

A Literature Review on Developing A Framework for Improving Quality of Supply Chain in Construction Industry

Nithin R¹ and Aswin Bharath A²

Post Graduate Student, M.E Construction Management, Department of Civil Engineering¹

Assistant Professor, M.E Construction Management, Department of Civil Engineering²

Kumaraguru College of Technology, Coimbatore, Tamil Nadu, India

Abstract: Quality management is of paramount importance in the construction industry's supply chain. The construction sector relies on a complex network of suppliers, subcontractors, and vendors to deliver projects of high quality. This abstract highlights the significance of quality in supply chain management within the construction industry. Effective quality management ensures that materials, products, and services meet the specified standards and requirements. It involves the establishment and implementation of robust quality assurance processes, including inspections, audits, and certifications. These measures aim to identify and rectify any quality issues at various stages of the supply chain, ensuring that only superior-quality inputs are utilized in construction projects. Supplier selection and management play a crucial role in maintaining quality in the supply chain. By carefully evaluating potential suppliers and maintaining strong relationships with existing ones, construction companies can ensure a reliable flow of high-quality materials and services. Supplier performance is regularly monitored, and improvement initiatives are undertaken to foster a culture of continuous quality improvement. Quality management also serves as a vital component of risk management in the construction supply chain. By enforcing stringent quality control measures, construction companies can minimize the risks associated with substandard materials, equipment failures, and non-compliant processes. This proactive approach reduces the likelihood of project delays, cost overruns, and safety incidents. Effective collaboration and communication among supply chain stakeholders are essential for achieving and maintaining quality standards. Clear and transparent communication channels enable timely information exchange, facilitating prompt decision-making and issue resolution. Collaborative efforts between contractors, suppliers, and subcontractors foster a shared commitment to quality, resulting in enhanced project outcomes.

Keywords: six sigma, supply chain, Effective quality management, stakeholders.

I. INTRODUCTION

Quality management plays a critical role in the construction industry's supply chain. With complex and interconnected processes involving multiple stakeholders, it is essential to ensure that materials, products, and services meet the required quality standards. Poor quality can lead to project delays, cost overruns, safety hazards, and dissatisfied clients. Therefore, effective quality management practices are imperative to uphold the reputation of construction companies and ensure successful project outcomes. The construction industry's supply chain encompasses various stages, from sourcing raw materials to delivering the final product or service to the client. Each stage presents unique challenges and opportunities for quality management. By implementing robust quality management practices throughout the supply chain, construction companies can minimize defects, enhance productivity, reduce risks, and maintain customer satisfaction. Quality management in the construction supply chain involves several key components. Firstly, it entails the selection and evaluation of suppliers and subcontractors who can consistently provide high-quality materials, equipment, and services. Rigorous supplier evaluation processes, including assessing certifications and past performance, help ensure a reliable supply of quality inputs. Secondly, quality management in the supply chain requires the establishment of comprehensive quality assurance procedures. These procedures involve conducting inspections,

audits, and quality control checks at various stages, such as during material procurement, fabrication, and construction activities. By monitoring quality at each step, potential issues can be identified and addressed promptly, reducing the likelihood of defects or non-compliance with standards. Thirdly, effective communication and collaboration among supply chain stakeholders are crucial for quality management. Clear communication channels facilitate the exchange of information, expectations, and requirements, enabling suppliers, subcontractors, and construction teams to align their efforts towards delivering the desired quality outcomes. Collaborative relationships foster a shared commitment to quality and encourage proactive problem-solving. Lastly, continuous improvement is a fundamental aspect of quality management in the construction supply chain. By collecting and analysing data, construction companies can identify areas for improvement, implement corrective actions, and enhance quality control processes. Regular review and evaluation of performance metrics help drive a culture of continuous learning and improvement, ensuring sustained quality throughout the supply chain

II. SIX SIGMA IN CONSTRUCTION INDUSTRY

Six Sigma is a widely recognized and applied methodology for process improvement in various industries, including the construction industry. Originally developed by Motorola in the 1980s, Six Sigma focuses on reducing process variation and defects to improve quality and efficiency. In the construction industry, where projects involve complex processes and numerous stakeholders, Six Sigma can be beneficial in several ways:

