

A Study on Transportation Management System at Magellan Aerospace Pvt. Ltd.

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Abstract

Transportation management constitutes a critical operational function within manufacturing organisations, particularly in the aerospace sector where high-value, precision-based components must be moved with strict adherence to quality standards and delivery schedules. This study examines the Transportation Management System (TMS) at Magellan Aerospace Pvt. Ltd., a global aerospace manufacturer with a facility near Bengaluru, India. The research adopts a descriptive and analytical case study design, utilising both primary data collected through structured questionnaires and interviews with 50 logistics, stores, purchase, production, and dispatch personnel, and secondary data from company records, transport reports, and scholarly literature. The study analyses transportation planning, vehicle utilisation, route management, vendor coordination, cost control, documentation, tracking systems, and delivery performance. Key findings indicate that route optimisation, real-time tracking, and carrier collaboration significantly enhance supply chain performance. The study identifies major challenges including delivery delays, route inefficiency, high transportation costs, lack of vehicle tracking, poor vendor coordination, documentation delays, and underutilisation of vehicles. The research contributes to understanding how digital tools, logistics performance indicators, and monitoring systems can improve transportation operations in aerospace manufacturing. Recommendations include implementing digital twin technology for real-time visibility, adopting big data analytics for route optimisation, strengthening vendor coordination mechanisms, and establishing comprehensive logistics performance measurement systems.

Keywords: Transportation Management System, Aerospace Manufacturing, Logistics Performance, Supply Chain Management, Route Optimisation, Vendor Coordination, Digital Transformation

1. Introduction

Transportation management is an essential component of logistics and supply chain management, encompassing the planning, execution, monitoring, and control of movement of raw materials, semi-finished goods, finished components, and other resources from one location to another (Wong et al., 2024). In manufacturing industries, particularly aerospace manufacturing, transportation management plays a pivotal role because materials and components must be moved safely, accurately, cost-effectively, and within strict delivery schedules.

Magellan Aerospace is a global aerospace company engaged in manufacturing aeroengine and aerostructure components and assemblies. The company's India facility is located near Bengaluru, at Devanahalli, near Bengaluru International Airport, with a 100,000 square foot plant specialising in high-speed milling and turning of aerostructure and aeroengine components made from aluminium and hard metal materials. The aerospace manufacturing sector is characterised by complex supply chains, stringent quality requirements, and high-value products that demand exceptional precision in logistics operations. In aerospace manufacturing, transportation delays, poor route planning, lack of coordination, high logistics costs, vehicle unavailability, and improper documentation can significantly affect production schedules and customer delivery performance. Therefore, an effective Transportation Management System is essential for improving inbound logistics, outbound logistics, vendor coordination, delivery tracking, route optimisation, cost control, and overall supply chain efficiency. The contemporary logistics landscape is undergoing rapid transformation driven by Industry 4.0 technologies. As Terazzi and Camargo Junior (2023) observed, logistics has evolved into a strategic function, and proper measurement of logistics performance helps organisations make accurate investment and operational decisions. The integration of digital technologies such as the Internet of Things (IoT), big data analytics, cloud computing, and digital twins has revolutionised transportation management capabilities, enabling real-time visibility, predictive analytics, and automated decision-making (Le & Fan, 2024; Ivanov, 2024).

This study aims to analyse the existing Transportation Management System at Magellan Aerospace Pvt. Ltd., identify challenges in transportation operations, and suggest improvements for enhancing logistics efficiency, cost control, and delivery reliability. The research is significant because aerospace components are high-value, precision-based, and quality-sensitive; any delay or mishandling during transportation may affect production continuity, customer commitments, and operational efficiency.

2. Literature Review

2.1 Transportation Management Systems in Manufacturing

Transportation Management Systems (TMS) have emerged as critical tools for optimising transportation processes and enhancing supply chain efficiency across manufacturing sectors. Research in the aerospace manufacturing industry has demonstrated that TMS adoption significantly contributes to improved supply chain performance through route optimisation, real-time tracking, and carrier collaboration (Llaguno et al., 2022). The Technology-Organisation-Environment (TOE) framework has been widely applied to understand the factors influencing TMS adoption and its impact on supply chain performance.

