needs to be done, contingency variables affect practitioners' success factors for adopting lean manufacturing.

The COVID-19 epidemic has had a substantial adverse effects on the textile and garment industries, resulting in a shortage of essential personal protective equipment (PPE) such as respirators, surgical face masks, and gloves. These supplies are essential for limiting the transmission of infections between patients and healthcare professionals and they are vital in defending people from viral infections like COVID-19 as shortages form in high-demand areas. In this context, a serious shortage of personal protective equipment (PPE), especially masks for surgery resulted owing to the epidemic, thus, Demirtas et al. (2022) demonstrated how the use of Kaizen and 5S techniques may decrease waste, foster a more productive and sustainable workplace, minimize lead times, boost productivity, raise customer satisfaction, and enhance PPE quality in a Turkish textile SME. Focusing on how the pandemic has affected industries related to cultural heritage, Hussain, (2021) examined technological convergence and digital platforms. Furthermore, this study also emphasized how crucial it is to change corporate societies into sustainable ones using cutting-edge technology and value addition. Samanta et al., (2023) focused on the success criteria for combining Industry 4.0 and LSS for manufacturing organizational excellence. In order to eliminate wastage and minimize expenses in lean SC design, Reyes et al., (2021) presented a theoretical model of reference combining Industry 4.0 digital technology with lean manufacturing techniques in large footwear companies. Moreover, Siagian & Tarigan (2021) investigated the link between IT capabilities and business performance using SC, vendor-managed inventory, and lean manufacturing techniques and developed a model for enhancing business performance during the Covid-19 epidemic and looked into whether IT capabilities directly impact, directly affects, or indirectly influences these practices through the mediating function that these practices play.

Despite the extensive discussion of the CSFs for Kaizen implementation in the literature, it is critical to highlight attention to the shortage of research on this topic in the context of the COVID-19 pandemic, particularly in the textile industry. The challenges and approaches needed for Kaizen implementation during a global crisis have not been sufficiently explored by existing studies. Due to the unexpected disruptions that the textile industry has gone through as a result of the pandemic, this gap in the literature is notable. The study seeks to fill this gap by offering a thorough examination of CSFs for Kaizen implementation that is especially suited to the demands of the COVID-19 pandemic in the textile industry.

3. Conceptual Framework for Critical Success Factors

A thorough review of the literature was undertaken in order to identify the CSFs that would be employed throughout this investigation. Initially, a paper list was created by integrating entangled themes and terms connected to the issue. After the identification of relevant articles on the issue, each of these publications and the factors they have covered have been rigorously analyzed from three perspectives: academia, industry, and government. The panel of academics then identified, debated, and eliminated the determined CSFs to find the most significant ones. During those expert discussions, the identified CSFs were reduced to 18 variables, which were then divided into segments under the perspective of the Triple Helix Actors for greater understanding as presented in the Table 1 below.

Table 1 Critical Success Factors for Kaizen Implementation in Textile Industry (Table by Authors)

Triple Helix Actors	*Dimensions*	*Criteria No*	*Critical Success Factors*	*References*
Government	Economic Dimension	C1	Compensation	Rivera-Mojica & Rivera-Mojica, (2014); García et al., (2013); Bakas et al., (2011); Vinodh & Chintha, (2011).
		C2	Financial infrastructure	
		C3	Cost management & economic benefit	
	Innovation Dimension	C4	Technology development	Díaz-Reza et al., (2018); Hernández Gómez et al., (2015); Vinodh & Chintha, (2011); Soltero & Waldrip, (2002).
	Performance Assessment Dimension	C5	Monitoring & evaluation of the system	Nguyen et al., (2019); Díaz-Reza et al., (2018); Piechnicki et al., (2015); Fryer et al., (2007); Rich & Bateman, (2003).
Industry	Strategy & Objectives Dimension	C6	Clear target and shared direction	Díaz-Reza et al., (2018); Hernández Gómez et al., (2015); Gómez et al., (2014); Zargun & Al-Ashaab, (2014); García et al., (2013); Vinodh & Chintha, (2011); Farris et al., (2009); Fryer et al., (2007); Bateman, (2005); Bradley & Willett, (2004); Patil, (2003).
		C7	Strategic alignment	
		C8	Change of organization directions	
	Communication Dimension	C9	Effective vertical & horizontal communication	Díaz-Reza et al., (2018); Hernández Gómez et al., (2015); Piechnicki et al., (2015); Rivera-Mojica & Rivera-Mojica, (2014); Zargun & Al-Ashaab, (2014); García et al., (2013); Bakas et al., (2011); Farris et al., (2009); Fryer et al., (2007); Rich & Bateman, (2003); Soltero & Waldrip, (2002).
	Process Management Dimension	C10	Standardized processes	Díaz-Reza et al., (2018); Hernández Gómez et al., (2015); García et al., (2013); Vinodh & Chintha, (2011); Fryer et al., (2007).
		C11	Development on continuous improvement practices	
Academia	Knowledge Dimension	C12	Knowledge sharing	Nguyen et al., (2019); Díaz-Reza et al., (2018); Zargun & Al-Ashaab, (2014); Farris et al., (2009); Bradley & Willett, (2004); Patil, (2003).
		C13	Team tool & process knowledge	
	Skills & Proficiency Dimension	C14	Setting goals for improvement programs	Nguyen et al., (2019); García et al., (2013); Bakas et al., (2011).
		C15	Employee learning & training for processes	
	Education & Expertise Dimension	C16	Lean education & training	Nguyen et al., (2019); Piechnicki et al., (2015); Gómez et al., (2014); Rivera-Mojica & Rivera-Mojica, (2014); Zargun & Al-Ashaab, (2014); García et al., (2013); Bakas et al., (2011); Glover et al., (2011); Farris et al., (2009); Fryer et al., (2007); Bateman, (2005); Cooney & Sohal, (2004).
		C17	Multidisciplinary Support & cooperation and collaboration	

3.1. Government Perspective

Kaizen is a low-cost method of increasing production that emphasizes the effective use of already-existing tools and labor without major capital expenditures or R&D. It is best suited for low-income nations with restricted finance access since its main objective is to develop internal capabilities and enable businesses to "graduate" from external direction (Ohno et al., 2009). Since all textile industries depend heavily on labor, maximizing worker productivity will guarantee the largest corporate profit (Akter et al., 2015). Employees appear to earn income, compensation, etc. for their involvement as part of their normal salaries or wages, and maybe even as overtime (when activities take place outside of regular business hours) (Farris, 2006). Another important factor for successful Kaizen implementation in the textile industry is financial infrastructure. Due to benefits including providing funds, resources, and investment possibilities for process improvements, personnel training, technology upgrades, etc., financial infrastructure is essential for enabling Kaizen implementation. It also enables companies to implement continuous improvement practices, increase productivity, and remain competitive. In that sense, cost management & economic benefit becomes substantial for Kaizen implementation to work smoothly.

Using Kaizen technologies including load balancing, lead time reduction, machine layout, standardization, automation, and KARAKURI (Murata & Katayama, 2010; Katayama 2007), manufacturing technology programs seek to teach workers how to design and enhance production systems by lowering costs, enhancing quality, and shortening cycle times (Lee et al., 2000). Businesses may increase their attempts and achieve sustainable improvements and growth inside their businesses by incorporating cutting-edge technology and regularly upgrading old systems. These tools facilitate improved decision-making, encourage Kaizen activities, assist in simplifying operations, decrease waste, and increase overall efficiency.

In order to maintain the change, kaizen implementation involves ongoing performance monitoring and reporting of results. In order to regulate the current system, spread the kaizen techniques, and ensure their sustainability, monitoring, and assessment of the system are crucial. At this particular level of specificity, active involvement in monitoring and improving process variability is essential for the majority of staff (Berger, 1997). In order to assure long-term success and pinpoint opportunities for further development, it entails routinely monitoring and evaluating the development, results, and efficiency of continuous improvement projects.

3.2. Industry Perspective

In relation to the effective implementation of Kaizen, team members who had shared goals for future state processes appeared to have a better knowledge of one another's roles and develop into a more cohesive unit (Van Aken et al., 2010). In addition, impressions of team members on how well the improvement goals of the Kaizen event team need to be clearly specified (Van Aken et al., 2010; Farris et al., 2008; Bradley & Willett, 2004; Melnyk et al., 1998). Stronger shared goals and clear targets transcended interpersonal issues as team members began to feel appreciated for their contributions to the event's success, which ultimately built the groundwork for collaboration and team cohesiveness. Incorporating Kaizen concepts into company strategy is crucial for promoting a culture of continuous improvement. Strategic alignment is essential for businesses to align their strategies, foster departmental cooperation, and ensure marketing and production operations are complementary. Textile companies can respond to market changes, and remain agile, competitive, and resilient by implementing continuous improvement practices and building a Kaizen culture. This strategy also conveys a strong message to stakeholders, demonstrating a commitment to excellence, boosting the organization's reputation, capturing customers, and maintaining long-term relationships.