- **Quality Improvement:** Six Sigma aims to minimize defects and errors by using statistical analysis and measurement techniques. This can help construction companies enhance the quality of their deliverables, leading to higher customer satisfaction and reduced rework.
- **Cost Reduction:** By identifying and eliminating waste, inefficiencies, and defects, Six Sigma can help construction companies reduce costs associated with rework, delays, and material waste. It promotes a data-driven approach to identify root causes of problems and implement effective solutions.
- **Time Management:** Six Sigma emphasizes streamlining processes and reducing cycle times. By identifying bottlenecks and process inefficiencies, construction projects can be completed more quickly, leading to improved project schedules and timely project delivery.
- **Risk Management:** Construction projects are inherently risky, and Six Sigma provides a structured approach to identify, measure, and mitigate risks. By analysing data and applying statistical tools, construction companies can better understand and manage project risks, reducing the likelihood of costly delays and errors.
- **Stakeholder Satisfaction:** Six Sigma focuses on understanding and meeting customer requirements. By implementing a customer-centric approach, construction companies can enhance stakeholder satisfaction by delivering projects that meet or exceed expectations.
- **Continuous Improvement:** Six Sigma promotes a culture of continuous improvement by utilizing feedback, data analysis, and process monitoring. Construction companies can benefit from ongoing measurement and analysis of key performance indicators, allowing them to make data-driven decisions and constantly improve their processes and outcomes.

III. LITERATURE REVIEW

Wenjuan Zeng , Mike YK Tse and Minmin Tang / (2018) The Chinese construction industry has experienced significant growth and development in recent years, necessitating effective supply chain quality management practices to ensure the delivery of high-quality projects. This investigation focuses on examining the state of supply chain quality management within the Chinese construction industry and aims to identify challenges, best practices, and areas for improvement.

The investigation adopts a comprehensive methodology, including a literature review, data collection through surveys, interviews, and site visits, data analysis using statistical techniques and qualitative methods, and the study of case studies. By analysing the collected data, the study aims to provide a comprehensive understanding of the current state of supply chain quality management practices, identify challenges and barriers, assess the impact of quality management on project outcomes, and explore best practices.

The expected outcomes of this investigation include a comprehensive understanding of current supply chain quality management practices in the Chinese construction industry, identification of challenges and barriers hindering effective quality management, insights into the impact of quality management on project outcomes, and recommendations for improving supply chain quality management. These recommendations may involve process improvements, technology adoption, training programs, and collaborative initiatives among stakeholders.

Georgios A. Papadopoulos*, Nadia Zamer, Sotiris P. Gayialis, Ilias P. Tatiopoulos / 2016 The construction industry operates within complex and dynamic supply chains, making supply chain management crucial for project success. This summary focuses on supply chain improvement in the construction industry, highlighting key challenges, strategies, and potential benefits. The construction industry faces challenges such as fragmented supply chains, lack of collaboration among stakeholders, poor communication, and inefficient processes. These challenges result in delays, cost overruns, and compromised project quality. Therefore, there is a need for supply chain improvement to enhance efficiency, reduce waste, and optimize resource allocation. To improve supply chain performance, various strategies can be implemented. These include implementing lean principles to streamline processes, adopting technology solutions for better communication and information sharing, fostering collaboration among stakeholders, and implementing supply chain sustainability practices. These strategies aim to enhance coordination, minimize disruptions, and improve overall project outcomes.

Supply chain improvement in the construction industry offers several benefits. It helps in reducing project costs through optimized procurement and inventory management, minimizing waste and rework, and enhancing productivity. Improved supply chains also contribute to faster project delivery, improved quality control, and enhanced customer satisfaction. Moreover, sustainable supply chain practices reduce environmental impact and promote social responsibility within the industry.

