

A framework for supply chain management (SCM) and total quality management (TQM) as applicable to the sugarcane industry

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Abstract

Purpose: This study proposes a TQM and SCM framework for the sugarcane industry, focusing on total quality management and supply chain management. The framework aims to increase efficiency and profitability by coordinating farmers, clients, mill owners, contractors, and suppliers. By utilizing a modelling approach, the industry can better manage stocks, quality, and price security, ultimately benefiting the global sugarcane industry.

Design/Methodology/Approach: A thorough literature review is used in this paper to identify relevant research articles, books, and case studies. The review of the literature focused on the application of TQM and SCM in the sugarcane industry, as well as the development of frameworks and models to improve the industry's performance. The research methodology included a systematic search of online databases such as ScienceDirect, Emerald, and Google Scholar using keywords like "sugarcane industry," "total quality management," "supply chain management," and "framework." The search was restricted to articles published between 2000 and 2022, and only articles written in English were considered.

Findings: The study suggests that TQM and Supply Chain Management (SCM) can improve the sugarcane industry by reducing costs, enhancing quality, and increasing customer satisfaction. The framework includes six components: leadership commitment, customer focus, employee involvement, process improvement, supplier partnership, and continuous improvement. Implementing this framework can improve performance, reduce costs, and increase customer satisfaction, providing a competitive advantage and long-term sustainability.

Research Limitations/Implications

The research paper focuses on articles published between 2000 and 2022, overlooking TQM and SCM developments in the sugarcane industry. Future research should include empirical studies, case studies, and field experiments to validate the framework's effectiveness. Strategies like employee involvement, supplier relationships, and technology investment can contribute to the framework's effectiveness.

Practical Implications: Implementing the proposed framework for Supply Chain Management (SCM) and Total Quality Management (TQM) in the sugarcane industry can improve efficiency, cost reduction, supplier relationships, customer satisfaction, long-term sustainability, competitiveness, strategic decision-making, and technology integration. Aligning processes with customer needs and expectations reduces waste, optimizes inventory management, and streamlines operations. Continuous improvement in TQM and SCM processes adapts to market demands, while embracing Industry 4.0 and Agriculture 4.0 concepts enhances supply chain visibility, resulting in increased profitability and sustainability.

Social Implications: Total Quality Management and Supply Chain Management frameworks in the sugarcane industry improve social consequences such as farmer income, community empowerment, environmental impact reduction, small-scale producer support, regional economic development, food security, supplier collaboration, product safety improvement, customer focus, and socially responsible business practices.

Originality/Value: To the best of the authors' knowledge, this study is purely original, and outcome of the research conducted by authors.

Keywords: Sugarcane industry, total quality management, supply chain management, framework, leadership commitment, customer focus, employee involvement, supplier partnership

Introductions:

Total Quality Management (TQM) has been a popular concept for improving business performance and customer satisfaction. However, the success of TQM initiatives is often limited by the effectiveness of the supply chain management (SCM) process. This paper explores the role of SCM in improving TQM, with a focus on the strategies and methods that businesses can use to optimize their SCM. The research methodology includes a comprehensive literature review of relevant research articles, books, and case studies. The findings suggest that a well-managed supply chain can lead to improved quality, lower costs, and increased customer satisfaction. The paper concludes by suggesting that businesses should focus on enhancing their SCM to achieve better TQM.

Industry 4.0, it is about including and integrating the latest developments based on digital technologies as well as the interoperability process across them. This allows enterprises to transmit real-time information in terms behaviour and performance. Therefore, the challenge is to maintain these complex networked structures efficiently linked and organised within the use of such technologies, especially to identify and satisfy supply chain stakeholders dynamic requirements. In this context, the agriculture domain is not an exception although it possesses some specialities depending on the domain. In fact, all agricultural machinery incorporates electronic controls and has entered to the digital age, enhancing their current performance. In