Effective vertical and horizontal communication is essential for the successful implementation of Kaizen. It is necessary to establish efficient lines of communication within departments and teams as well as between hierarchical levels. A sense of dedication and cooperation is fostered by vertical communication, which guarantees a clear cascade of objectives, strategies, and information. The Departmental collaboration and knowledge sharing are encouraged through horizontal communication, which uses diverse viewpoints and areas of expertise. Problems and opportunities are better understood in their entirety when people work together. An environment that values ongoing development and adaptability in the face of adversity needs to be reinforced by efficient communication.

Standard processes are crucial for the successful implementation of Kaizen, as they provide consistency, effectiveness, and scalability in operations. These processes eliminate variations and minimize errors and waste, enabling organizations to focus on continuous improvement. Employees can share best practices across teams and departments through knowledge transfer and training. The textile sector can expand operations while maintaining quality and efficiency. Staying updated with industry developments and trends is essential for improving Kaizen initiatives. Businesses must actively seek new approaches and equipment to stay competitive and create an innovative culture. Technological advancements like automation and data analytics can strengthen Kaizen initiatives by obtaining valuable data, automating tasks, and enabling real-time monitoring.

3.3. Academia Perspective

Academic institutions play a crucial role in promoting knowledge sharing within organizations by conducting research, producing insights, and spreading knowledge about Kaizen practices. This promotes cross-functional learning and empowers organizations to base decisions on existing knowledge. Employees are encouraged to contribute their knowledge and experiences, fostering a culture of continuous learning and improvement. The Kaizen approach is essential for employees and departments to accept and use, as everyone should participate in personal progress. Team tool and process knowledge refers to the understanding and competence of teams in using specific techniques and methodologies related to Kaizen. By creating and spreading knowledge about these tools, academia helps businesses make informed decisions about their implementation, encouraging staff members to participate in Kaizen projects, improve their capacity, and create positive change within the business.

Clear, well-defined goals are crucial for improvement initiatives, and Kaizen is no exception. These goals provide a roadmap for navigating challenges and maintaining focus. The CSF of "Setting goals for improvement programs" ensures effective channeling of energy and resources, enabling the textile industry to weather disruptions while striving for sustainability. Empowering employees with continuous learning and training opportunities is a cornerstone of Kaizen's success. A skilled workforce drives the adoption of Kaizen practices and facilitates agility in response to disruptions. Employees become proactive problem solvers, contributing to the industry's ability to adapt and innovate. Investing in employee learning and training for processes reinforces the textile industry's resilience by investing in its most valuable asset: its people.

Lean principles are crucial in Kaizen, focusing on efficiency, waste reduction, and value creation. During disruptive events, these principles become even more important. Lean education and training enable organizations to streamline operations, optimize resource utilization, and minimize waste. The "Multidisciplinary Support & Cooperation and Collaboration" CSF emphasizes fostering strong relationships within the industry, academia, and government. By collaborating across disciplines, the textile industry can tap into diverse expertise, innovative solutions, and collective resilience, ensuring long-term sustainability and resilience.

4. Methodology

The use of MCDM (Multi-Criteria Decision Making) techniques is a highly beneficial strategy for solving a wide range of decision-making problems. Engineering, manufacturing, SC management, healthcare, logistics, and other industries all use these techniques (Sagnak et al., 2021). According to experts, MCDM is a useful tool for analyzing complex problems with multiple criteria. MCDM essentially involves selecting the best option from a set of available options (Berberoglu et al., 2023). This selection procedure makes use of a set of attributes or criteria for assessing and contrasting options. Decision makers can use MCDM methods to make deliberate decisions in line with their goals and priorities, taking into account multiple factors at the same time. Practically speaking, MCDM techniques provide a methodical framework for evaluating and ranking alternatives based on how well they perform against various criteria (Kumar et al., 2017). By using MCDM methods, decision-makers can improve their decision-making processes and produce more effective and efficient results in their fields (Opricovic and Tzeng, 2004). Under this section of the study, the ISM approach and MICMAC analysis have been applied to reveal the substantial CSFs towards Kaizen implementation for the textile sector. Thereby, this study addressed the CSFs needed for the textile sector to successfully apply Kaizen principles during disruptive events like the COVID-19 pandemic. With the help of MCDM, which offers a well-structured framework for decision-making, factors based on adaptability, sustainability, and resilience are evaluated. In order to ensure the sustainability of Kaizen principles, the study aims to comprehend how the textile industry can adapt and flourish in the face of disruptions.

Recent research has utilized MCDM and Structuring modeling to model critical success factors (Citybabu & Yamini, 2022; Joshi et al., 2022). ISM allows for understanding direct and indirect relationships among variables affecting the system under consideration, integrating elements measured on ordinal scales (Khaba et al., 2020). This approach allows for qualitative factors to be integrated into the model. The ISM and MICMAC techniques are used in this study to assess Critical Success Factors (CSFs) in Kaizen implementation in the textile sector during disruptive periods such as the COVID-19 pandemic. ISM aids in the identification of hierarchical structures, whereas MICMAC categorizes components based on influence and reliance, prioritizing CSFs. This strategy helps decision-makers and companies adapt and improve Kaizen techniques, therefore contributing to long-term growth and industrial resilience.

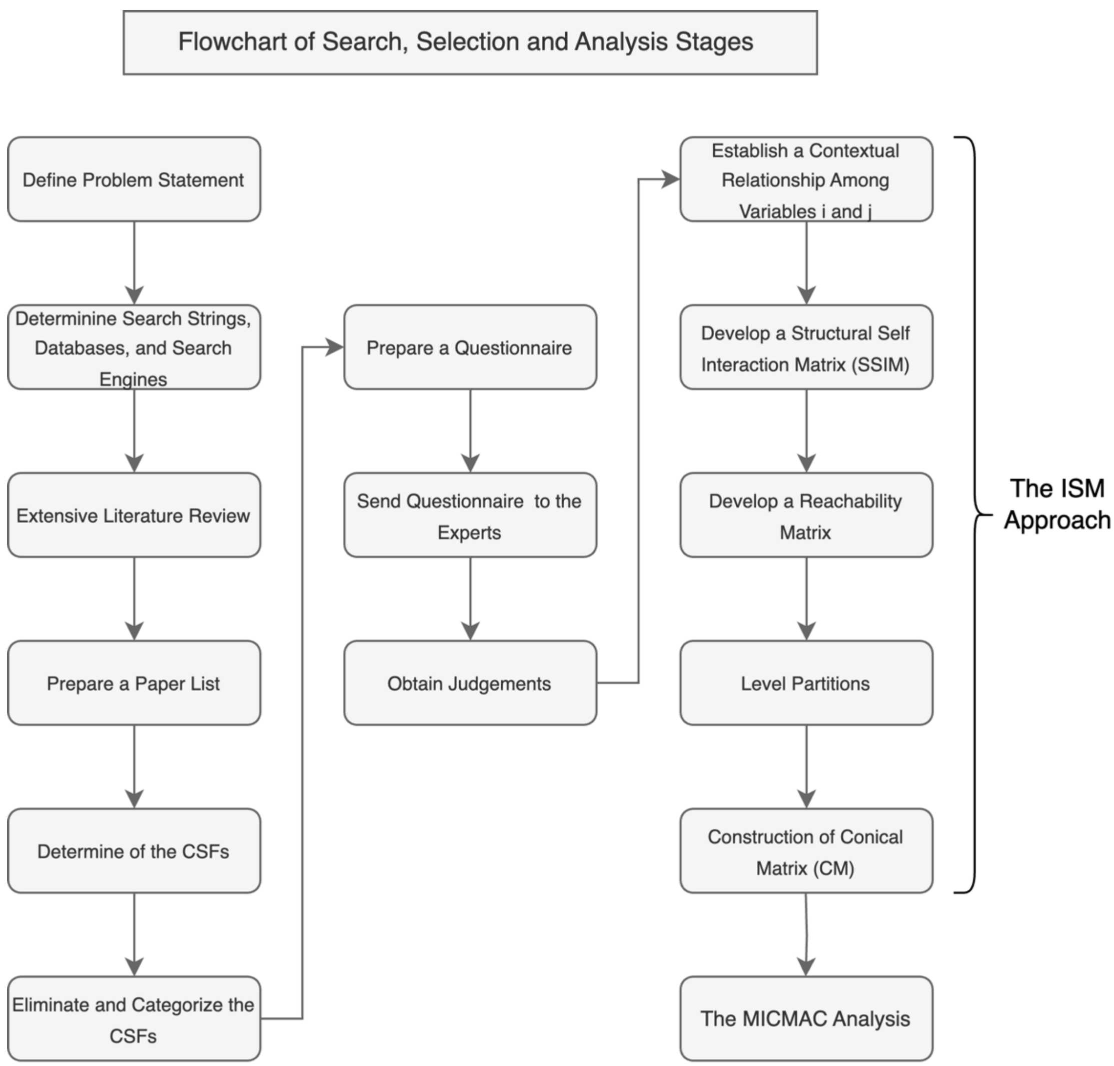

Figure 2 Flowchart of the Methodology (Figure by Authors)

The flowchart of the study can be seen in Figure 2. The research procedure entails formulating a problem statement, selecting search strings, performing a thorough literature review, selecting CSFs, preparing a questionnaire, consulting with experts, determining contextual relationships between variables, developing a structural self-interaction matrix, creating reachability matrix level partitions, and building a conical matrix. By classifying factors according to their relative strengths and dependencies, the MICMAC analysis offers a thorough understanding of the research question. This procedure makes sure the study is organized. Engaging with experts and examining their responses strengthens the study's reliability.