Erin M.mitchell, Jamison V.kovach / 2016 The construction industry operates within complex and dynamic supply chains, making supply chain management crucial for project success. This summary focuses on supply chain improvement in the construction industry, highlighting key challenges, strategies, and potential benefits. The construction industry faces challenges such as fragmented supply chains, lack of collaboration among stakeholders, poor communication, and inefficient processes. These challenges result in delays, cost overruns, and compromised project quality. Therefore, there is a need for supply chain improvement to enhance efficiency, reduce waste, and optimize resource allocation. To improve supply chain performance, various strategies can be implemented. These include implementing lean principles to streamline processes, adopting technology solutions for better communication and information sharing, fostering collaboration among stakeholders, and implementing supply chain sustainability practices. These strategies aim to enhance coordination, minimize disruptions, and improve overall project outcomes. Supply chain improvement in the construction industry offers several benefits. It helps in reducing project costs through optimized procurement and inventory management, minimizing waste and rework, and enhancing productivity. Improved supply chains also contribute to faster project delivery, improved quality control, and enhanced customer satisfaction. Moreover, sustainable supply chain practices reduce environmental impact and promote social responsibility within the industry.

Alfred Wong /2010 Total Quality Management (TQM) is a management approach focused on continuous improvement, customer satisfaction, and defect prevention. This summary discusses the application of TQM in the construction industry in Hong Kong, specifically from a supply chain management perspective. In Hong Kong's construction industry, the effective implementation of TQM practices is crucial to enhance project quality, meet customer expectations, and maintain a competitive edge. TQM emphasizes the involvement of all stakeholders in quality improvement efforts, including contractors, subcontractors, suppliers, and clients. From a supply chain management perspective, TQM in the construction industry involves implementing quality management practices throughout the entire supply chain. This includes establishing strong relationships with suppliers, ensuring the quality of materials and equipment, and promoting collaboration and communication among all parties involved in the construction process. The key principles of TQM in the construction industry in Hong Kong include a customer-

focused approach, continuous improvement, employee involvement and empowerment, data-driven decision-making, and a process-oriented mindset. By adhering to these principles, construction companies can improve project quality, reduce defects and rework, and enhance overall supply chain performance. To effectively implement TQM, construction companies in Hong Kong need to adopt a systematic approach that includes setting quality objectives, developing quality control processes, conducting regular inspections and audits, and providing training and development opportunities for employees. Continuous monitoring and evaluation of performance are also vital to ensure ongoing improvement.

Universidade do Minho, Braga, Portugal, and Huy Quang Truong / 2015 The proposed conceptual model emphasizes the seamless coordination and collaboration between supply chain activities and quality management practices. It recognizes that effective quality management is essential at every stage of the supply chain, from supplier selection to product/service delivery.

The key components of the conceptual model include:

- **Supplier Quality Management:** Implementing robust supplier evaluation and selection processes, conducting supplier audits, and fostering strong relationships with high-quality suppliers to ensure the procurement of reliable and consistent inputs.
- **Quality Assurance:** Developing quality control processes and implementing quality assurance activities to prevent defects, ensure compliance with standards, and maintain consistent product/service quality throughout the supply chain.
- **Continuous Improvement:** Emphasizing a culture of continuous improvement through techniques such as Lean Six Sigma, Kaizen, and Total Quality Management (TQM). This involves identifying areas for improvement, implementing corrective actions, and monitoring performance metrics to drive ongoing enhancement.
- **Information Sharing and Collaboration:** Facilitating effective communication and information sharing among supply chain partners to improve visibility, transparency, and responsiveness. Collaborative efforts help identify and address quality issues promptly, streamline processes, and enhance overall supply chain performance.
- **Performance Measurement:** Establishing key performance indicators (KPIs) and metrics to monitor quality performance at various stages of the supply chain. This enables organizations to track progress, identify deviations, and make data-driven decisions to ensure quality standards are met consistently.

By integrating SCM and QM through this conceptual model, organizations can achieve several benefits, including improved product/service quality, enhanced customer satisfaction, reduced costs, increased efficiency, and a competitive advantage in the marketplace.

