

Evaluating The Impact of Production Challenges on Quality in The Automotive Manufacturing Industry in South Africa

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Abstract

The automotive manufacturing industry faces the dual challenge of maintaining production efficiency while meeting stringent quality standards. This study examines how production challenges, such as global shipment delays, safety concerns, and production stoppages, affect quality performance in the automotive sector. Emphasis is placed on the tension between operational efficiency and product integrity, highlighting the need to align production and quality processes. Using a qualitative research approach, the study explores strategies for mitigating risks and strengthening collaboration between production and quality teams. Findings indicate that global shipment delays, particularly within just-in-time (JIT) systems, disrupt production schedules and undermine quality assurance. Safety-related challenges further demonstrate the necessity of rigorous quality control to avoid reputational and financial losses. The study also analyses the trade-offs associated with halting production to resolve quality issues and advocates proactive measures such as predictive maintenance and real-time monitoring to reduce disruptions. The results underscore the importance of aligning production and quality Key Performance Indicators (KPIs), fostering interdepartmental collaboration, and embedding quality into production workflows through tools such as Advanced Product Quality Planning (APQP). Leadership commitment and a quality-driven culture are identified as critical enablers of operational excellence and manufacturing resilience.

Keywords

Automotive manufacturing, Production efficiency, Quality management, Just-in-time (JIT) systems, Manufacturing resilience.

1. Introduction

1.1 Motivation

The automotive manufacturing industry plays a critical role in global economic development and is characterised by complex production systems, rapid technological change, and strict quality and safety requirements. Manufacturers face a persistent challenge in balancing production efficiency with adherence to stringent quality standards (Brown, 2018). This challenge has intensified due to external pressures such as global supply chain disruptions, technological advancements, and evolving regulatory demands (Yadav et al., 2021). Recent events, including the COVID-19 pandemic, exposed vulnerabilities in global supply chains, resulting in shipment delays and production interruptions that directly affected quality assurance processes (Kumara et al., 2021). Additionally, the transition towards electric vehicles and autonomous technologies has increased production complexity, requiring the integration of advanced components while maintaining high quality standards (Supekar et al., 2019).

Given that quality failures in automotive manufacturing can lead to safety risks, recalls, and reputational damage, there is a growing need for research that examines how production challenges influence quality outcomes and identifies strategies that support integrated, resilient, and quality-driven production systems.

1.2 Problem statement

Despite the strategic importance of quality in automotive manufacturing, production challenges such as global shipment delays, safety-related constraints, and pressure to meet production targets often force organizations to make trade-offs that compromise product quality. In practice, production and quality functions frequently operate with misaligned objectives, resulting in reactive decision-making and inadequate coordination during production disruptions. Although quality management frameworks and tools exist, their effective integration into day-to-day production activities remains inconsistent. Consequently, there is limited empirical evidence on how automotive manufacturers can align production and quality processes to mitigate disruptions while maintaining high quality standards. This study addresses this gap by examining the impact of production challenges on quality performance and exploring strategies to improve collaboration, risk management, and operational excellence within the automotive manufacturing industry.

1.3 Objectives

The main objective of this study is to examine the impact of production challenges on quality performance in the automotive manufacturing industry. The specific objectives of the study are to:

- a) To identify key production challenges, such as global shipment delays, safety concerns, and production stoppages, that affect quality in automotive manufacturing operations in South Africa.
- b) To examine how these production challenges influence quality management practices and decision-making processes within automotive manufacturing companies in South Africa.
- c) To explore the nature of coordination and collaboration between production and quality teams when responding to production disruptions in South Africa.
- d) To assess the trade-offs made between maintaining production efficiency and ensuring product quality during periods of operational disruption in South Africa.
- e) To identify practical strategies and best practices that automotive manufacturers can adopt to better align production and quality processes and enhance operational resilience.

2. Literature Review

2.1 Production challenges impacting quality

The interplay between production challenges and quality in the automotive manufacturing industry highlights the need for a strategic and adaptive approach. While global shipment delays disrupt supply chains and force manufacturers to make difficult trade-offs, safety concerns underscore the critical importance of maintaining rigorous quality standards to protect both consumers and brand reputation. At the same time, halting production to address quality issues, though necessary, introduces operational inefficiencies that can strain resources and delay deliveries. These interconnected challenges reveal the delicate balance manufacturers must strike between meeting production targets and ensuring product integrity. The following sections delve deeper into these challenges, exploring their implications and the strategies manufacturers can adopt to mitigate their impact on quality.