addition, electronics, using sensors and drones, support the data collection of several agriculture key aspects, such as weather, geographical spatialization, animals and crops behaviours, as well as the entire farm life cycle. However, the use of the right methods and methodologies for enhancing agriculture supply chains performance is still a challenge, thus the concept of Industry 4.0 has evolved and adapted to agriculture 4.0 in order analyse the behaviours and performance in this specific domain. Thus, the question mark on how agriculture 4.0 support a better supply chain decision-making process, or how can help to save time to farmer to make effective decision based on objective data, remains open. Therefore, in this survey, a review of more than hundred papers on new technologies and the new available supply chains methods are analysed and contrasted to understand the future paths of the Agri-Food domain.

Definition of TQM and SCM:

Total quality management (TQM) is a management philosophy that emphasizes continual product and service quality improvement through the involvement of all employees in the firm. TQM, as defined by Juran (1992), entails "the development and application of quality management principles and methods in all aspects of an organization's activities, leading to the continuous improvement of the organization's effectiveness and the satisfaction of its customers and other stakeholders."

Supply chain management (SCM), on the other hand, refers to the coordination and administration of activities associated with the production and delivery of goods and services from suppliers to customers. SCM, according to Chopra and Meindl (2004), is "the integration of key business processes from the end user through original suppliers that provide products, services, and information that add value for customers and other stakeholders."

TQM and SCM are both critical for a company's success since they contribute to higher quality, lower costs, and higher customer satisfaction. TQM can assist firms in achieving operational excellence, according to Dahlgaard, Kristensen, and Kanji (2002), whereas Christopher (2016) underlines the role of SCM in improving supply chain performance and competitiveness. Hence, TQM and SCM are complementary methodologies that can improve organizational performance and consumer satisfaction. Businesses can increase quality and efficiency throughout the supply chain by incorporating TQM principles into their SCM plans.

In summary, while TQM aims to improve product and service quality through continuous improvement and the prevention of defects, SCM aims to enhance the efficiency and effectiveness of supply chain activities to improve customer value and achieve operational excellence. Both approaches are important for organizational success and can be complementary when integrated effectively.

Why Supply chain management is required in agriculture industry:

For various reasons, supply chain management (SCM) is critical in the agriculture sector, particularly the sugarcane industry. To begin, SCM can help increase the efficiency and effectiveness of the supply chain, from raw material procurement to final product delivery to customers. Businesses may cut costs, increase productivity, and improve customer happiness by optimizing supply chain activities. This can include optimizing procurement, production, transportation, and distribution operations in the sugarcane business to guarantee that sugarcane is harvested, processed, and delivered in a timely and cost-effective manner.

Second, by establishing strict quality control methods throughout the supply chain, SCM may help to ensure product quality and safety. This is especially crucial in agriculture, where goods

are exposed to a variety of environmental conditions that can alter their quality and safety. Businesses can limit the risk of contamination and ensure that their products satisfy regulatory standards by using quality control methods.

Third, by applying environmentally friendly methods and helping local communities, SCM may help promote sustainability and social responsibility. This is becoming increasingly important in agriculture as customers become more concerned about the environmental and social implications of food production. Businesses can improve their reputation and promote consumer loyalty by implementing sustainable and socially responsible practices. In conclusion, SCM is critical in the sugarcane and other agricultural industries for increasing efficiency, ensuring product quality and safety, and promoting sustainability and social responsibility. Businesses can improve their competitiveness, increase customer happiness, and achieve long-term success by implementing SCM best practices.