Carol J. Robinson, Manoj K. Malhotra/2005 Supply chain quality management is a concept that focuses on ensuring the delivery of high-quality products or services throughout the supply chain. It involves implementing strategies, processes, and practices to monitor and control quality at every stage of the supply chain, from raw material procurement to end-user delivery. This summary highlights the relevance of supply chain quality management to both academic research and industrial practice. In academic research, supply chain quality management is a topic of interest due to its potential impact on organizational performance, customer satisfaction, and competitive advantage. Researchers explore various aspects of quality management, such as quality control methods, supplier evaluation, quality assurance practices, and continuous improvement techniques. Studying supply chain quality management contributes to the development of theoretical frameworks, empirical models, and best practices that can be applied across industries. In industrial practice, supply chain quality management is crucial for organizations to meet customer expectations, mitigate risks, and achieve operational excellence. Effective quality management practices throughout the supply chain ensure that products or services consistently meet or exceed quality standards. It involves collaboration and coordination among supply chain partners, supplier management, process optimization, data-driven decision-making, and continuous improvement initiatives. By implementing supply chain quality management, organizations can enhance customer satisfaction, reduce costs, improve efficiency, and gain a competitive edge in the market. The relevance of supply chain quality management lies in its potential to improve overall supply chain performance, ensure

product/service quality, and strengthen customer relationships. It provides a systematic approach to identify and address quality issues, improve processes, and drive continuous improvement. Academic research contributes to the understanding and advancement of supply chain quality management principles and practices, while industrial practice applies these concepts to achieve operational excellence and customer satisfaction.

Malik Khalfan¹, Peter McDermott and Rachel Cooper/2004 Integrating the supply chain within the construction industry is a critical step towards enhancing efficiency, productivity, and overall project success. Supply chain integration involves aligning and collaborating with various stakeholders involved in the construction process, including suppliers, contractors, subcontractors, designers, and clients. This integration can be achieved through the following key strategies:

- **Collaboration and Communication:** Effective communication and collaboration are essential for supply chain integration. Establishing clear lines of communication, sharing information, and fostering collaborative relationships among all stakeholders facilitate smooth coordination and decision-making.
- **Early Involvement:** Involving suppliers, contractors, and subcontractors early in the project planning stage enables their active participation in design and decision-making processes. Their expertise can be leveraged to optimize project plans, improve constructability, and identify potential challenges upfront.
- **Supplier Relationship Management:** Building strong relationships with suppliers is crucial for supply chain integration. Developing long-term partnerships based on trust, reliability,

Erfan Taghavi, Alireza Fallahpour, Kuan Yew Wong, Seyed Amirali Hoseilni /2021 To implementing green supply chain management in the construction industry involves identifying and prioritizing several effective factors:

- **Supplier Selection:** Prioritize suppliers who practice eco-friendly methods, offer sustainable materials, and have green certifications.
- **Material Selection:** Choose environmentally friendly materials with low carbon footprints, such as recycled or renewable materials. Prioritize energy-efficient, non-toxic, and recyclable/reusable options.
- **Waste Management:** Implement effective waste management practices, including recycling, waste reduction, and proper disposal techniques.
- **Energy Efficiency:** Prioritize energy-efficient equipment, machinery, and processes to minimize energy consumption and reduce carbon emissions.
- **Transportation and Logistics:** Optimize transportation routes, consolidate shipments, and promote the use of low-emission vehicles to minimize environmental impact.
- **Stakeholder Engagement:** Involve and educate stakeholders, such as contractors, subcontractors, and employees, about green practices and encourage their participation in sustainable initiatives.
- **Regulatory Compliance:** Ensure compliance with relevant environmental regulations and standards to avoid legal issues and penalties.
- **Performance Measurement:** Establish metrics to measure and track the environmental performance of the supply chain, such as carbon emissions, waste generation, and resource usage.
- **Continuous Improvement:** Foster a culture of continuous improvement by promoting innovation and seeking new ways to enhance sustainability within the supply chain.
- By focusing on these factors and incorporating sustainable practices throughout the supply chain, the construction industry can make significant strides towards green supply chain management and environmental responsibility.