4.1. Interpretive Structural Modeling

The term ISM refers to the systematic application of basic graph theory concepts to construct a graph structure, or network depiction, of a complex pattern of a contextual link among a set of elements (Malone, 1975). ISM is a well-known approach for determining correlations between distinct pieces that describe a problem or issue (Attri et al., 2013; Jharkharia & Shankar, 2005). Furthermore, ISM is a managerial decision-making technique that uses both subjective and quantitative methodologies to analyze and prioritize multi-criteria decision considerations (Muruganantham et al., 2018; Kannan et al., 2014). This method is primarily used as a technique to aid those investigating forces in making sense of complex relationships at the preliminary stage of problem-solving (Nasim, 2011). The basic principle of ISM is to divide a complicated system into numerous sub-sections and develop a structural model with several levels to emphasize the dominating aspects involved in system implementation (Vinodh et al., 2016). The link between each variable and the others is recognized and expressed in a matrix form, making this technique interpretive (Muruganantham et al., 2018). Many researchers employ ISM and TISM techniques in a variety of applications, including product & process design and engineering, big data, engineering challenges, strategic planning, complex issues, and other technical problems (Kaur et al., 2019). The main purpose of using ISM for this research paper is to examine the success factors of the resilient SC in order to predict and manage demand by adopting ICT. For this purpose, the expert's view was requested in order to determine the contextual relationship, and the logic behind the identified relationship was elicited (Nasim, 2011). The six steps of ISM are presented below:

Step 1: Identifying the variables.

Identifying and defining the variables or elements that interactions will represent is the initial stage in any structural modeling (Nasim, 2011).

Step 2: Determine contextual relationship.

To improve the structural model by linking the components, it is necessary to describe the contextual interactions among the elements (Nasim, 2011). To capture tThe underlying connection that exists among the elements, experts' opinion connected the barriers, elements, variables, items, or factors needs to be developed using the brainstorming technique (Yeravdekar & Behl, 2017).

Step 3. Structural self-interaction matrix.

Step 3 can be named as the essential first stage toward the ISM method. Conventional ISM aims to capture contextual relationships, but it does not reflect how they work in practice. In constructing the contextual link among the variables, the ISM approach suggests using expert views depending on different management strategies such as brainstorming (Barve et al., 2007; Hasan et al., 2007; Ravi et al., 2005). The experts' opinions were based on an extensive comprehension of the variables and their interrelationships (Muruganantham et al., 2018). Therefore, the structural self-interaction matrix (SSIM) provides a pairwise analysis of variables, with the connection displayed using standard symbols based on an expert survey (Thirupathi & Vinodh, 2016).

The following symbols which are V, A, X, and O, are utilized for the method to express the interaction amidst two elements i and j (Vinodh et al., 2016):

V: Element i has an influence on element j;

A: Element j has an influence on element i;

X: Elements i and j have mutual interaction with each other; and

O: There is no interrelatedness between elements i and j.

Step 4: Establishment of Reachability Matrix

The four symbols of SSIM, which are V, A, X, or O, are expressed by 1 or 0 depending upon the symbols' corresponding numbers in the initial reachability matrix to convert SSIM into the initial reachability matrix (Attri et al., 2013). The following rules (Muruganantham et al., 2018; Govindan et al., 2015) determine the substitution of 1s and 0s:

(1) In SSIM, if entry (i, j) is presented by symbol V, put 1 for "i to j" & put 0 for "j to i".

(2) In SSIM, if entry (i, j) is presented by symbol A, put 0 for "i to j" & put 1 for "j to i".

(3) In SSIM, if entry (i, j) is presented by symbol X, put 1 for both "i to j" & "j to i"

(4) In SSIM, if entry (i, j) is presented by symbol O, put 0 for both the linkages "i to j" & "j to i"

(5) If both i and j are the same, diagonal elements will be allocated 1.

Then, the transitivity check needs to be used by examining the elements of one another for revealing embedded relations, to prepare the final reachability matrix (RM). If there is a transitive or indirect interaction among elements, this results in the conversion of 0 to 1* (Kaur et al., 2019). The final RM is generated by including the transitivity property as explained (Attri et al., 2013).

Step 5: Level Partitions

There are three sets for the final RM listed below to identify the level partitioning (Kaur et al., 2019).

- Reachability Set
- Antecedent Set
- Intersection Set

The reachability and antecedent sets for each element are calculated using the final reachability matrix (Jena et al., 2017). The matrix of reachability tries for establishing sets of reachability and antecedent for every component (Vinodh et al., 2016). The reachability set includes the element and any other elements it may affect, whereas the antecedent set includes the element and any other elements that may affect it (Attri et al., 2013). Interdependence is represented by the intersection of these two sets (Muruganantham et al., 2018). A third set emerges depending upon the intersection of the two previous sets, which are reachability and antecedent Sets.

Step 6: Construction of Conical Matrix (CM)

The final reachability matrix's conical matrix is created by segmenting components at the same level throughout the rows and columns (Attri et al., 2017). The conical matrix was created by categorizing all of the parts into two groups: driving power and dependency power. The driving power of an element is found by adding all of the 1s in that element's row, and the dependence power is determined by adding all of the 1s in that element's column (Kaur et al., 2019).

4.2. The MICMAC Analysis

The MICMAC analysis is a strategic management approach that incorporates complex issue-solving and systems thinking to study links and interactions between system parts, identifying essential aspects and their effects on one another. The MICMAC analysis is carried out depending on the powers of driving and dependent of the variables. In accordance with their relative powers, the variables will be divided into four groups (Deepu & Ravi, 2023). These four clusters are identified in the system: autonomous, dependent, linkage, and independent factors (see Figure 3). Autonomous factors, cluster I, were classified as factors that have little or no dependency on other factors; Dependent factors, cluster II, factors heavily rely on other variables; Linkage factors, cluster III, were the linking elements that have the greatest impact on others; Independent factors, cluster IV, which these elements are given the most attention since they are the strongest important factors and have little effect from other ones (Ahmad et al., 2019).

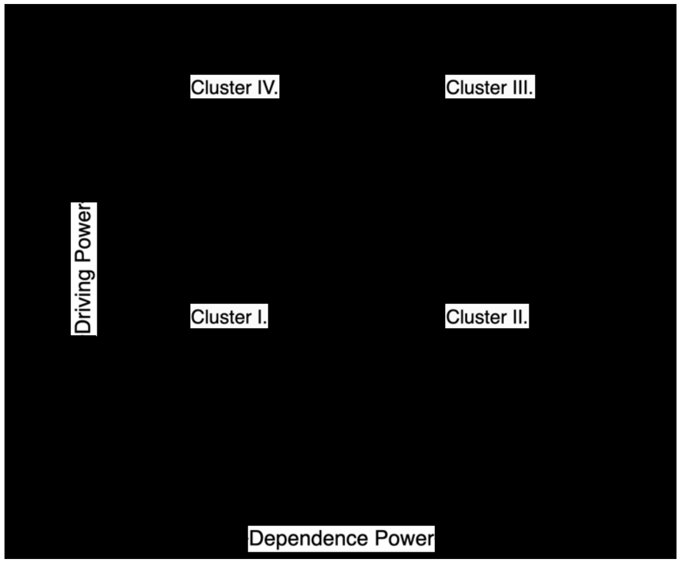

Figure 3 Standard Representation of the MICMAC Analysis, Driving and Dependence Power Diagram (Figure by Authors)

5. Case implementation and Analysis

The application of this study relates to the examination of CSFs in terms of Triple Helix Actors stated earlier (prior section). According to that viewpoint, the three components of academia, industry, and government, which are the actors in the Triple Helix, have been split in the discovered CSFs in the Kaizen literature in the textile industry. We have separated the CSFs into various actors to offer a more sophisticated and specialized set of guidelines to each of these members of this viewpoint. Due to its distinct characteristics and research gap, this study focuses on the textile industry, a labor-intensive sector with a global supply network. The COVID-19 epidemic has brought attention to the value of flexibility and quick adaptation. During the COVID-19 epidemic, the textile industry played a critical role in meeting the demands of the healthcare sector by swiftly producing personal protective equipment, medical textiles, and equipment coverings. During the crisis, the textile sector's resilience was vital because it secured a consistent supply of critical medical supplies, maintained economic stability, stimulated innovation, and strengthened national security, emphasizing its pivotal role in times of disruption. Hereby, the textile sector has been chosen for the implementation of this study for its supplementary, vital, resilient characteristics. For this purpose, examining CSFs and integrating Kaizen into this sector as an implementation strategy during difficult times might offer textile manufacturers helpful advice on how to handle crises successfully. Recognizing the factors that lead to successful Kaizen implementation within this industry is vital because it will affect the employment situation in the textile industry and the economic growth of emerging economies. To assist decision-makers in making critical decisions about these ever-changing sectoral dynamics, this paper aims to analyze and propose multi-criteria decision-making solutions by adopting the ISM and MICMAC.