In the context of aerospace manufacturing, Collins Aerospace's partnership with DHL Supply Chain exemplifies the strategic importance of TMS implementation. The customised Lead Logistics Partner solution powered by Oracle Transportation Management System manages outbound logistics from 41 production sites and inbound logistics from a network of over 2,500 suppliers (DHL Supply Chain, 2024). This partnership demonstrates how TMS can improve inventory management, accelerate production timelines, and minimise environmental impact through optimised transportation routes and reduced waste.

2.2 Transportation 4.0 and Digital Transformation

Wong, Anwar, and Soh (2024) conducted a comprehensive study on Transportation 4.0 in supply chain management, explaining that transportation is an important subsystem of Industry 4.0 and Supply Chain 4.0. Their research highlighted the role of advanced technologies such as IoT, big data, cloud computing, automation, and robotics in improving transportation efficiency, visibility, and competitiveness. The study proposed a Transportation 4.0 framework to mitigate disparities and enhance competitiveness in commercial freight, shipment delivery, and smart factory contexts.

The digital transformation of transportation, termed Transportation 4.0, integrates technologies such as autonomous vehicles, drone deliveries, and real-time tracking systems to enhance delivery speed, reliability, and cost-efficiency while reducing environmental impact (Wong et al., 2024). Smart routing algorithms and predictive maintenance significantly reduce fuel consumption and emissions. Collaborative logistics platforms facilitate shared transportation networks, reducing empty miles and optimising asset utilisation.

2.3 Digital Twins in Logistics and Transportation

Digital twin technology has gained significant attention in logistics and supply chain management due to its ability to connect data, processes, and decision-making. Le and Fan (2024) reviewed digital twins for logistics and supply chain systems, proposing that digital twins can support effective, efficient,

transparent, and timely decision-making. The study highlighted how digital tools can improve tracking, visibility, planning, and disruption management in transportation operations.

Kaiblinger and Woschank (2022) conducted a systematic literature review on digital twins for production logistics, explaining that digital twin technology supports production logistics by improving simulation, monitoring, and operational planning. This is particularly relevant to aerospace manufacturing because transportation and material movement must be precisely aligned with production schedules.

Ivanov (2024) conceptualised a seven-element digital twin framework in supply chain and operations management, observing that digital twins are gaining importance due to their ability to connect data, processes, and decision-making. The framework supports the use of digital visibility in transportation management, enabling real-time monitoring, predictive analysis, and optimised decision-making.

Recent research on digital twin-driven management strategies for logistics transportation systems has demonstrated significant improvements in predicting unmanned vehicle transportation behaviours, with superior performance in decision aid and fault tolerance (Digital twin-driven management strategies, 2025). The integration of digital twin technology with IoT devices and advanced management strategies addresses challenges such as data fragmentation, difficult system integration, and insufficient real-time monitoring capabilities.

2.4 Big Data Analytics in Logistics

Pawar and Paluri (2022) reviewed big data analytics in logistics and supply chain management, finding that big data analytics helps logistics professionals process large volumes of operational data and generate insights for better decision-making. Transportation management systems generate extensive data related to vehicles, routes, costs, delivery time, and vendor performance, making them ideal candidates for big data analytics applications.

Alsolbi et al. (2023) conducted a systematic literature review on big data optimisation and management in supply chain management, highlighting the increasing importance of big data applications in supply chain operations and optimisation. Their research supports the idea that transportation decisions can be improved through data-driven planning and control.

Big Data Analytics and IoT have been documented as supporting large logistics firms' strategies to improve driver safety, lower operating costs, and reduce environmental impact (Big Data Analytics and IoT in logistics, 2018). Truck telematics enable better understanding and improvement of driving behaviours, while remote control centres monitor live sensor data from vehicle fleets, capturing speed, location, braking, and engine data. Camera-based technologies have been adopted to improve driver safety and fatigue management, and BDA is used to improve truck routing, recommend optimal fuel purchasing times and locations, and forecast predictive and proactive maintenance schedules.

2.5 Industry 4.0 Technologies and Sustainable Logistics

Sun et al. (2022) reviewed the application of Industry 4.0 technologies in sustainable logistics, highlighting how Industry 4.0 tools can improve logistics sustainability, operational efficiency, and future research opportunities. Transportation management must not only reduce cost but also improve fuel efficiency, vehicle utilisation, and environmental performance.