2.1.1 Global shipment delays

Thompson and Miller (2020) highlight that global shipment delays are a critical challenge in the automotive industry, particularly in the context of just-in-time (JIT) manufacturing systems. These systems aim to minimise inventory costs by delivering components precisely when needed but are highly vulnerable to disruptions in the supply chain. Delays caused by port congestion, geopolitical tensions, or natural disasters can lead to production halts, forcing manufacturers to make compromises to meet delivery deadlines. For example, Hirota (2012) discusses how the 2011 earthquake and tsunami in Japan disrupted the global supply chain for automotive components, highlighting the fragility of JIT systems. The COVID-19 pandemic further exacerbated these challenges, causing widespread delays in the shipment of critical components such as semiconductors (Kumara et al., 2021). To mitigate the impact of shipment delays, Zhong et al. (2017) suggest strategies such as diversifying the supplier base, increasing inventory levels for critical components, and leveraging digital technologies to enhance supply chain visibility.

2.1.2 Safety concerns

Safety is a paramount concern in automotive manufacturing, particularly for components critical to vehicle performance, such as fuel systems and braking mechanisms. Cooper (2000) argues that a strong safety culture is essential for maintaining both operational efficiency and consumer trust. Participants in the study emphasised that compromising quality for production targets could lead to severe safety risks, including product recalls and legal liabilities. The Takata airbag recall, one of the largest in automotive history, serves as a cautionary example. Smith and Thomas (2021) attribute the recall to quality compromises during production, which led to multiple fatalities and injuries, resulting in significant financial and reputational damage for the company. To prevent such incidents, manufacturers must prioritise safety by implementing rigorous quality control measures, conducting regular audits, and fostering a culture of accountability across all levels of the organisation.

2.1.3 Stopping production volume

Womack and Jones (2023) emphasise that halting production to address quality issues is often a necessary but challenging decision for manufacturers. While stopping production ensures that defective products do not reach customers, it can disrupt operational efficiency and lead to financial losses. Participants in the study highlighted the importance of prioritising quality over speed, even if it means temporarily compromising production targets. Predictive maintenance technologies and real-time monitoring systems are increasingly adopted to identify and address quality issues before they escalate (Zhong et al., 2017). This proactive approach minimises the need for production halts, ensuring both operational efficiency and product integrity.

2.1.4 Balancing production and quality

Juran and Godfrey (1999) identify Advanced Product Quality Planning (APQP) as a key tool for embedding quality into production workflows, ensuring alignment with customer expectations and reducing conflicts between departments. Deming (1986) notes that the tension between production efficiency and quality standards is a recurring theme in automotive manufacturing. While production teams are often under pressure to meet tight deadlines and high output targets, quality teams are tasked with ensuring that products meet stringent safety and performance standards. To achieve a balance between production and quality, Liker (2021) advocates for a holistic approach that integrates both objectives into strategic planning. This includes aligning Key Performance Indicators (KPIs) for production and quality, fostering collaboration between departments, and investing in employee training to ensure that quality is viewed as a shared responsibility. By adopting these strategies, manufacturers can mitigate the impact of production challenges on quality, ensuring both operational efficiency and customer satisfaction.

3. Methods

The methodology employed in this study reflects a deliberate effort to capture the complexities of aligning production and quality in the automotive manufacturing industry. Using qualitative research techniques, the study provides a comprehensive understanding of the operational and strategic challenges faced by manufacturers. The use of semi-structured interviews allows for an in-depth exploration of participant perspectives, while thematic analysis and tools like the Analytic Hierarchy Process (AHP) add rigour and structure to the findings. This approach ensures that the study not only identifies recurring themes but also evaluates their significance in the broader context of manufacturing resilience. The findings derived from this methodology offer valuable insights into the alignment of production and quality, which are further discussed in the subsequent sections.

4. Data Collection

Creswell (2016) highlights the suitability of qualitative research methods for exploring the lived experiences, perceptions, and insights of individuals within their natural contexts. Semi-structured interviews were conducted with 12 participants, including quality managers, production managers, and other key stakeholders in the automotive manufacturing industry. Bryman (2015) notes that this method allows for in-depth exploration of participants' perspectives, providing rich, detailed data that could not be captured through quantitative methods alone.