Initially, logical knowledge-based expert opinions were obtained from 7 experts who are from different sections of the textile sector, for both obtaining data and validation analysis. The background, expertise, and job description of the experts are presented in Table 2 below. These expert opinions were gathered as a pair-wise contextual interaction amidst the CSFs for the purpose of effective implementation of kaizen. Based on the obtained results from the experts, the answers of each expert were separately translated from letter expressions (V, A, X, O) to numerical expressions (1.0), and a matrix was established (see Table 3 below). Then, the geometric mean of all the experts' answers was formed, and a single matrix was created which is called the initial reachability matrix (see Table 4 below).

Table 2 The Expert Profile in Terms of Job Position & Experiences (Table by Authors)

Number of Experts	*Job Descriptions / Position*	*Years of Work Experience (In Total)*
1	Quality Engineer	15 years
2	Project Management Specialist	7 years
3	Marketing Communication Specialist	6 years
4	Research and Development Specialist	4 years
5	Product Development Specialist	8 years
6	Textile Engineer	13 years
7	Production Planning Manager	14 years

Table 3 Symbols used in the ISM and their meanings & corresponding numbers (Table by Authors)

Symbols	*Interaction between i and j*	*Corresponding*
V	Element i has an influence on element j;	1
A	Element j has an influence on element i;	0
X	Elements i and j have mutual interaction with each other; and	1
O	There is no interrelatedness between elements i and j.	0

Table 4. Initial Reachability Matrix (Table by Authors)

IRM	*C1*	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*	*C8*	*C9*	*C10*	*C11*	*C12*	*C13*	*C14*	*C15*	*C16*	*C17*

C1	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0
C2	1	1	0	1	1	0	0	1	0	1	1	0	1	1	1	1	0
C3	1	0	1	1	1	0	0	1	0	1	1	0	0	0	0	0	0
C4	0	0	0	1	1	0	0	0	1	1	1	0	1	1	1	1	0
C5	0	0	0	0	1	0	0	1	1	1	1	0	0	1	1	1	0
C6	0	0	0	0	0	1	1	1	1	0	0	1	0	1	0	0	1
C7	0	0	0	0	0	1	1	1	1	0	0	1	0	1	0	0	1
C8	0	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
C9	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1	1	0
C10	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
C11	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	1	0
C12	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	1
C13	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0
C14	0	0	0	1	1	0	0	0	0	1	1	0	1	1	1	1	0
C15	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	0
C16	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0
C17	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1

I*RM:* Initial *reachability matrix*

After establishing the initial reachability matrix, the transitivity property was applied from one element to another, and newly added elements were represented by "1*". The logic underneath transitivity links is about revealing the transitive or indirect relationship among "j" and "i" elements. The final reachability matrix is determined by completing the transitivity check.

Parts having the number 1 in the rows and columns of the final reachability matrix, which shows a link between these items, were gathered in the following phase of the approach. Then, driving power was found by summing the relationships of the rows, which is indicated as 1. Similarly, dependence power was calculated by counting the relationships in the columns. Finally, the ranking was prepared separately for both rows and columns (see Table 5.)

Table 5 Final Reachability Matrix (Table by Authors)

FRM	*C1*	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*	*C8*	*C9*	*C10*	*C11*	*C12*	*C13*	*C14*	*C15*	*C16*	*C17*	*DRP*
C1	1	1	0	1*	1*	0	0	1*	1	1*	1*	1*	1	1*	1*	1*	0	**13**
C2	1	1	0	1	1	0	1*	1	1*	1	1	1*	1	1	1	1	1*	**15**
C3	1	1*	1	1	1	0	1*	1	1*	1	1	1*	1*	1*	1*	1*	1*	**16**
C4	1*	0	0	1	1	0	1*	1*	1	1	1	1*	1	1	1	1	1*	**14**

C5	1*	1*	0	1*	1	0	1*	1	1	1	1	1*	1*	1	1	1	1*	**15**
C6	0	1*	0	0	1*	1	1	1	1	1*	1*	1	1*	1	1*	1*	1	**14**
C7	0	1*	0	1*	1*	1	1	1	1	1*	1*	1	1*	1	1*	1*	1	**15**
C8	1*	1	0	1*	1*	1*	1	1	1	1	1	1	1	1	1	1	1	**16**
C9	1*	0	0	0	0	0	1*	0	1	1	1	1	1	1*	1	1	1*	**11**
C10	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
C11	1*	0	0	0	0	1*	1	1*	1*	1	1	1	1	1*	1	1	1*	**13**
C12	0	0	0	0	0	0	1*	0	1	1*	1*	1	1	1*	1*	1*	1	**10**
C13	0	0	0	1*	1*	0	0	0	0	1	1*	0	1	1	1*	1*	0	**8**
C14	1*	0	0	1	1	0	1*	1*	1*	1	1	1*	1	1	1	1	0	**13**
C15	1	1*	0	0	0	0	0	0	1*	1	0	0	1	1*	1	1	0	**8**
C16	1	1*	0	0	0	0	0	0	1*	1	0	0	1	1*	1	1	0	**8**
C17	0	0	0	0	0	1*	1	1*	1*	0	0	1*	0	1*	0	0	1	**7**
DEP	**11**	**9**	**1**	**9**	**10**	**5**	**12**	**11**	**15**	**16**	**13**	**13**	**15**	**16**	**15**	**15**	**11**	

FRM: Final reachability matrix, DEP: Dependence power, DRP: Driving power.

The reachability, antecedent, & intersection sets, and the level partitioning were prepared and submitted from the FRM to determine the different levels of the CSFs. Depending on the partitioning, five levels have been determined (see Table 6). The reachability set consists of the interactions among the elements, which is represented by 1 in the matrix, horizontally. On the other side, the antecedent set is constituted by presenting relationships among elements vertically. The intersection set has been prepared by typing conflicting elements. By doing that the CSFs that have priority were clarified in levels depending on their dependency and driving power over other aspects.

Table 6 The Reachability, Antecedent, and Intersection Sets (Table by Authors)

Reachability Set	Antecedent Set	Intersection Set	Level
1,2,9,13	1,2,3,15,16	1,2	II
1,2,4,5,8,10,11,13,14,15,16	1,2,8	1,2,8	IV
1,3,4,5,8,10,11	3	3	I
4,5,9,10,11,13,14,15,16	2,3,4,14	4,14	II
5,8,9,10,11,14,15,16	2,3,4,5,14	5,14	II
6,7,8,9,12,14,17	6,7	6,7	II
6,7,8,9,12,14,17	6,7,8,11,17	6,7,8,17	IV
2,7,8,9,10,11,12,13,14,15,16,17	2,3,5,6,7,8	2,7,8	V
9,10,11,12,13,15,16	1,4,5,6,7,8,9,12	9,12	II
10	2,3,4,5,8,9,10,11,13,14,15,16	10	I

7,10,11,12,13,15,16	2,3,4,5,8,9,11,14	11	I
9,12,13,17	6,7,8,9,11,12	9,12	II
10,13,14	1,2,4,8,9,11,12,13,14,15,16	13,14	II
4,5,10,11,13,14,15,16	2,4,5,6,7,8,13,14	4,5,13,14	III
1,10,13,15,16	2,4,5,8,9,11,14,15	15	I
1,10,13,16	2,4,5,8,9,11,14,15,16	16	I
7,17	6,7,8,12,17	7,17	II

Depending on the table above, five levels have been determined at the end of the implementation of the ISM methodology. The reachability and antecedent set for each factor are determined from the final reachability matrix and the levels that have been established assist in creating the digraph and ISM's final model Talib et al., (2011). According to these levels, we can claim that “Cost management & economic benefit” (C3), “Standardized processes” (C10), “Development on continuous improvement practices” (C11), “Employee learning & training for processes” (C15), and “Lean education & training” (C16) were classified as the level I which is the top CSFs towards successful Kaizen implementation. Correspondingly, as we can see in the table above, “Compensation” (C1), “Technology development” (C4), “Monitoring & evaluation of the system” (C5), “Clear target and shared direction” (C6), “Effective vertical & horizontal communication” (C9), “Knowledge sharing” (C12), “Team tool & process knowledge” (C13), and “Multidisciplinary Support & cooperation and collaboration” (C17), were categorized under the level II. While “Setting goals for improvement programs” (C14) were segmented under level III, “Financial infrastructure” (C2), and “Strategic alignment” (C7) were found in level IV. Lastly, “Change of organization directions” (C8) has been listed as the last level of the level partitions which corresponds to level V.

As the next and final step for our methodology, the driving and dependent power of CSFs for Kaizen implementation in the textile sector was examined by MICMAC analysis. Similar to the foundations of the MICMAC analysis, related CSFs are divided into autonomous, linkage, dependent, and independent clusters at the end of the methodology section (Tamtam & Tourabi, 2021; Takyi-Annan and Zhang, 2023). In the adoption process, drivers in the autonomous cluster have poor driving and dependence power, those in the independent cluster exhibit strong driving but weak dependency power, drivers in the dependent cluster possess strong dependence but weak driving power, and drivers in the linkage cluster have both strong driving and strong dependence power (Palit et al., 2022; Debnath et al., 2023).