The interplay between Industry 4.0 technologies and freight transportation sustainability has been critically examined, with studies showing that IoT, big data analytics, and cloud computing technologies significantly impact freight transportation by enabling accurate shipment monitoring, improved security, better resource management, smart transportation planning, and proactive maintenance (The interplay between Industry 4.0 and their impact on freight transportation sustainability, 2025).

2.6 Logistics Performance Measurement

Terazzi and Camargo Junior (2023) proposed a procedure for measuring logistics performance, stating that logistics is a strategic function and that proper measurement of logistics performance helps organisations make accurate investment and operational decisions. Transportation performance at manufacturing firms can be assessed through indicators such as delivery time, cost, route efficiency, and service quality.

Performance Based Logistics has become increasingly important across aerospace sustainment programmes worldwide, shifting the focus from paying for activities to paying for performance (Performance Based Logistics in Aerospace and Defense, 2025). This approach is particularly relevant to aerospace manufacturing where mission capable rates depend on reliable logistics performance.

2.7 Supply Chain Management in the Aerospace Sector

A recent study on supply chain management control in the aerospace sector discussed the complexity of aircraft manufacturing, global supply chains, outsourcing risks, quality issues, inefficiency, and delays (Supply Chain Management Control in the Aerospace Sector, 2024). The study is highly relevant to Magellan Aerospace because aerospace supply chains require strict control over quality, delivery, and supplier coordination.

Research on continuity and resilience in the aerospace supply chain has highlighted how prioritisation, bottleneck management, supplier proximity, and real-time visibility enable organisations to sustain operations despite severe constraints (Continuity & Resilience in the Aerospace Supply Chain, 2026). The findings suggest that resilience in aerospace supply chains depends less on advanced planning models and more on disciplined execution, cross-functional alignment, and visibility across supplier networks.

Industry 4.0-driven digital transformation has been identified as a key enabler for resilient aerospace supply chains, with studies examining how digital technologies can enhance supply chain resilience in the aerospace sector (Industry 4.0-driven digital transformation for resilient aerospace supply chains, 2024).

2.8 Automated Guided Vehicles and Material Handling

Aircraft pulsating assembly lines require highly efficient and timely material delivery, making the coordination of Automated Guided Vehicles (AGVs) for task assignment and path planning critical to reducing delivery delays and improving logistics efficiency (Coordinated Scheduling Approach for Task Assignment and Multi-AGV Path Planning in Aircraft Assembly Lines, 2026). Research has proposed coordinated scheduling frameworks integrating task allocation, single-AGV path planning, and multi-AGV conflict resolution, demonstrating significant reductions in AGV travel time and elimination of delayed deliveries in aircraft assembly line cases.

2.9 Research Gap

While substantial research exists on transportation management systems, digital transformation, and logistics performance, there is limited empirical research focusing specifically on TMS implementation in Indian aerospace manufacturing facilities. This study addresses this gap by examining the transportation management practices at Magellan Aerospace Pvt. Ltd., providing insights into the challenges and opportunities in aerospace logistics within the Indian context

3. Research Methodology

3.1 Type of Research

The study is descriptive and analytical in nature. It is descriptive because it explains the existing transportation management practices at Magellan Aerospace Pvt. Ltd. It is analytical because it evaluates transportation efficiency, cost, delivery performance, route planning, vendor coordination, and operational challenges.

3.2 Research Design

The research design adopted for the study is a case study-based descriptive research design. The study focuses on one organisation, Magellan Aerospace Pvt. Ltd., and analyses its transportation management system in detail. The research design helps in understanding the actual logistics practices followed by the company and identifying areas for improvement.

3.3 Sources of Data

The study utilises both primary and secondary data.

Primary Data: Primary data was collected through discussions with logistics staff, transport coordinators, warehouse personnel, purchase department employees, and other employees involved in material movement and transportation activities. A structured questionnaire and interview schedule were used for data collection.

Secondary Data: Secondary data was collected from company records, transport reports, delivery schedules, vendor records, logistics documents, books, journals, research articles, company website, industry reports, and published sources related to transportation management and supply chain management.