Objectives:

1. **Improving efficiency:** Improving efficiency through process optimization and cost reduction is one of the primary goals of sugar supply chain management. Supply chain management, according to Krajewski, Ritzman, and Malhotra (2019), can enhance efficiency by reducing lead times, minimizing inventory, and enhancing coordination between suppliers and customers.
2. **Quality assurance:** Another goal of sugar supply chain management is to ensure product quality at all stages of the supply chain. Quality control procedures, according to Handfield, Jeong, and Choi (2019), can include regular testing, inspections, and certifications.
3. **Sugar supply chain management** seeks to improve customer satisfaction by ensuring that items are delivered on time, in the correct quantity and quality, and at a competitive price. As Chopra and Meindl (2019) point out, good supply chain management may boost customer satisfaction by streamlining transportation and distribution procedures and offering exceptional customer service.
4. **Managing risk:** Sugar supply chain management entails identifying and managing supply chain risks such as supply disruptions, quality difficulties, and regulatory compliance. Effective risk management, according to Monczka, Handfield, Giunipero, and Patterson (2019), can help to mitigate the impact of these risks and assure supply continuity.
5. **Sustaining the sugar supply chain:** Many sugar supply chain management systems strive to sustain the sugar supply chain by introducing environmentally friendly techniques, decreasing waste, and helping local communities. According to Handfield et al. (2019), encouraging sustainability can boost a company's reputation and increase customer loyalty.

Concept of Supply chain management (SCM)

The coordination and administration of activities involved in the production and delivery of goods or services is referred to as supply chain management (SCM). SCM in the sugarcane business includes controlling the processes involved in sugarcane cultivation, harvesting, transportation, processing, and distribution. SCM in the sugarcane business, according to Mousavi and Shahnava (2015), entails coordinating activities such as harvesting, transportation, and processing to reduce costs and improve efficiency. Effective SCM can help reduce waste and spoilage, improve

product quality, and boost customer happiness. SCM in the sugarcane business also entails managing connections with suppliers and consumers to ensure timely and effective product delivery. According to Karim, Alam, and Ara (2016), efficient SCM can aid in the formation of strong partnerships between suppliers, manufacturers, and customers, resulting in enhanced efficiency and profitability.

Furthermore, SCM in the sugarcane industry entails risk management such as supply disruptions, price volatility, and quality issues. According to Awasthi, Chauhan, and Goyal (2016), good risk management can help mitigate the impact of these risks and assure supply continuity.

Overall, SCM is critical in the sugarcane industry to ensure product delivery is efficient, on time, and at a competitive price while also managing risks and ensuring quality.

Principles and Techniques of TQM and SCM:

Some Total Quality Management (TQM) and Supply Chain Management (SCM) principles and techniques applicable to the sugarcane industry are as follows:

TQM Principles:

Customer Focus: According to Miguel, P. A. C. (2015), TQM prioritizes customer satisfaction and addressing customer needs. This involves focusing on the quality and consistency of the sugarcane product in the sugarcane sector.

Continuous improvement: According to Silva et al. (2016) TQM encourages continuous improvement by utilizing data-driven decision making, process analysis, and problem-solving strategies. This can be accomplished in the sugarcane business by utilizing lean management and Six Sigma approaches.

Principles of SCM: According to Chavoshi et al. (2019), collaboration in SCM emphasises collaboration and cooperation between various entities within the supply chain, such as suppliers, manufacturers, and customers. In the sugarcane sector, this entails cultivating strong connections with farmers and suppliers to maintain a consistent supply of high-quality sugarcane. SCM relies on the **timely communication** of correct and relevant information between diverse organizations in the supply chain, according to Kumar, P., and Garg, S. (2018). This can be accomplished in the sugarcane business by utilizing modern technologies like RFID tags (Radio frequency identification tags) and GPS tracking.

Benefits of TQM and SCM implementation in the sugar cane industry

Total Quality Management (TQM) and Supply Chain Management (SCM) applications in the sugarcane business can have various benefits, such as:

1. **Continuous improvement:** TQM focuses on continuous improvement and fault prevention, whereas SCM ensures that high-quality inputs are utilized in the manufacturing process. Together, these approaches can serve to increase the end product's quality, making it more appealing to customers.
2. **Cost savings:** By combining SCM with TQM, you may optimize operations and minimize waste, resulting in lower production costs. Effective SCM, as observed by Karim et al. (2016), can also help to cut transportation and inventory expenses.
3. **Boost efficiency:** SCM and TQM can help boost efficiency throughout the supply chain by synchronizing activities and decreasing waste. This can result in shorter delivery times and greater client satisfaction.