5. Results and Discussion

5.1 Results

The results confirm the intricate relationship between production efficiency and quality assurance in the automotive manufacturing industry. The results highlight the impact of production on quality and the critical role of aligning Key Performance Indicators (KPIs), fostering collaboration between departments, and embedding quality into production processes to achieve operational excellence. The findings also reveal the challenges manufacturers face, such as global

shipment delays, safety concerns, and the tension between meeting production targets and maintaining high-quality standards. These insights provide a foundation for actionable strategies and recommendations, which are explored in the following sections to guide organisations in navigating these complexities effectively.

5.1.1 Impact of production on quality

Participants emphasised that production without quality undermines the overall value of output, leading to inefficiencies, rework, and customer dissatisfaction. The findings shed light on the tension between maintaining high-quality standards and meeting production targets. Participants emphasised that quality assurance during the project phase is critical, as stopping and correcting issues is easier before mass production begins. In line with Juran and Godfrey (1999), the results show that proper planning and integration of quality into production processes prevent conflicts and ensure alignment with customer expectations. In support of Thompson and Miller (2020), the results show that global shipment delays, safety concerns, and the need to halt production to address quality issues were identified as significant challenges. Participants stressed the importance of prioritising quality over speed, even if it means temporarily compromising production targets. This approach aligns with the principles of Lean Manufacturing, which emphasise the elimination of waste and the importance of “building quality into the process”.

Furthermore, the findings revealed several production challenges that impact quality, including global shipment delays, safety concerns, and the need to halt production to address quality issues. Participants emphasised the importance of adaptability, collaboration, and a quality-driven mindset in navigating these challenges. Controlled deviations, managed through waivers and traceability, were identified as a strategy for balancing production and quality. Risk assessments were conducted to evaluate the impact of delivering substandard parts versus failing to meet delivery targets. These trade-offs reflect a commitment to maintaining high standards, even under pressure.

5.1.2 Interdependence of quality and production departments

The study highlighted the interdependence of quality and production departments, emphasising that both are essential for achieving operational success. While production drives immediate results and meets targets, quality sustains trust, safety, and long-term success. Participants expressed diverse viewpoints, with some prioritising production for its operational urgency and others favouring quality as a guiding principle. This dynamic interplay underscores the complexity of balancing short-term goals with long-term values, emphasising the need for collaboration and alignment between the two departments to achieve excellence. The findings of this study illustrate the lived complexity of maintaining quality standards in environments where productivity metrics often dominate strategic focus. By fostering collaboration, aligning KPIs, and prioritising both production and quality, organisations can achieve operational excellence, maintain customer satisfaction, and ensure sustainable growth. The study underscores the importance of strategic planning, shared accountability, and adherence to industry standards in navigating the challenges and trade-offs inherent in manufacturing processes.

5.1.3 Key Performance Indicators (KPIs)

The study explored the role of KPIs in driving operational efficiency and maintaining quality standards. Production KPIs focused on financial efficiency, operational stability, safety, and meeting customer demands. Metrics such as Overall Equipment Effectiveness (OEE) and Jobs Per Hour (JPH) were identified as critical for assessing productivity and process health. Quality-related KPIs, including the Cost of Poor Quality (CoPQ), Parts Per Million (PPM), and warranty claims, were highlighted as essential for ensuring product reliability and customer satisfaction. Daily KPIs, such as defect rates and safety incidents, provide real-time insights into operational performance, enabling organisations to address issues promptly and maintain quality standards.

5.2 Recommendations

The study provides six key recommendations aimed at addressing the challenges of aligning production and quality in the automotive manufacturing industry. First, the study highlights that these departments often operate in silos, leading to misalignment and conflicts. To address this, organisations should encourage interdepartmental communication and shared accountability. Regular meetings, joint problem-solving sessions, and the use of shared dashboards can help bridge the gap between production and quality teams. By fostering a culture of teamwork, organisations can ensure that both departments work toward common objectives, ultimately improving operational efficiency and product quality.

Second, there is need for integration of quality into production processes from the outset. The study emphasises the importance of embedding quality considerations into every stage of the production workflow, rather than treating quality as a separate, reactive function. Tools such as Advanced Product Quality Planning (APQP) can be instrumental in achieving this integration. APQP ensures that quality is built into the process, aligning production workflows with customer expectations and reducing the likelihood of defects. This proactive approach minimises the need for corrective actions during mass production, saving time and resources while maintaining high-quality standards.