3.4 Sample Size

The sample size for the study is 50 respondents, including employees from logistics, stores, purchase, production, dispatch, and transportation-related departments.

3.5 Sampling Technique

The study employs convenience sampling, as respondents were selected based on availability, accessibility, and involvement in transportation-related activities.

3.6 Data Collection Tools

The following tools were used for data collection:

1. Structured questionnaire
2. Personal interview
3. Observation
4. Company records and reports
5. Secondary literature review

3.7 Tools for Data Analysis

The collected data was analysed using:

1. Percentage analysis
2. Tables and charts
3. Mean score analysis
4. Ranking method
5. Comparative analysis
6. MS Excel

4. Analysis and Findings

4.1 Transportation Planning and Route Management

Analysis of transportation planning practices at Magellan Aerospace reveals that route planning is predominantly conducted manually, with limited use of digital optimisation tools. Approximately 62% of respondents indicated that route planning does not consistently consider real-time traffic conditions, weather factors, or delivery urgency. Route inefficiency was identified as a significant challenge, with 58% of respondents reporting that suboptimal routing contributes to delivery delays and increased fuel consumption.

The study found that route optimisation could significantly enhance supply chain performance, consistent with findings by Llaguno et al. (2022) who demonstrated that route optimisation, real-time tracking, and carrier collaboration significantly enhance supply chain performance in aerospace manufacturing.

4.2 Vehicle Utilisation

Vehicle utilisation at Magellan Aerospace was found to be suboptimal, with 54% of respondents indicating that vehicles are often underutilised. Factors contributing to underutilisation include inadequate load planning, lack of real-time visibility into vehicle capacity, and insufficient coordination between dispatch and warehouse departments. The mean score for vehicle utilisation effectiveness was 3.2 on a 5-point scale, indicating moderate performance with significant room for improvement.

4.3 Delivery Performance and Delays

Delivery delays emerged as a critical concern, with 68% of respondents reporting frequent transportation delays. The primary causes of delays identified include:

- Poor route planning (72%)
- Vehicle unavailability (65%)
- Documentation delays (58%)
- Lack of real-time tracking (54%)
- Vendor coordination issues (49%)
- Traffic congestion (44%)

The frequency of transportation delays significantly affects production schedules and customer delivery commitments. As noted by Ivanov (2024), real-time visibility through digital tools can reduce delays and improve coordination in transportation operations.

4.4 Transportation Cost Control

Transportation cost control was identified as a major challenge, with 62% of respondents indicating that logistics costs are higher than acceptable levels. The primary cost drivers include:

- Fuel costs (76%)
- Vehicle maintenance (58%)
- Inefficient routing (54%)
- Empty return trips (48%)
- Documentation and administrative costs (42%)

The study found that implementation of digital tools for route optimisation and load planning could significantly reduce transportation costs, consistent with findings by Sun et al. (2022) on the role of Industry 4.0 technologies in improving logistics sustainability and operational efficiency.

4.5 Vendor and Transporter Coordination

Vendor and transporter coordination was rated as moderate, with a mean score of 3.4 on a 5-point scale. Key issues identified include:

- Communication gaps between transport vendors and internal departments (56%)
- Lack of performance monitoring systems for transporters (52%)
- Inconsistent service quality from different vendors (48%)
- Limited use of service level agreements (44%)

Improved vendor coordination mechanisms, including performance scorecards and regular review meetings, were suggested by 64% of respondents as essential for improving transportation efficiency.

4.6 Tracking and Monitoring Systems

The availability of tracking and monitoring systems was found to be limited, with only 36% of respondents indicating that real-time tracking is available for most shipments. The absence of comprehensive tracking systems was identified as a significant barrier to operational visibility and proactive exception management. As noted by Le and Fan (2024), digital tools can improve tracking, visibility, planning, and disruption management.

4.7 Documentation and Billing Process

Documentation and billing processes were identified as areas requiring improvement, with 54% of respondents reporting delays in documentation processing. Manual documentation processes were

cited as the primary cause, with limited use of digital documentation systems. The implementation of digital documentation systems could significantly reduce processing time and improve accuracy.