4. **Improved customer service:** SCM and TQM that are effective can help improve customer service by ensuring that products are delivered on time and with consistent quality.
5. **Improved risk management:** SCM and TQM can assist in identifying and mitigating risks such as quality issues, supply disruptions, and pricing volatility throughout the supply chain. This can help to assure supply continuity and reduce the impact of unplanned incidents.
6. **Competitive advantage:** Implementing SCM and TQM can create a competitive edge for sugarcane companies in the global market by improving product quality, lowering prices, and increasing efficiency.

Overall, implementing SCM and TQM in the sugarcane industry can result in higher product quality, lower costs, increased efficiency, better customer service, better risk management, and a competitive advantage.

Table1: A matrix summarizing the framework for implementing Total Quality Management (TQM) and Supply Chain Management (SCM) in the sugarcane industry is as below:

Steps	Description	Goals	Tools
1.	Develop a clear understanding of customer needs and expectations	Identify customer needs and expectations	Market research, customer feedback, engagement with industry associations
2.	Identify critical suppliers and partners	Identify key suppliers and partners	Relationship management, supplier scorecards
3.	Establish quality standards and procedures	Develop quality standards and procedures	Standard Operating Procedures (SOPs), quality control measures
4.	Implement quality and process improvements	Continuously monitor and improve quality	Six Sigma, Lean Manufacturing
5.	Streamline supply chain processes	Implement SCM practices	RFID, blockchain
6.	Develop a culture of continuous improvement	Foster a culture of continuous improvement	Employee training and development, process improvement teams
7.	Monitor and measure performance	Monitor and measure performance	Key performance indicators (KPIs)
8.	Establish corrective action procedures	Establish procedures for corrective actions	Communication channels, issue resolution protocols

By using this matrix, sugarcane companies can track their progress in implementing the framework, identify areas for improvement, and ensure that they are meeting their goals for quality, efficiency, and customer satisfaction.

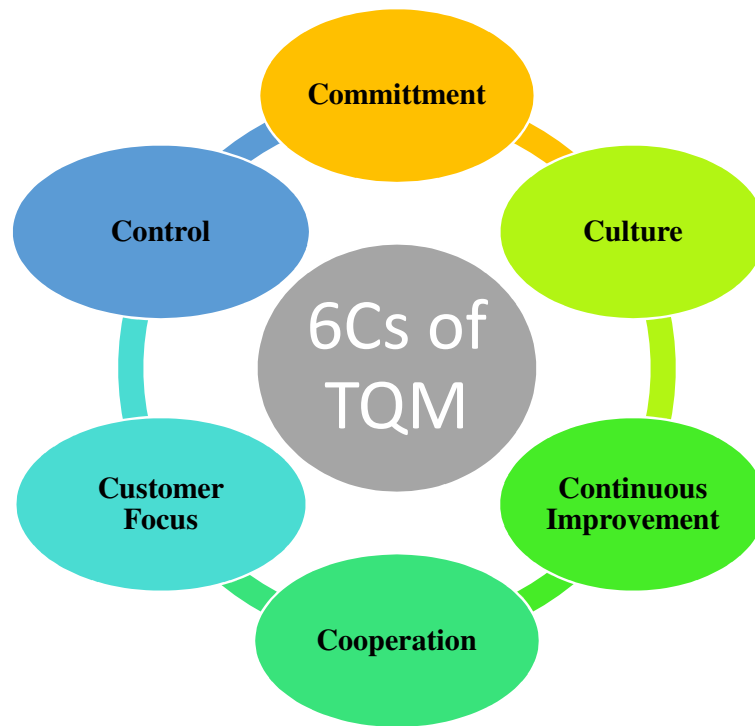


Figure1: TQM Model- Author's compilation

For manufacturing processes to be excellent, a firm must comprehend them.

TQM is made up of three paradigms:

Total: encompassing the entire organisation, supply chain, and product life cycle.