These drivers, however, are relatively unstable, and any change to them has an impact on the other drivers that are connected to them. While higher driving values suggest that more CSFs can be eliminated higher reliance values imply that there are more CSFs to remove. Figure 4 contains the dependency vs. driving power scheme by adopting MICMAC analysis.

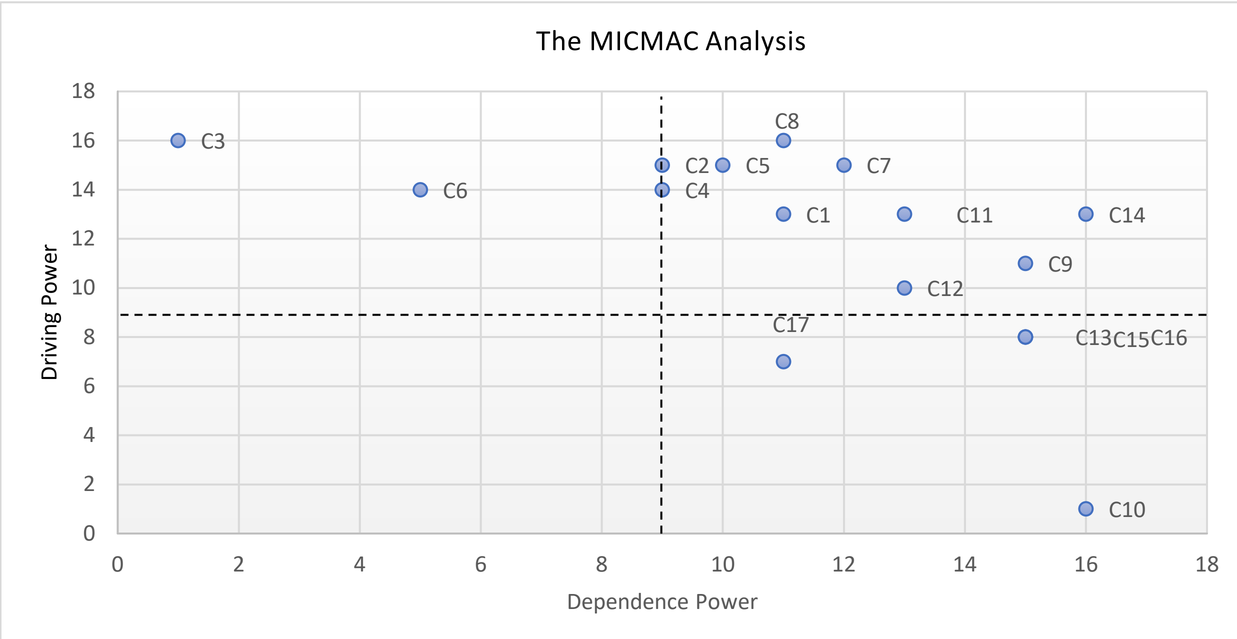

Figure 4 MICMAC Analysis of CSFs for Kaizen Implementation in the Textile Sector (Figure by Authors)

Several CSFs fall under the cluster of linkage, including "Financial infrastructure" (C2), "Technology development" (C4), "Monitoring & evaluation of the system" (C5), "Strategic alignment" (C7), "Change of organization directions" (C8), "Effective vertical & horizontal communication" (C9), and "Development on continuous improvement practices" (C11). These CSFs, which also depend on other factors, are crucial for accelerating the adoption process. Because of their interdependencies and relative instability, it is possible for changes to one of these factors to have an impact on the adoption process as a whole.

The CSFs for "Standardized processes" (C10), "Team tool & process knowledge" (C13), "Employee learning & training for processes" (C15), "Lean education & training" (C16), and "Multidisciplinary Support & cooperation and collaboration" (C17) in the independent cluster exhibit strong driving power. While they may not be heavily dependent on other factors, these factors can directly advance the adoption process. However, their low dependence power suggests that they have some degree of autonomy. Dependent cluster include "Cost management &

economic benefit" (C3) and "Clear target and shared direction" (C6). The adoption process is heavily influenced by other factors in these CSFs. Their high degree of dependence suggests that changes in other factors may have a big impact on them. These results highlight the importance of understanding the various functions and connections among the CSFs. The categorization offers a framework for prioritizing adoption-related efforts while considering the relative importance, dependencies, and possible impacts of the various factors. It emphasizes the need for a well-balanced strategy, where factors with strong driving power are supported while acknowledging the factors that may be more vulnerable to changes from the outside because of their strong dependence.

6. Discussion of the Results and Implications

The study identifies the CSFs for successful Kaizen implementation in the textile industry, especially during disruptive events like the COVID-19 pandemic. Several studies have been undertaken to illustrate the benefits of Kaizen adoption in the textile sector including the ability to accumulate minor changes over time, reduce waste, increase production, motivate personnel, promote cooperation, and establish a corporate culture based on frugal habits and efficiency (Thomas Dao, 2022). For instance, according to research conducted by Chan & Tay (2018), the application of Kaizen in the textile industry has increased productivity, notably in the printing sector. decreased cycle time, work in progress, and product advancement were achieved via the use of line-balancing tools, facility layout, and standardized work, resulting in decreased waste and enhanced throughput. Also, Akter et al., (2015) claimed that Kaizen increases worker safety, job happiness, and labor recognition, all of which motivate workers to work. Proper training boosts motivation and line efficiency by 7%, resulting in more output, higher quality, and lower waste. Hence, Kaizen implementation is critical for the textile sector in an industrial context because it allows the industry to adapt, improve productivity, reduce waste, improve worker safety and motivation, and establish an efficient culture, all of which are critical for long-term success, particularly during disruptive events like the COVID-19 pandemic. Furthermore, Kaizen improves worker safety and job happiness, as well as motivation and overall labor performance. This strategy also fosters a company culture oriented on frugality and efficiency, which is critical for long-term success in the textile business, where innovation and response to market dynamics are critical to staying competitive. In this context, CSFs have been explored under three categories: Triple Helix Actors, industry, academia, and government views, for successful Kaizen implementation in times of crises. According to the results of the study, these CSFs are categorized into autonomous, independent, dependent, and linkage clusters, with the help of MICMAC analysis, for providing valuable insights into the dynamics and interdependencies within the adoption process.

6.1. Policy Implications

The results claimed that governmental actors play a significant role in creating an environment conducive to successful Kaizen implementation, emphasizing strategic alignment (C7) and clear target-setting (C6). Financial infrastructure (C2) and effective communication (C9) are crucial in the linkage category, ensuring access to financial resources and promoting transparent communication channels. Continuous improvement practices (C11) emphasize the need for a supportive policy landscape that encourages innovation and resilience-building. The findings highlight the need for active government participation in supporting Kaizen implementation in the textile sector is significant. In this context, policymakers should promote more strategic alignment and explicit target-setting to link the textile industry that aims with national objectives in order to achieve these results. Furthermore, investments in financial infrastructure and effective communication channels are required to guarantee that firms have access to resources and accurate information, for encouraging innovation and resilience. A legislative environment that fosters continuous improvement processes can help the sector adapt and grow, especially in the face of disruptive occurrences like the COVID-19 epidemic.

6.2. Practical Implications

For textile industry practitioners, the study offers valuable insights for enhancing adaptability, resilience, and long-term growth. Depending on the results, the CSFs such as standardized processes (C10), team tool & process knowledge (C13), and employee learning & training for processes (C15) have strong driving power, suggesting that industry players should focus on these factors to advance the adoption process. Investing in training and knowledge-sharing initiatives can foster a culture of continuous improvement. Linkage category CSFs, such as financial infrastructure (C2) and technology development (C4), demonstrate their critical role in accelerating the adoption process. Industry stakeholders should prioritize innovation and financial stability to navigate disruptions successfully. In the ISM technique, "high driving power" refers to a given factor's effect or potential to drive or affect other components in the system. When a factor has a high driving power, it has a great potential to influence and shape other elements in the model. As a result, concentrating on specific CSFs may have an impact on the overall system.

In light of this information, this study's practical implications for textile industry practitioners should include prioritizing standardization, training, and knowledge-sharing to support continual development, to increase flexibility and resilience. Furthermore, textile firms should invest in financial stability and innovation, acknowledging their critical role in Kaizen implementation. Furthermore, collaboration with political actors to harmonize sector goals, as well as maintaining a long-term strategy for sustainable growth, are other important lessons to take. These initiatives will enable textile sector companies to successfully handle changes and prosper in a competitive setting.