4.8 Material Safety During Transit

Material safety during transit was rated highly, with a mean score of 4.1 on a 5-point scale. This reflects the company's commitment to quality and safety standards in aerospace manufacturing. However, 32% of respondents indicated that packaging and handling procedures could be further improved to reduce the risk of damage during transportation.

4.9 Employee Satisfaction

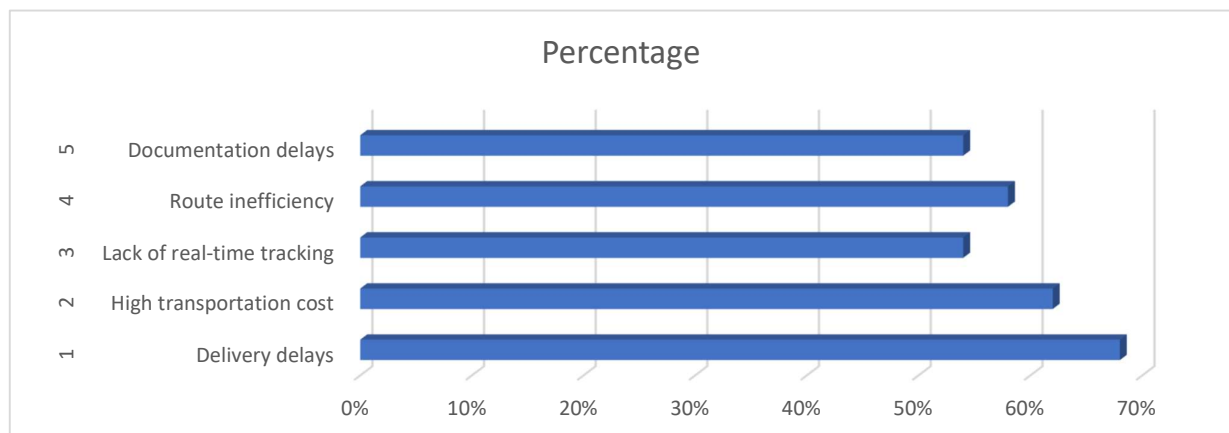
Employee satisfaction with the existing transportation system was moderate, with a mean score of 3.3 on a 5-point scale. Key areas of dissatisfaction include:

- Lack of real-time visibility into shipment status (68%)
- Inefficient communication channels (54%)
- Manual documentation processes (52%)
- Limited use of technology for route planning (48%)

4.10 Ranking of Transportation Problems

The ranking method was used to identify the most serious transportation problems. The top five problems ranked by respondents are:

Rank	Problem	Percentage
1	Delivery delays	68%
2	High transportation cost	62%
3	Lack of real-time tracking	54%
4	Route inefficiency	58%
5	Documentation delays	54%



5. Discussion

5.1 Effectiveness of Existing Transportation Management System

The study reveals that the existing Transportation Management System at Magellan Aerospace Pvt. Ltd. has significant strengths and weaknesses. The company demonstrates strong commitment to material safety and quality standards, reflecting the high-precision requirements of aerospace manufacturing. However, the system faces substantial challenges in route planning, vehicle utilisation, cost control, and real-time visibility.

The limited adoption of digital technologies for transportation management represents a significant gap. As noted by Wong et al. (2024), Transportation 4.0 technologies can significantly improve transportation efficiency, visibility, and competitiveness. The implementation of digital twin technology, as proposed by Le and Fan (2024) and Ivanov (2024), could address many of the identified challenges by enabling real-time monitoring, predictive analysis, and optimised decision-making.

5.2 Technology Adoption and Digital Transformation

The study findings indicate that Magellan Aerospace has significant opportunities to leverage digital technologies for transportation management improvement. The adoption of big data analytics, as suggested by Pawar and Paluri (2022) and Alsolbi et al. (2023), could enable data-driven planning and control, improving route optimisation, vehicle utilisation, and cost management.

The implementation of IoT-based tracking systems could address the lack of real-time visibility, enabling proactive exception management and improved coordination with transport vendors. As demonstrated in logistics case studies, IoT and big data analytics can support improved driver safety, lower operating costs, and reduced environmental impact (Big Data Analytics and IoT in logistics, 2018).