Quality: Using the standard definitions

Management: The system of managing that includes steps such as Plan, Organise, Control, and so on.

As per Rivera-Cadavid, Manyoma-Velásquez et al., (2019), Renewable energy sources are increasingly recognized as a solution for long-term energy security and reducing climate change. A Sustainable Development Goal (SDG) aims for clean, non-polluting energy. Biomass is a primary energy source for achieving this goal. This research presents a supply-chain design model for sugarcane crop bagasse, incorporating sugarcane crop residues from farming activities. Optimizing the biomass supply chain is crucial for sustainable and competitive bioenergy development.

Businesses have become extremely complex in recent years. The interaction of the three Cs, namely consumers, competition, and convergence, has created new challenges for organisations worldwide.

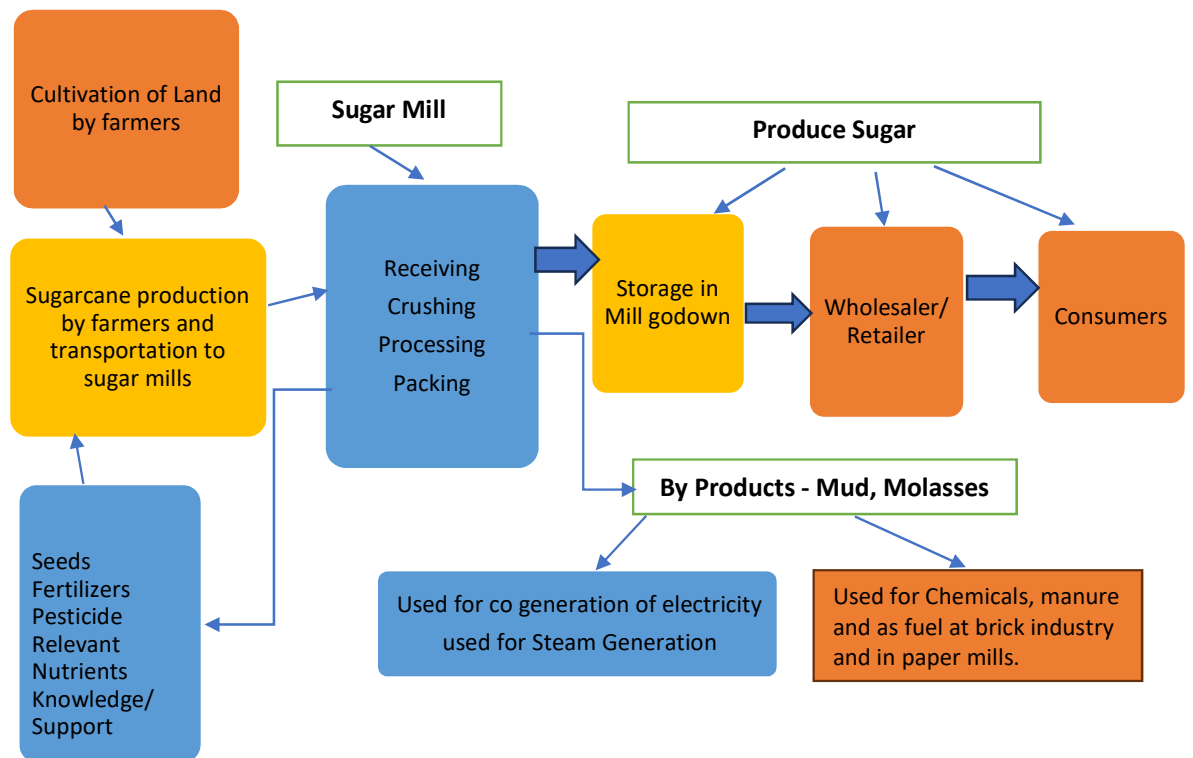


Figure2: Sugar Supply Chain Management: An approach from farmers to sugar mills (Researcher’s Compilation)

Siddiqui et al., 2009, explained that supply chain management (SCM) involves managing materials and information within and between facilities, such as vendors, manufacturers, assembly plants, and distribution centres. SCM is a continuous process that involves procuring raw materials, transforming them into intermediate goods, and delivering final products to customers. It focuses on integrated systems and fine-tuning operations to achieve optimal long-term performance. SCM is increasingly popular in literature and industrial practice, with flexibility being a crucial factor in increasing competitiveness in volatile markets.