6.3. Academia Implications

Academic institutions play an essential part in the resilience and innovation of the textile sector. Findings underscore the importance of knowledge sharing (C12) and development of continuous improvement practices (C11). Academia can contribute by offering specialized training programs, research insights, and disseminating best practices related to Kaizen implementation in the textile sector. Strategic alignment (C7) and clear target-setting (C6) are essential CSFs that academia can promote. By aligning research efforts with industry needs and fostering a shared vision, academia can bridge the gap between theoretical knowledge and practical application, ultimately enhancing the industry's ability to overcome disruptions. Depending on these findings, this study has important implications for academics, emphasizing their critical part in strengthening the textile sector's resilience and creativity. According to the prominent CSFs in terms of academic perspective, academic institutions should prioritize information exchange, the establishment of continuous improvement techniques, and the promotion of strategy alignment and goal-setting clarity in the textile sector. Also, academia can bridge the gap between theory and practice by offering specialized training and education, executing relevant research, and aligning their efforts with industry needs, thereby enhancing the textile industry's ability to adapt and innovate, especially during disruptive events like the COVID-19 pandemic.

7. Conclusion

The international textile industry, which makes a considerable contribution to commerce and employment, is faced with several difficulties, such as shifting consumer preferences, fierce competition, and disruptive events. Significant changes were made to manufacturing, supply systems, and customer demands because of the COVID-19 epidemic in sectors including textiles. As the COVID-19 epidemic continued, it was also crucial to provide customers with high-quality surgical masks, a necessary piece of personal protective equipment (PPE), as promptly and safely as possible (Demirtas et al., 2022). Another issue resulting from the pandemic was related to the response times of the supplies. While a faster market response is more crucial in process-based businesses like textiles than it is in discrete or continuous operations, long lead times and high waste rates raise manufacturing costs (Ajmera et al., 2017). A continual improvement strategy is necessary to address these issues and provide resilience. Success has been found in many industries employing the Japanese idea of Kaizen, which emphasizes steady improvement. Further research is necessary, however, to determine its precise applicability in the textile industry, particularly in disruptive situations like the pandemic. Therefore, this research delves into the specific application of Kaizen in the textile industry during disruptive events like the COVID-19 pandemic by analyzing CSFs within industry, academia, and government perspectives. Also, this study offers valuable guidance to textile businesses striving for adaptability, resilience, and long-term growth.

With industry, academia, and government acting perspectives, this study utilizes the Triple Helix paradigm to investigate the CSFs of textile enterprises. Also, this study uses ISM and MICMAC analysis to evaluate the identified CSFs, integrating Triple Helix Actors. It provides insights and recommendations for each actor's contribution, such as industry engagement for financial stability, academia's role in research and instruction, and government support for regulatory environment and continuous improvement. The major contribution of this study to the existing literature could be the implications we have presented which can contribute to a deeper knowledge of how Kaizen can be successfully used in the textile industry during disruptions and assist the sector in successfully managing problems.

Considering the sample size as a limitation, generalizability can be the major limitation of this study. To enhance the generalizability of the study, it is important to conduct it with larger samples. Additionally, since this study was conducted in a specific country, it may not be fully adaptable to other countries. Because geographical changes and economic and social differences for CSFs are not the same in other countries, they may lead to different results.

7.1. Further Research Ideas

There are several promising areas for further investigation that can expand and refine our knowledge. Firstly, in-depth case studies can unlock practical knowledge by examining organizations that have successfully implemented Kaizen during disruptive events. Secondly, by comparing the CSFs identified in the textile industry with those from sectors like manufacturing, technology, or healthcare, researchers can discern common patterns and unique factors. Thirdly, the rapid advancement of technology, particularly the emergence of Industry 4.0 solutions, has the potential to revolutionize the way Kaizen is applied in the textile industry. Also, future research should explore the integration of these technological advancements with Kaizen practices, such as data analytics, artificial intelligence, smart manufacturing, and digital SC management. the textile industry during disruptive events. This collaborative effort between academia, practitioners, and policymakers will foster a more resilient and sustainable textile industry while serving as a model for other sectors seeking to navigate the complexities of a rapidly changing world.

Declaration of Competing Interest

The authors affirm that they do not possess any recognizable financial interests or personal associations that might have seemed to affect the research presented in this paper.

References

1. Abbes, N., Sejri, N., Xu, J., & Cheikhrouhou, M. (2022). New Lean Six Sigma readiness assessment model using fuzzy logic: Case study within clothing industry. *Alexandria Engineering Journal*, *61*(11), 9079-9094.
2. Adikorley, R. D., Rothenberg, L., & Guillory, A. (2017). Lean Six Sigma applications in the textile industry: a case study. *International journal of lean six sigma*, *8*(2), 210-224.
3. Ahmad, M., Tang, X. W., Qiu, J. N., & Ahmad, F. (2019). Interpretive structural modeling and MICMAC analysis for identifying and benchmarking significant factors of seismic soil liquefaction. *Applied Sciences*, *9*(2), 233.
4. Ajmera, R., Umarani, P., & Valase, K. G. (2017). Lean six sigma implementation in textile industry. *International Research Journal of Engineering and Technology*, *4*(04), 1670-1676.
5. Akter, S., Raiyan Yasmin, F., & Ferdous, M. A. (2015). Implementation of kaizen for continuous improvement of productivity in garment industry in Bangladesh. *American Academic & Scholarly Research Journal*, *7*(3), 229-243.
6. Akter, S., Raiyan Yasmin, F., & Ferdous, M. A. (2015). Implementation of kaizen for continuous improvement of productivity in garment industry in Bangladesh. *American Academic & Scholarly Research Journal*, *7*(3).
7. Al Smadi, S. (2009). Kaizen strategy and the drive for competitiveness: challenges and opportunities. Competitiveness Review: An International Business Journal, 19(3), 203-211.
8. Alvarado-Ramírez, K. M., Pumisacho-Álvaro, V. H., Miguel-Davila, J. Á., & Suárez Barraza, M. F. (2018). Kaizen, a continuous improvement practice in organizations: a comparative study in companies from Mexico and Ecuador. *The TQM Journal*, *30*(4), 255-268.
9. Attri, R., Dev, N., & Sharma, V. (2013). Interpretive structural modelling (ISM) approach: an overview. *Research journal of management sciences*, *2319*(2), 1171, 3-8.
10. Attri, R., Singh, B., & Mehra, S. (2017). Analysis of interaction among the barriers to 5S implementation using interpretive structural modeling approach. *Benchmarking: An International Journal*, *24*(7), 1834-1853.

11. Bakas, O., Govaert, T., & Van Landeghem, H. (2011). Challenges and success factors for implementation of lean manufacturing in European SMES. In *13th International conference on the modern information technology in the innovation processes of the industrial enterprise (MITIP 2011)* (Vol. 1). Tapir Academic Press.
12. Barve, A., Kanda, A., & Shankar, R. (2007). Analysis of interaction among the barriers of third party logistics. *International Journal of Agile Systems and Management*, *2*(1), 109-129.
13. Bateman, N. (2005). Sustainability: the elusive element of process improvement. *International journal of operations & production management, 25*(3), 261-276.
14. Berberoglu, Y., Kazancoglu, Y., & Sagnak, M. (2023). Circularity assessment of logistics activities for green business performance management. *Business Strategy and the Environment*.
15. Berger, A. (1997). Continuous improvement and kaizen: standardization and organizational designs. *Integrated manufacturing systems*, *8*(2), 110-117.
16. Bhat, S., Gijo, E. V., Rego, A. M., & Bhat, V. S. (2021). Lean Six Sigma competitiveness for micro, small and medium enterprises (MSME): an action research in the Indian context. *The TQM Journal*, *33*(2), 379-406.
17. Bradley, J. R., & Willett, J. (2004). Cornell students participate in Lord Corporation's kaizen projects. *Interfaces*, *34*(6), 451-459.
18. Brunet, A. P., & New, S. (2003). Kaizen in Japan: an empirical study. International Journal of Operations & Production Management, *23*(12), 1426-1446.
19. Chan, C. O., & Tay, H. L. (2018). Combining lean tools application in kaizen: a field study on the printing industry. *International Journal of Productivity and Performance Management*, *67*(1), 45-65.
20. Chiarini, A., & Kumar, M. (2022). What is Quality 4.0? An exploratory sequential mixed methods study of Italian manufacturing companies. *International Journal of Production Research*, *60*(16), 4890-4910.
21. Citybabu, G., & Yamini, S. (2022). The implementation of Lean Six Sigma framework in the Indian context: a review and suggestions for future research. *The TQM Journal*, *34*(6), 1823-1859.

22. Cooney, R., & Sohal, A. (2004). Teamwork and total quality management: a durable partnership. *Total Quality Management & Business Excellence*, *15*(8), 1131-1142.

23. Debnath, B., Bari, A. M., de Jesus Pacheco, D. A., & Karmaker, C. L. (2023). An integrated Best–Worst Method and Interpretive Structural Modeling approach for assessing the barriers to circular economy implementation. *Decision Analytics Journal*, *7*, 100250.

24. Deepu, T. S. & Ravi, V. (2023). An ISM-MICMAC approach for analyzing dependencies among barriers of supply chain digitalization. *Journal of Modelling in Management*, *18*(3), 817-841.