Husnain Arshad, Tarek Zayed /2022 Modular integrated construction (MIC) is a construction methodology that involves fabricating building components off-site and assembling them on-site. The supply chain management (SCM) in MIC plays a crucial role in ensuring the timely and efficient delivery of modular components to the construction site. Several critical influencing factors impact SCM in MIC, and here is a summary of some of them:

- **Component Standardization:** Standardization of modular components is vital for effective SCM in MIC. It enables mass production, reduces complexity, and facilitates the smooth flow of materials throughout the supply chain.
- **Supplier Selection:** Choosing the right suppliers is crucial in MIC SCM. Suppliers should have expertise in modular construction, provide high-quality components, meet delivery schedules, and have a track record of successful collaborations.
- **Logistics and Transportation:** Efficient logistics and transportation management.

Adel Azar, Reza Ahmadi Kahnali And AllahviridiTaghavi/2010 Supply chain quality management practices refer to the strategies and activities implemented by organizations to ensure the quality of products or services throughout the supply chain. These practices have a significant impact on the overall organizational performance. Here is a summary of the relationship between supply chain quality management practices and their effects on organizational performance:

- **Enhanced Product Quality:** Implementing robust quality management practices in the supply chain helps organizations ensure that the products or services meet or exceed customer expectations. This leads to improved product quality, reduced defects, and increased customer satisfaction, ultimately enhancing organizational performance.
- **Reduced Costs:** Effective supply chain quality management practices can help organizations identify and eliminate inefficiencies, defects, and rework. By streamlining processes and reducing waste, organizations can achieve cost savings, improve operational efficiency, and enhance overall financial performance.
- **Supplier Collaboration:** Collaborating closely with suppliers on quality management practices can lead to better supplier performance and product quality. Establishing clear quality standards, conducting supplier assessments, and fostering strong relationships can result in improved supplier quality, on-time deliveries, and reduced supply chain disruptions, contributing to enhanced organizational performance.
- **Continuous Improvement:** Organizations that emphasize continuous improvement in their supply chain quality management practices can drive innovation, optimize processes, and identify areas for enhancement. This proactive approach allows organizations to stay ahead of competitors, adapt to changing market dynamics, and achieve sustainable growth.
- **Reputation and Brand Image:** Maintaining a strong reputation and positive brand image is crucial for organizational success. Effective supply chain quality management practices ensure consistent delivery of high-quality products or services, which enhances customer trust and loyalty. A positive reputation and brand image can lead to increased market share, customer retention, and overall organizational performance.

Lin Lin, Peter Gibson/2010 Implementing supply chain quality management in a subcontracting system for construction quality involves establishing standardized quality requirements, evaluating and selecting subcontractors based on their past performance, promoting collaboration and communication, conducting regular quality audits and inspections, fostering continuous improvement, monitoring subcontractor performance through key metrics, and providing training and support. This implementation ensures consistent quality throughout the supply chain, reduces variations, enhances project quality, and drives continuous improvement.

Katarzyna Antosz ,Malgorzata jasiulew – Kaczmarek, Robert Wazkowski , Jose Machado / 2011 In a manufacturing plant case study, Lean Six Sigma was applied for suitable maintenance. The project involved value stream mapping, root cause analysis, standardizing work procedures, implementing 5S methodology, adopting Total Productive Maintenance (TPM), and utilizing Statistical Process Control (SPC). The outcomes included reduced downtime, cost savings, improved equipment reliability, and increased employee engagement. By optimizing maintenance processes, the plant achieved enhanced efficiency and effectiveness.

Hikmet Erbiyik"*, Muhsine Saru/ 2015 In the automotive subsidiary industry in Bursa, Turkey, implementing Six Sigma methodologies in the supply chain has proven to be beneficial. Here is a summary of how Six Sigma was applied and its impact on the industry:

Application of Six Sigma in the Supply Chain:

- Define Phase: The project began by clearly defining the goals and objectives of the supply chain improvement initiative. Key performance indicators (KPIs) were established to measure process efficiency, customer satisfaction, and cost reduction.
- Measure Phase: Data was collected and analysed to identify areas of improvement within the supply chain. Key metrics such as lead time, on-time delivery, inventory accuracy, and defect rates were measured to assess the current performance.
- Analyse Phase: Root cause analysis techniques were used to identify the underlying causes of supply chain issues. Tools like Pareto charts, fishbone diagrams, and process mapping were employed to pinpoint bottlenecks and inefficiencies in the supply chain.
- Improve Phase: Based on the findings from the analysis phase, process improvements were implemented. This involved streamlining processes, reducing variation, eliminating waste, and enhancing communication and collaboration among supply chain partners.
- Control Phase: Control mechanisms and monitoring systems were established to sustain the improvements made. Regular performance tracking, ongoing data analysis, and continuous improvement efforts were put in place to maintain the gains achieved.

Impact of Six Sigma Implementation in the Supply Chain:

- Cost Reduction: By identifying and eliminating waste, reducing defects, and streamlining processes, Six Sigma implementation led to significant cost savings within the supply chain. This included reduced inventory holding costs, decreased rework or scrap expenses, and optimized resource allocation.
- Improved Delivery Performance: Through Six Sigma methodologies, the automotive subsidiary industry improved its on-time delivery performance. This led to enhanced customer satisfaction, increased trust, and improved overall customer relationships.
- Enhanced Quality: By focusing on defect reduction and process improvement, Six Sigma implementation resulted in improved product quality. This, in turn, reduced customer complaints, increased product reliability, and enhanced the reputation of the industry.
- Supply Chain Efficiency: The application of Six Sigma methodologies enabled the identification and elimination of bottlenecks and inefficiencies within the supply chain. This resulted in improved process flow, reduced lead times, and increased overall supply chain efficiency.
- Employee Engagement: Six Sigma implementation also fostered a culture of continuous improvement and employee involvement. Employees were trained in Six Sigma principles and empowered to identify and contribute to process improvements, which increased engagement and motivation.

Assrarsabry / 2014 The success of a Six Sigma quality program in Lebanese hospitals depends on several critical factors and their influence on performance indicators. Here is a short summary of these factors:

- Leadership Support: Strong leadership commitment and support are essential for the success of a Six Sigma quality program. When hospital leaders prioritize and actively participate in the program, it creates a culture of quality improvement and encourages staff engagement. This commitment positively impacts performance indicators such as patient satisfaction, quality of care, and operational efficiency.
- Employee Engagement and Training: Engaging and training hospital staff in Six Sigma methodologies and tools is vital. When employees are involved in the improvement process and equipped with the necessary skills, they can effectively contribute to quality initiatives. This engagement and expertise positively influence performance indicators, including reduced errors, improved patient outcomes, and increased efficiency.
- Data-Driven Decision Making: A key aspect of Six Sigma is the use of data to drive decision-making. Collecting and analysing relevant data enables hospitals to identify areas for improvement, measure performance, and make informed decisions. Data-driven decision-making positively impacts performance indicators by facilitating continuous improvement, reducing variation, and enhancing patient safety and satisfaction.

- **Process Standardization:** Standardizing processes and workflows is critical to achieving consistent and reliable outcomes. By defining and implementing standardized procedures, hospitals can reduce errors, improve efficiency, and enhance the quality of care. Process standardization positively influences performance indicators such as patient safety, reduced waiting times, and increased adherence to clinical guidelines.
- **Continuous Improvement Culture:** Fostering a culture of continuous improvement is fundamental to the success of a Six Sigma quality program. When hospitals encourage and support staff to identify and address quality issues proactively, it drives ongoing improvement efforts. A continuous improvement culture positively impacts performance indicators by promoting innovation, reducing waste, and optimizing resource utilization.