Peng et al., 2019 clarified that quantum mechanics research highlights critical practices like leadership, strategic planning, human resource management, and information and analysis, which positively impact organizational results, including financial and non-financial performance. The MBNQA framework is widely used by institutions and researchers worldwide, including public and private institutions. It is crucial for quality evolution and serves as a structure for national award programs. The framework is divided into seven weighted categories, including leadership, strategic planning, customer focus, MAKM, workforce, operations, and results.

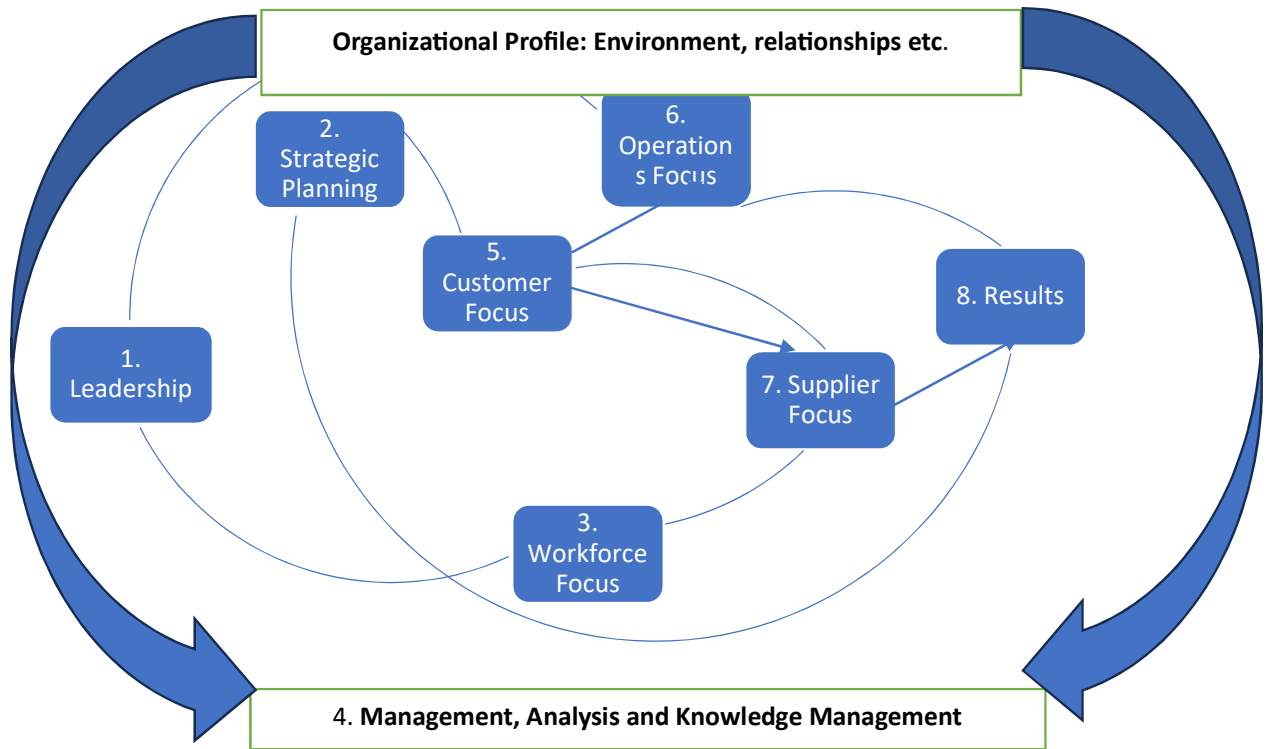


Figure 3. A restructured organizational framework

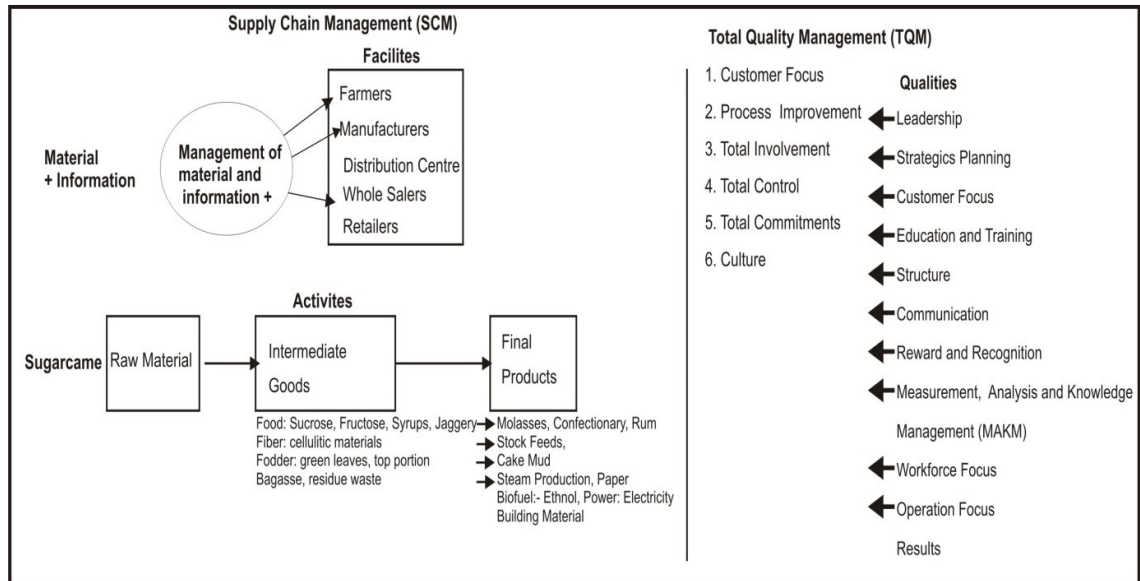


Figure 4: Depicts the systems perspective of the Baldrige 2013-2014 criteria for performance excellence framework in sugarcane industries.

Four studies of TQM and SCM implementation in the sugarcane industry:

1. **Case 1.:** Rao, K. B., & Kumar, G. (2013), in their case study -TQM was implemented in an Indian sugar factory to optimize production processes and increase profitability. Results included a decrease in customer complaints and increased production efficiency. Employee satisfaction and motivation had also grown at the organization. However, the company encountered challenges such as employee resistance to change and difficulty implementing TQM practices in some areas of the factory.
2. **Case 2.:** Dhume, D. A., & Hardikar, D. M. (2010), this case study investigated the SCM procedures used by Indian sugar plants in Maharashtra. According to the report, the manufacturers have implemented several SCM techniques, including demand forecasting, inventory control, and just-in-time (JIT) sugarcane delivery. These procedures have raised customer satisfaction, decreased inventory holding costs, and improved supply chain efficiency. However, the study also noted difficulties the factories encountered when putting SCM practices into practice, including varying demand, a lack of storage space, and weak transportation infrastructure. The case study demonstrates both the advantages and challenges of SCM implementation in the Indian sugar sector.