25. Deming W E (1995), *The New Economics for Industry Government and Education*, 2nd Edition, MIT Press, Cambridge, MA.

26. Demirtas, E. A., Gultekin, O. S., & Uskup, C. (2022). A case study for surgical mask production during the COVID-19 pandemic: continuous improvement with Kaizen and 5S applications. *International Journal of Lean Six Sigma*, *14*(3), 679-703.

27. Díaz-Reza, J. R., García-Alcaraz, J. L., Avelar-Sosa, L., Mendoza-Fong, J. R., Saenz Diez-Muro, J. C., & Blanco-Fernández, J. (2018). The role of managerial commitment and TPM implementation strategies in productivity benefits. *Applied Sciences*, *8*(7), 1153.

28. Farhana, K., Mahamude, A. S. F., & Mica, M. T. (2022). The Scenario of Textile Industry in Malaysia: A Review for Potentiality. *Materials Circular Economy*, *4*(1), 20.

29. Farris, J. A. (2006). *An empirical investigation of kaizen event effectiveness: outcomes and critical success factors* (Doctoral dissertation). ETDs: Virginia Tech Electronic Theses and Dissertations – USA.

30. Farris, J. A., Van Aken, E. M., Doolen, T. L., & Worley, J. (2008). Learning from less successful Kaizen events: a case study. *Engineering management journal*, *20*(3), 10-20.

31. Farris, J. A., Van Aken, E. M., Doolen, T. L., & Worley, J. (2009). Critical success factors for human resource outcomes in Kaizen events: An empirical study. *International journal of production economics*, *117*(1), 42-65.

32. Fryer, K. J., Antony, J., & Douglas, A. (2007). Critical success factors of continuous improvement in the public sector: A literature review and some key findings. *The TQM magazine*, *19*(5), 497-517.

33. García, J. L., Rivera, D. G., & Iniesta, A. A. (2013). Critical success factors for Kaizen implementation in manufacturing industries in Mexico. *The International Journal of Advanced Manufacturing Technology*, *68*, 537-545.
34. Glover, W. J., Farris, J. A., Van Aken, E. M., & Doolen, T. L. (2011). Critical success factors for the sustainability of Kaizen event human resource outcomes: An empirical study. *International journal of production economics*, *132*(2), 197-213.
35. Gómez, J. A. H., Morales, S. N., Pérez, L. R., López, R. R., & Anaya, L. G. G. (2014). Factores críticos de éxito para la implementación estratégica del MPT: una revisión de literatura. *Ingeniería Industrial. Actualidad y Nuevas Tendencias*, *4*(13), 92-105.
36. Govindan, K., Azevedo, S. G., Carvalho, H., & Cruz-Machado, V. (2015). Lean, green and resilient practices influence on supply chain performance: interpretive structural modeling approach. *International Journal of Environmental Science and Technology*, *12*, 15-34.
37. Hasan, M. A., Shankar, R., & Sarkis, J. (2007). A study of barriers to agile manufacturing. *International Journal of Agile Systems and Management*, *2*(1), 1-22.
38. Hernández Gómez, A., Escobar Toledo, C., Larios Prado, J. M., & Noriega Morales, S. (2015). Factores críticos de éxito para el despliegue del mantenimiento productivo total en plantas de la industria maquiladora para la exportación en Ciudad Juárez: una solución factorial. *Contaduría y administración*, *60*, 82-106.
39. Hoque, I., Maalouf, M. M., Tanha, M., Islam, M. S., Alam, M. Z., & Sarker, M. (2023). Implementing and sustaining lean, buyer-supplier role, and COVID-19 pandemic: insights from the garment industry of Bangladesh. *International Journal of Lean Six Sigma*, 2040-4166.
40. Hussain, Z. (2021). Paradigm of technological convergence and digital transformation: The challenges of CH sectors in the global COVID-19 pandemic and commencing resilience-based structure for the post-COVID-19 era. *Digital Applications in Archaeology and Cultural Heritage*, *21*, e00182.
41. Imai, M. (1994). *Kaizen: a estratégia para o sucesso competitivo*. Imam.
42. Jacob, D. (2017). Quality 4.0 impact and strategy handbook: getting digitally connected to transform quality management. *LNS Research: Cambridge, MA, USA*.
43. Janjić, V., Todorović, M., & Jovanović, D. (2020). Key success factors and benefits of Kaizen implementation. *Engineering Management Journal*, *32*(2), 98-106.

44. Jena, J., Sidharth, S., Thakur, L. S., Kumar Pathak, D., & Pandey, V. C. (2017). Total interpretive structural modeling (TISM): approach and application. *Journal of Advances in Management Research*, *14*(2), 162-181.
45. Jharkharia, S., & Shankar, R. (2005). IT-enablement of supply chains: understanding the barriers. *Journal of Enterprise Information Management*, *18*(1), 11-27.
46. Joshi, S., Sharma, M., Bartwal, S., Joshi, T., & Prasad, M. (2022). Critical challenges of integrating OPEX strategies with I4. 0 technologies in manufacturing SMEs: A few pieces of evidence from developing economies. *The TQM Journal*.
47. Kannan, D., Diabat, A., & Shankar, K. M. (2014). Analyzing the drivers of end-of-life tire management using interpretive structural modeling (ISM). *The International Journal of Advanced Manufacturing Technology*, *72*(9-12), 1603-1614.
48. Kapuria, T. K., Rahman, M., & Haldar, S. (2017). Root cause analysis and productivity improvement of an apparel industry in Bangladesh through kaizen implementation. *Journal of applied research on industrial engineering*, *4*(4), 227-239.
49. Katayama, H. (2007). On a framework of inter-generation transfer of Kaizen technology. In *Proceeding of the 3rd International Congress on Logistic and SCM Systems*, 19-28.
50. Kaur, J., Sidhu, R., Awasthi, A., & Srivastava, S. K. (2019). A Pareto investigation on critical barriers in green supply chain management. *International Journal of Management Science and Engineering Management*, *14*(2), 113-123.
51. Khaba, S., Bhar, C., & Ray, A. (2021). A study on key lean enablers of the coal mining sector using ISM, MICMAC and SEM. *The TQM Journal*, *33*(6), 1281-1305.
52. Köksal, D., Strähle, J., Müller, M., & Freise, M. (2017). Social sustainable supply chain management in the textile and apparel industry—A literature review. Sustainability, 9(1), 100.
53. Kumar, A., Sah, B., Singh, A. R., Deng, Y., He, X., Kumar, P., & Bansal, R. C. (2017). A review of multi criteria decision making (MCDM) towards sustainable renewable energy development. *Renewable and Sustainable Energy Reviews*, *69*, 596-609.
54. Lee, S. S., Dugger, J. C., & Chen, J. C. (2000). Kaizen: An essential tool for inclusion in industrial technology curricula. *Journal of Industrial Technology*, *16*(1), 1-7.
55. Malone, D. W. (1975). An introduction to the application of interpretive structural modeling. *Proceedings of the IEEE*, *63*(3), 397-404.

56. Malsinghe, M. T. D., Gunathilaka, M. H. A., Dinesh Bandara, I. P. C., Wijerathne, A. I., Nagendrakumar, N., & Madhavika, W. D. N. (2022). Sustainable Supply Chains of Sri Lankan Manufacturing Organizations: A Study on Operational Excellence Models During the COVID-19 Pandemic. *Operations and Supply Chain Management: An International Journal*, *15*(2), 228-239.
57. McMaster, M., Nettleton, C., Tom, C., Xu, B., Cao, C., & Qiao, P. (2020). Risk management: Rethinking fashion supply chain management for multinational corporations in light of the COVID-19 outbreak. *Journal of Risk and Financial Management*, *13*(8), 173.
58. Melnyk, S. A., Calantone, R. J., Montabon, F. L., & Smith, R. T. (1998). Short-term action in pursuit of long-term improvements: introducing Kaizen events. *Production and Inventory Management Journal*, *39*(4), 69.
59. Mishra, T., Chatterjee, S., & Thakkar, J. J. (2023). Effect of coronavirus pandemic in changing the performance barriers for textile and apparel industry in an emerging market. *Journal of Cleaner Production*, *390*, 136097.
60. Murata, K., & Katayama, H. (2010). Development of Kaizen case-base for effective technology transfer–a case of visual management technology. *International Journal of Production Research*, *48*(16), 4901-4917.
61. Muruganantham, G., Vinodh, S., Arun, C. S., & Ramesh, K. (2018). Application of interpretive structural modelling for analysing barriers to total quality management practices implementation in the automotive sector. *Total Quality Management & Business Excellence*, *29*(5-6), 524-545.
62. Nasim, S. (2011). Total interpretive structural modeling of continuity and change forces in e-government. *Journal of Enterprise Transformation*, *1*(2), 147-168.
63. Netland, T. H. (2016). Critical success factors for implementing lean production: the effect of contingencies. *International Journal of Production Research*, *54*(8), 2433-2448.
64. Nguyen, T. L. (2019). STEAM-ME: a novel model for successful kaizen implementation and sustainable performance of SMEs in vietnam. *Complexity*, *2019*.
65. Ohno, I., Ohno, K., Uesu, S., Ishiwata, A., Hosono, A., Kikuchi, T., & Uenda, T. (2009). Introducing kaizen in Africa. In *GRIPS Development Forum*, 1(1), 1-8.