Rohini Titmarsh, Fadi Assad, Robert Harrison/ 2020 Lean Six Sigma, combined with the principles of Industry 4.0, offers significant contributions to achieving suitable manufacturing requirements. Here is a short summary of these contributions:

- **Process Optimization:** Lean Six Sigma focuses on eliminating waste, reducing variation, and streamlining processes. When integrated with Industry 4.0 technologies like automation, IoT, and data analytics, it enables real-time monitoring, data-driven decision-making, and predictive maintenance. This optimization improves manufacturing efficiency, reduces defects, and ensures suitable production outputs.
- **Continuous Improvement:** Lean Six Sigma emphasizes a culture of continuous improvement, and Industry 4.0 technologies provide the tools for ongoing optimization. By leveraging real-time data and analytics, manufacturers can identify areas for improvement, address issues proactively, and drive innovation. This combination enhances product quality, reduces lead times, and increases customer satisfaction.
- **Quality Assurance:** The integration of Lean Six Sigma and Industry 4.0 facilitates advanced quality assurance techniques. By collecting and analysing data from various sensors and connected devices, manufacturers can monitor product quality in real-time, detect anomalies, and take corrective actions promptly. This approach minimizes defects, ensures suitable manufacturing requirements, and reduces rework or scrap.
- **Supply Chain Optimization:** Lean Six Sigma, in combination with Industry 4.0 technologies, enables end-to-end visibility and optimization in the supply chain. Through data sharing, collaboration, and automation, manufacturers can enhance supply chain efficiency, reduce inventory levels, improve demand forecasting accuracy, and achieve suitable delivery performance.
- **Agile Response to Change:** Industry 4.0 technologies provide manufacturers with increased agility and responsiveness to changing market demands. When combined with Lean Six Sigma principles, manufacturers can quickly adapt their processes, optimize production, and meet suitable manufacturing requirements, even in dynamic and uncertain environments.

Chitra LekhaKarmaker, Tazim Ahmed, Sayem Ahmed, Syed Mithun Ali Md. Abdul Moktadir, Golam Kabire /2021 In the context of the COVID-19 pandemic in an emerging economy, improving supply chain sustainability is crucial. An integrated model was developed to explore the drivers of supply chain sustainability. Here is a short summary:

Objective: The objective of this study was to identify the drivers that contribute to improving supply chain sustainability during the COVID-19 pandemic in an emerging economy.

Methodology:

Integrated Model: An integrated model was developed by considering multiple factors that influence supply chain sustainability. This model incorporated economic, social, and environmental dimensions to provide a comprehensive understanding of sustainability drivers.

Data Collection and Analysis: Data was collected from various sources, including surveys and interviews with supply chain stakeholders. The collected data was analysed using statistical techniques to identify the key drivers of supply chain sustainability.

Results:

Resilience and Adaptability: The study found that supply chain resilience and adaptability were critical drivers of sustainability during the COVID-19 pandemic. Companies that were able to quickly adapt their operations and supply chain strategies in response to disruptions demonstrated higher sustainability performance.

Collaboration and Cooperation: Effective collaboration and cooperation among supply chain partners were identified as important drivers. Strong relationships, trust, and information sharing among stakeholders contributed to enhanced sustainability by enabling better risk management and resource optimization.

Technology Adoption: The study highlighted the significance of technology adoption in improving supply chain sustainability. Technologies such as digital platforms, automation, and data analytics supported efficient and transparent supply chain operations, reducing waste, and enhancing sustainability performance.

Stakeholder Engagement: Engaging stakeholders, including employees, customers, and local communities, was found to positively impact supply chain sustainability. Stakeholder engagement practices that focused on social responsibility, ethical business practices, and community support were key drivers in maintaining sustainability during the pandemic.

Regulatory Compliance: Adherence to regulatory requirements and standards played a crucial role in ensuring supply chain sustainability. Compliance with environmental regulations, labour laws, and health and safety guidelines helped mitigate risks and improve sustainability performance.

Jason Matthews, Leah Pellew, Florence Phua and Steve Rowlinson / 2000 Quality relationships and effective partnering in the construction supply chain are crucial for project success. Here is a short summary:

Objective: The objective is to emphasize the importance of quality relationships and partnering within the construction supply chain to achieve project success.

Collaboration and Communication: Quality relationships and partnering foster collaboration and effective communication among stakeholders in the construction supply chain. Open lines of communication, mutual trust, and shared goals facilitate the exchange of information, timely decision-making, and problem-solving.