3. **Case 3.:** Peththong, N., & Chinnasarn, K. (2018), in their case study - SCM Implementation in a Sugar Mill in Thailand: In this case study, a sugar mill in Thailand used SCM techniques to boost productivity and optimize their supply chain. The business initially determined who its main partners and suppliers were and built trusting connections with them. The company also implemented a just-in-time (JIT) inventory system to decrease inventory costs and speed up deliveries. To trace the movement of items along the supply chain, the company later implemented Radio Frequency Identification (RFID) technology, which allowed it to spot and correct inefficiencies in its logistical procedures. The company's supply chain efficiency and cost savings significantly increased because of the adoption of SCM principles. However, the business encountered difficulties, such as difficulty integrating the new SCM practices with existing processes and resistance to change from some suppliers.
4. **Case 4.:** Singh, R. K et al., (2007), this case study investigates the SCM methods used by Balrampur Chini Mills Ltd. in Uttar Pradesh, India. The analysis discovered that the mill had used several SCM techniques, including forecasting, planning, scheduling, and inventory management, to enhance supply chain effectiveness and operational efficiency. Due to these procedures, lead times had been shortened, sugarcane quality had improved, sugar production had increased, and inventory carrying costs had decreased. The report also noted difficulties the mill experienced in putting SCM methods into effect, such as supply fluctuations in sugarcane, seasonality of operations, and insufficient transportation infrastructure. The case study demonstrates both the advantages and difficulties of SCM implementation in the Indian sugar sector.