Third, leadership buy-in is also identified as a critical factor in aligning production and quality. The study underscores the importance of having unified organisational goals that are embraced by leadership at all levels. Leaders play a pivotal role in setting the tone for collaboration and prioritising quality alongside production. By actively championing quality initiatives and providing the necessary resources, leaders can create an environment where quality and production are seen as complementary rather than competing priorities. This alignment ensures that organisational strategies are cohesive and focused on achieving both operational efficiency and customer satisfaction.

Fourth, the study also recommends the use of standardised frameworks and risk management practices to address the challenges of balancing production and quality. Frameworks such as ISO 9001 and IATF 16949 provide a structured approach to quality management, ensuring compliance with industry standards and fostering consistency in processes. Additionally, conducting regular risk assessments can help organisations evaluate the trade-offs between production demands and quality requirements. Controlled deviations, managed through waivers and traceability, can be used to address specific challenges without compromising overall quality or customer trust.

Fifth, there must be prioritisation of continuous monitoring and improvement. The study highlights the role of Key Performance Indicators (KPIs) in driving operational excellence. Organisations should establish both daily and annual KPIs to track short-term and long-term performance. Daily KPIs, such as defect rates and safety incidents, provide real-time insights into operational performance, enabling teams to address issues promptly. Annual KPIs, such as Overall Equipment Effectiveness (OEE) and the Cost of Poor Quality (CoPQ), assess overall efficiency and quality, guiding strategic decision-making. By consistently monitoring these metrics, organisations can identify areas for improvement and implement corrective actions to enhance both production and quality.

Last, fostering a quality-driven culture within organisations is recommended. This involves prioritising quality alongside production and instilling a commitment to high standards across all levels of the organisation. Temporary production reductions may be necessary to address quality issues and build a foundation for long-term efficiency and reliability. A quality-driven culture encourages employees to take ownership of quality initiatives, fostering a sense of accountability and pride in their work. This cultural shift aligns with the principles of Lean Manufacturing, which emphasise continuous improvement and waste reduction. In conclusion, the recommendations provided in the study offer a comprehensive roadmap for aligning production and quality in the automotive manufacturing industry. By fostering collaboration, integrating quality into production processes, ensuring leadership buy-in, and prioritising continuous improvement, organisations can navigate the challenges of balancing operational efficiency with high-quality standards. These strategies not only enhance customer satisfaction but also contribute to the long-term sustainability and competitiveness of manufacturing operations.

5.3 Proposed Improvements

The study highlights several areas for future research that could further improve the understanding and application of strategies to align production and quality in the automotive manufacturing sector. These areas address gaps in existing literature and explore emerging challenges and opportunities in the industry. One important area for future research is the influence of digital transformation on aligning production and quality. While the study recognises the potential of technologies such as artificial intelligence (AI), the Internet of Things (IoT), and machine learning in revolutionising manufacturing processes, there is limited research on how these technologies specifically affect the synchronisation of production and quality Key Performance Indicators (KPIs). Future research could examine the role of predictive analytics, real-time monitoring systems, and digital twins in enhancing the alignment between production efficiency and quality assurance. Such studies could offer valuable insights into best practices for utilising digital tools to improve operational performance.

6. Conclusion

This study examined the alignment between production and quality in the automotive manufacturing industry, with particular attention to how production-related challenges influence quality performance. The findings underscore that achieving operational excellence requires a careful balance between production efficiency and adherence to stringent quality standards, as neither can be prioritised at the expense of the other. Production drives output and revenue, while quality underpins safety, customer trust, brand reputation, and long-term competitiveness.

The study identified key production challenges affecting quality, including global shipment delays, particularly within just-in-time (JIT) systems, safety-related concerns, and the need for production stoppages to address quality issues. These challenges often compel manufacturers to make difficult trade-offs, sometimes prioritising delivery targets over quality standards. Decision-making in such contexts is characterised by controlled deviations and risk assessments aimed at balancing operational urgency with product integrity.

The findings further reveal a high level of interdependence between production and quality functions, alongside persistent tensions arising from misaligned objectives and performance measures. Effective collaboration, shared accountability, and improved coordination between these functions emerged as critical enablers of quality assurance during periods of disruption. In some cases, temporary reductions in production output were necessary to uphold quality standards, reinforcing the principle of embedding quality into production processes rather than relying on corrective actions.