Mutual Benefits: Quality relationships focus on creating mutual benefits for all parties involved in the construction supply chain. This includes contractors, suppliers, subcontractors, and other stakeholders. By working together and aligning interests, efficiency and effectiveness can be maximized, leading to improved project outcomes.

Early Involvement: Effective partnering involves early involvement of all key stakeholders in the construction supply chain. By engaging stakeholders from the project's initial stages, valuable input, expertise, and perspectives can be shared, resulting in better project planning, risk management, and overall project success.

Risk Sharing: Quality relationships in the construction supply chain promote the sharing of risks and responsibilities among stakeholders. By jointly managing risks and addressing potential challenges, the likelihood of project delays, cost overruns, and disputes is reduced.

Continuous Improvement: Partnering in the construction supply chain encourages a culture of continuous improvement. By regularly evaluating and learning from past projects, stakeholders can identify areas for enhancement, implement best practices, and drive innovation.

Long-Term Relationships: Building long-term relationships in the construction supply chain leads to repeat business and trust. Establishing strong partnerships over time foster's reliability, mutual understanding, and enhanced collaboration, which are critical for successful project delivery.

Hanbin Luo a,b, Ling Lin a,b, Ke Chen, Maxwell Fordjour Antwi-Afari, Lijuan Chen / The review explores the application of digital technology for quality management in construction. It highlights the potential benefits and challenges associated with adopting digital tools and techniques in improving construction quality.

Key findings from the review include:

- **Quality Data Collection and Analysis:** Digital technology enables the collection of real-time quality data through sensors, IoT devices, and mobile applications. This data can be analyzed using advanced analytics techniques, providing valuable insights for quality improvement and decision-making.

- Automation and Robotics: Digital technology, such as automation and robotics, can be employed for quality control processes. Automated inspections and robotic systems help to reduce human errors, increase accuracy, and enhance the consistency of quality checks.
- Virtual and Augmented Reality: Virtual and augmented reality technologies offer opportunities for immersive simulations and visualizations, aiding

Anne Vincent, DonnahPocius, Yun Huang /2021 This two-year review aimed to assess the Six Sigma performance of quality indicators in the total testing process of point-of-care glucose measurement. The review collected data from a healthcare facility and analysed metrics such as process capability, defects per million opportunities (DPMO), and sigma levels.

Key findings from the review include:

- Process Capability: The analysis of process capability indicated the ability of the total testing process to meet desired specifications and tolerance limits.
- Defects and Error Rates: The calculated DPMO provided insights into the number of defects or errors per million opportunities in the testing process, helping assess quality performance.
- Sigma Levels: The sigma levels calculated from the data provided an overall measure of process performance and quality, with higher sigma levels indicating better process capability and reduced variation.
- Performance Trends: The two-year review allowed for the identification of performance trends in quality indicators, helping evaluate improvements or deteriorations over time and assess process optimization efforts.

IV. CONCLUSION

Six Sigma offers valuable tools and techniques for supply chain quality management in the construction industry. By applying Six Sigma principles, construction companies can enhance quality, reduce costs, improve time management, mitigate risks, and increase stakeholder satisfaction. Through the identification and elimination of defects and process variations, Six Sigma helps construction companies deliver high-quality products and services to their customers. This leads to increased customer satisfaction and improved reputation in the industry. By minimizing waste, inefficiencies, and errors, Six Sigma enables cost reduction in the construction supply chain. This includes reducing rework, material waste, and project delays, resulting in improved profitability and competitiveness. Time management is a critical aspect of the construction industry, and Six Sigma provides tools and methodologies to streamline processes, identify bottlenecks, and reduce cycle times. This helps construction companies meet project schedules, deliver projects on time, and improve overall project efficiency. In terms of risk management, Six Sigma allows construction companies to identify, measure, and mitigate risks through data analysis and statistical tools. This proactive approach helps prevent costly delays, errors, and disruptions in the supply chain. Furthermore, Six Sigma fosters a customer-centric approach, ensuring that customer requirements and expectations are met or exceeded. By continuously improving processes and outcomes, construction companies can enhance stakeholder satisfaction and build long-term relationships with clients.

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