66. Omotayo, T. S., Kulatunga, U., & Bjeirmi, B. (2018). Critical success factors for Kaizen implementation in the Nigerian construction industry. *International Journal of Productivity and Performance Management*, *67*(9), 1816-1836.
67. Opricovic, S., & Tzeng, G. H. (2004). Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS. *European journal of operational research*, *156*(2), 445-455.
68. Palit, T., Bari, A. M., & Karmaker, C. L. (2022). An integrated Principal Component Analysis and Interpretive Structural Modeling approach for electric vehicle adoption decisions in sustainable transportation systems. *Decision Analytics Journal*, *4*, 100119.
69. Palmer, V. S. (2001). Inventory management KAIZEN. In *Proceedings 2nd International Workshop on Engineering Management for Applied Technology. EMAT 2001,* 55-56. IEEE.
70. Patil, H. A. (2003). *A standard framework for sustaining Kaizen events* (Doctoral dissertation, Wichita State University, Department of Industrial and Manufacturing Engineering).
71. Piechnicki, A. S., Sola, A. V. H., & Trojan, F. (2015). Decision-making towards achieving world-class total productive maintenance. *International journal of operations & production management*, *35*(12), 1594-1621.
72. Prasad, M. M., Dhiyaneswari, J. M., Jamaan, J. R., Mythreyan, S., & Sutharsan, S. M. (2020). A framework for lean manufacturing implementation in Indian textile industry. *Materials today: proceedings*, *33*, 2986-2995.
73. Quddus, M. A., & Ahsan, A. N. (2014). A shop-floor kaizen breakthrough approach to improve working environment and productivity of a sewing floor in RMG industry. *Journal of Textile and Apparel, Technology and Management*, *8*(4).
74. Rajpoot, P. S., Kurmi, L., & Thakur, R. S. (2021). Productivity Improvement in Indian Garments Industry through Lean Manufacturing Kanban Tool. *Journal homepage: www. ijrpr. com ISSN*, *2582*, 7421.
75. Ravi, V., Shankar, R., & Tiwari, M. K. (2005). Productivity improvement of a computer hardware supply chain. *International Journal of Productivity and Performance Management*, *54*(4), 239-255.

76. Razak, A. A., & White, G. R. (2015). The Triple Helix Model for Innovation: A holistic exploration of barriers and enablers. *International Journal of Business Performance and Supply Chain Modelling*, *7*(3), 278-291.
77. Reyes, J., Mula, J., & Díaz-Madroñero, M. (2021). Development of a conceptual model for lean supply chain planning in industry 4.0: multidimensional analysis for operations management. *Production Planning & Control*, 1-16.
78. Rich, N., & Bateman, N. (2003). Companies' perceptions of inhibitors and enablers for process improvement activities. *International Journal of Operations & Production Management*, *23*(2), 185-199.
79. Rivera-Mojica, D., & Rivera-Mojica, L. (2014). Critical success factors for kaizen implementation. *Lean Manufacturing in the Developing World: Methodology, Case Studies and Trends from Latin America*, 157-178.
80. Rochmawati. (2013). Development of the Kaizen Model with the Fishbone Cause and Effect Diagram Tool for Improving the Quality of the Integrated Bojonegoro Model School. Thesis: Program Studi Management Pendidikan, State University of Malang.
81. Sagnak, M., Berberoglu, Y., Memis, İ., & Yazgan, O. (2021). Sustainable collection center location selection in emerging economy for electronic waste with fuzzy Best-Worst and fuzzy TOPSIS. *Waste Management*, *127*, 37-47.
82. Saleeshya, P. G., Raghuram, P., & Vamsi, N. (2012). Lean manufacturing practices in textile industries–a case study. *International journal of collaborative enterprise*, *3*(1), 18-37.
83. Samanta, M., Virmani, N., Singh, R. K., Haque, S. N., & Jamshed, M. (2023). Analysis of critical success factors for successful integration of lean six sigma and Industry 4.0 for organizational excellence. *The TQM Journal*.
84. Siagian, H., & Tarigan, Z. (2021). The central role of it capability to improve firm performance through lean production and supply chain practices in the COVID-19 era. *Uncertain Supply Chain Management*, *9*(4), 1005-1016.
85. Silva, N., Perera, H. S. C., & Samarasinghe, D. (2011). Factors affecting successful implementation of lean manufacturing tools and techniques in the apparel industry in Sri Lanka. *Available at SSRN 1824419*.

86. Singh, J., & Singh, H. (2009). Kaizen philosophy: a review of literature. *IUP journal of operations management*, *8*(2), 51.
87. Soltero, C., & Waldrip, G. (2002). Using kaizen to reduce waste and prevent pollution. *Environmental Quality Management*, *11*(3), 23-23.
88. Sony, M., Antony, J., & Douglas, J. A. (2020). Essential ingredients for the implementation of Quality 4.0: a narrative review of literature and future directions for research. *The TQM Journal*.
89. Suárez-Barraza, M. F., Ramis-Pujol, J., & Kerbache, L. (2011). Thoughts on kaizen and its evolution: Three different perspectives and guiding principles. *International Journal of Lean Six Sigma*, *2*(4), 288-308.
90. Sumarliah, E., Usmanova, K., Fauziyah, F., & Mousa, K. (2021). Managing the risks in the clothing supply chain considering the coronavirus pandemic. *Operations and Supply Chain Management: An International Journal*, *14*(4), 576-587.
91. Takyi-Annan, G. E., & Zhang, H. (2023). A bibliometric analysis of building information modelling implementation barriers in the developing world using an interpretive structural modelling approach. Heliyon.
92. Talib, F., Rahman, Z., & Qureshi, M. N. (2011). Analysis of interaction among the barriers to total quality management implementation using interpretive structural modeling approach. *Benchmarking: An International Journal*, *18*(4), 563-587.
93. Tamtam, F., & Tourabi, A. (2021). Interpretive structural modeling of supply chain leagility during COVID-19. *IFAC-PapersOnLine*, *54*(17), 12-17.
94. Thirupathi, R. M., & Vinodh, S. (2016). Application of interpretive structural modelling and structural equation modelling for analysis of sustainable manufacturing factors in Indian automotive component sector. *International Journal of Production Research*, *54*(22), 6661-6682.
95. Thomas Dao. (2022, December 20). Kaizen In Garment Industry: Understanding The Importance of Kaizen Implementation. Retrieved from: https://vietnamclothingmanufacturer.com/kaizen-in-garment-industry/
96. Tseng, M. L., Bui, T. D., Lim, M. K., Fujii, M., & Mishra, U. (2022). Assessing data-driven sustainable supply chain management indicators for the textile industry under industrial

disruption and ambidexterity. *International Journal of Production Economics*, *245*, 108401.

97. Van Aken, E. M., Farris, J. A., Glover, W. J., & Letens, G. (2010). A framework for designing, managing, and improving Kaizen event programs. *International Journal of Productivity and Performance Management*, *59*(7), 641-667.
98. Vieira, L., Balbinotti, G., Varasquin, A., & Gontijo, L. (2012). Ergonomics and Kaizen as strategies for competitiveness: a theoretical and practical in an automotive industry. *Work*, *41*(Supplement 1), 1756-1762.
99. Vinodh, S., & Chintha, S. K. (2011). Leanness assessment using multi-grade fuzzy approach. *International Journal of Production Research*, *49*(2), 431-445.
100. Vinodh, S., Ramesh, K., & Arun, C. S. (2016). Application of interpretive structural modelling for analysing the factors influencing integrated lean sustainable system. *Clean Technologies and Environmental Policy*, *18*, 413-428.
101. Wickramasinghe, G. L. D., & Wickramasinghe, V. (2016). Effects of continuous improvement on shop-floor employees' job performance in lean production: the role of lean duration. *Research Journal of Textile and Apparel*, *20*(4), 182-194.
102. Wittenberg, G. (1994). Kaizen—The many ways of getting better. *Assembly Automation*, *14*(4), 12-17.
103. Yeravdekar, S., & Behl, A. (2017). Benchmarking model for management education in India: a total interpretive structural modeling approach. *Benchmarking: An International Journal*, *24*(3), 666-693.
104. Zargun, S., & Al-Ashaab, A. (2014). Critical success factors for lean manufacturing: a systematic literature review an international comparison between developing and developed countries. *Advanced Materials Research*, *845*, 668-681.
105. Zighan, S., & Ruel, S. (2023). SMEs' resilience from continuous improvement lenses. *Journal of Entrepreneurship in Emerging Economies*, *15*(2), 233-253.

The analysis of critical success factors for successful kaizen implementation during the COVID-19 pandemic: a textile industry case study

Kazancoglu, Yigit

Kazancoglu Y, Lafci C, Berberoglu Y, et al., (2023) The analysis of critical success factors for successful kaizen implementation during the COVID-19 pandemic: a textile industry case study. The TQM Journal, Available online 18 December 2023

https://doi.org/10.1108/TQM-08-2023-0254