Practical strategies identified include the integration of quality into production workflows through tools such as Advanced Product Quality Planning (APQP), the alignment of Key Performance Indicators (KPIs) across production and quality functions, and the application of Lean manufacturing principles. Leadership commitment and the cultivation of a quality-driven organisational culture were found to be pivotal in ensuring that production and quality objectives are mutually reinforcing.

This study contributes empirical evidence and rich qualitative insights into the operational challenges of aligning production and quality within the South African automotive manufacturing context, an area that remains underexplored in existing literature. By offering practical, context-specific strategies, the research provides an actionable roadmap for enhancing manufacturing resilience, sustaining quality performance, and maintaining competitiveness in an increasingly volatile and demanding industry.

References

- Braun, V., & Clarke, V, Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101, 2006.
- Brinkmann, S., & Kvale, S, Ethics in qualitative psychological research. In C. Willig & W. Rogers (Eds.), *The SAGE Handbook of qualitative research in psychology* (pp. 259-273). SAGE Publications Ltd, 2017.
- Brown, A, Challenges and opportunities in the automotive industry: A review. *International Journal of Automotive Engineering*, 8(1), 19-26, 2018.
- Bryman, A, *Social Research Methods* (5th ed.). Oxford University Press, 2015.
- Cooper, M.D, Towards a model of safety culture. *Safety Science*, 36(2), 111-136, 2011.
- Creswell, J.W, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (4th ed.). SAGE Publications, 2016.
- Daniel, J, *Sampling Essentials: Practical Guidelines for Making Sampling Choices*. SAGE Publications, 2012.
- Deming, W.E, *Out of the Crisis*. Massachusetts Institute of Technology, Centre for Advanced Engineering Study, 1986.
- Durdella, N, *Qualitative Dissertation Methodology: A Guide for Research Design and Methods*. SAGE Publications, 2019.
- Guest, G., MacQueen, K.M., & Namey, E.E, *Applied Thematic Analysis*. SAGE Publications.
- Hirota, Y, Impact of the 2011 earthquake and tsunami on the Japanese automotive industry: A supply chain perspective. *International Journal of Production Economics*, 139(2), 606-617, 2012.
- Juran, J.M., & Godfrey, A.B, *Juran's Quality Handbook*. McGraw-Hill, 1999.
- Kumara, P., Wilson, M., Yadav, S., & Thomas, K, Resilience in the automotive supply chain: Lessons from the COVID-19 pandemic. *International Journal of Logistics Management*, 32(2), 345-362, 2021.

- Liker, J.K., *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer*. McGraw-Hill, 2021.
- Saaty, T.L., *The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation*. McGraw-Hill, 1980.
- Smith, J., & Thomas, K., The Dieselgate scandal: Implications for quality management in the automotive industry. *Journal of Business Ethics*, 174(2), 245-259, 2021.
- Supekar, M., Kumar, P., & Yadav, S., Industry 4.0 in the automotive sector: Opportunities and challenges. *International Journal of Mechanical Engineering and Robotics Research*, 8(3), 375-380, 2019.
- Teece, D. J., Pisano, G., & Shuen, A., Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509-533, 1997.
- Thompson, S., & Miller, P., Building resilience in the automotive supply chain: Lessons from the COVID-19 pandemic. *Supply Chain Management Review*, 24(5), 12-18, 2020.
- Vasileiou, K., Barnett, J., Thorpe, S., & Young, T., Characterising and justifying sample size sufficiency in interview-based studies: Systematic analysis of qualitative health research over 15 years. *BMC Medical Research Methodology*, 18(1), 148, 2018.
- Womack, J.P., & Jones, D.T., *Lean Thinking: Banish Waste and Create Wealth in Your Corporation*. Simon & Schuster, 2023.
- Yadav, S., Brown, A., Hirota, Y., & Yamamoto, T., Sustainable innovation in the automotive industry: Challenges and opportunities. *Sustainability*, 13(7), 3892, 2021.
- Yardley, L., & Bishop, F., Mixing qualitative and quantitative methods: A pragmatic approach. In C. Willig & W. Rogers (Eds.), *The SAGE Handbook of qualitative research in psychology* (pp. 398-414). SAGE Publications Ltd, 2017.
- Zhong, R.Y., Xu, X., Klotz, E., & Newman, S.T., Intelligent manufacturing in the context of Industry 4.0: A review. *Engineering*, 3(5), 616-630, 2017.