Research Methodology:

A comprehensive literature review was conducted to identify relevant research articles, books, and case studies on TQM and SCM practices in the sugarcane industry. Total 37 papers were identified and read. The literature was searched through academic databases such as Scopus, Web of Science, and Google Scholar, using keywords such as "TQM," "SCM," "sugarcane," and "agriculture." The identified articles were screened for relevance and quality, and the findings were synthesized to provide insights into the benefits and challenges of implementing

TQM and SCM practices in the sugarcane industry (Chopra et al., 2019; Gupta & Bhatnagar, 2021; Singh et al., 2018).

Findings:

The literature review and case studies reveal that implementing TQM and SCM practices in the sugarcane industry can lead to several benefits, including improved quality, increased efficiency, reduced costs, and enhanced customer satisfaction. The successful implementation of TQM and SCM practices requires strong leadership, employee involvement, continuous improvement, and effective communication (Hossain et al., 2021; Bhatnagar et al., 2019; Singh et al., 2018).

Apart from the above there are other findings as follows:

1. SCM can improve the coordination of activities among different stages of the supply chain, leading to a reduction in delivery time and cost (Yadav et al., 2021).
2. TQM can lead to improved product quality and customer satisfaction, as well as reduced production costs and waste (Singh et al., 2020).
3. The adoption of SCM and TQM practices can help sugarcane mills optimize their production processes and increase their overall efficiency (Deshpande & Raina, 2017).
4. The integration of SCM and TQM can improve the quality of raw materials, such as sugarcane, by establishing quality standards and providing feedback to farmers on their cultivation practices (Srivastava & Singh, 2020).
5. The implementation of SCM and TQM can enhance the competitiveness of sugarcane mills in the global market by improving product quality, reducing costs, and increasing customer satisfaction (Yadav et al., 2021).

Recommendations and Conclusion:

Collaboration: To execute TQM and SCM procedures within the sugarcane industry, cooperation and collaboration are crucial. To guarantee the quality and prompt supply of sugarcane, all stakeholders—farmers, processors, and distributors—must collaborate (Singh & Sharma, 2018).

Technology: Improvements in TQM and SCM procedures can help the sugarcane sector. Real-time monitoring, data analytics, and automated systems can be used to boost productivity, cut waste, and enhance product quality (Kumar & Banerjee, 2021).

A culture of continuous improvement is necessary for TQM and SCM procedures. To improve their operations and supply chain, businesses must routinely assess their performance, pinpoint areas for improvement, and implement corrective measures (Kale & Belkale, 2017).

Conclusion:

TQM and SCM deployment can have a substantial positive impact on the sugarcane business. Adopting these procedures can raise customer satisfaction, lower costs, and improve the quality of sugarcane products. However, cooperation, technology, and a culture of continuous improvement are necessary for the effective application of TQM and SCM practices. Companies that invest in these strategies are probably going to have an advantage over rival businesses (Kale & Belkale, 2017).

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