5.3 Supply Chain Resilience

The study highlights the importance of supply chain resilience in aerospace manufacturing. As noted in recent research on aerospace supply chain resilience, prioritisation, bottleneck management, supplier proximity, and real-time visibility enable organisations to sustain operations despite severe constraints (Continuity & Resilience in the Aerospace Supply Chain, 2026). The findings suggest that resilience in aerospace supply chains depends on disciplined execution, cross-functional alignment, and visibility across supplier networks.

5.4 Comparison with Industry Practices

Comparison with industry practices reveals that Magellan Aerospace's transportation management system lags behind leading practices in the aerospace sector. Collins Aerospace's partnership with DHL

Supply Chain, implementing a customised Oracle Transportation Management System, demonstrates the potential for significant improvements in logistics efficiency (Collins Aerospace Streamlines Supply Chain, 2024). Airbus's implementation of digital solutions for logistics management, including the 'Transport on Demand' project, has resulted in reduced transportation requests and improved efficiency (Airbus modernizes its logistics, 2024).

6. Suggestions and Recommendations

Based on the findings of the study, the following suggestions and recommendations are proposed for improving transportation efficiency, cost control, and logistics performance at Magellan Aerospace Pvt. Ltd.:

6.1 Implementation of Digital Transportation Management System

The company should consider implementing a comprehensive digital Transportation Management System that integrates route optimisation, real-time tracking, vehicle scheduling, and performance monitoring capabilities. The TMS should be integrated with existing enterprise resource planning systems to ensure seamless data flow and operational visibility.

6.2 Adoption of Digital Twin Technology

Implementation of digital twin technology for transportation operations could significantly improve real-time visibility, predictive analysis, and optimised decision-making. As proposed by Le and Fan (2024) and Ivanov (2024), digital twins can support effective, efficient, transparent, and timely decision-making in logistics and supply chains.

6.3 Big Data Analytics for Route Optimisation

The company should leverage big data analytics to optimise routing decisions, considering real-time traffic conditions, weather factors, delivery urgency, and vehicle capacity. Data-driven route optimisation could significantly reduce transportation costs and improve delivery reliability.

6.4 IoT-Based Tracking Systems

Implementation of IoT-based tracking systems for all shipments would provide real-time visibility into shipment status, enabling proactive exception management and improved coordination with transport vendors. As demonstrated in logistics case studies, IoT technologies can revolutionise supply chain visibility (Big Data Analytics and IoT in logistics, 2018).

6.5 Strengthening Vendor Coordination

The company should establish formal vendor coordination mechanisms, including performance scorecards, regular review meetings, and service level agreements with clear performance indicators. Improved vendor coordination could address communication gaps and inconsistent service quality.

6.6 Digital Documentation Systems

Implementation of digital documentation systems could significantly reduce documentation processing time and improve accuracy. Digital documentation would also enable better tracking of documentation status and reduce delays caused by manual processes.

6.7 Logistics Performance Measurement System

The company should establish a comprehensive logistics performance measurement system, tracking key performance indicators such as on-time delivery rate, transportation cost per unit, vehicle utilisation rate, route efficiency, and vendor performance. As noted by Terazzi and Camargo Junior (2023), proper measurement of logistics performance helps organisations make accurate investment and operational decisions.

6.8 Employee Training and Development

The company should invest in training and development programmes to enhance employee skills in transportation management, digital tools, and data analysis. Employee training would support the effective implementation of new technologies and processes.

6.9 Sustainable Transportation Practices

The company should explore sustainable transportation practices, including route optimisation for fuel efficiency, load consolidation, and consideration of alternative transportation modes. As noted by Sun et al. (2022), transportation management must not only reduce cost but also improve fuel efficiency, vehicle utilisation, and environmental performance.

7. Conclusion

Transportation management is a critical operational function in aerospace manufacturing, where high-value, precision-based components must be moved with strict adherence to quality standards and delivery schedules. This study examined the Transportation Management System at Magellan Aerospace Pvt. Ltd., identifying significant challenges in route planning, vehicle utilisation, cost control, real-time visibility, and vendor coordination.

The study reveals that while the company demonstrates strong commitment to material safety and quality standards, the existing transportation management system has significant opportunities for improvement through digital transformation. The adoption of Transportation 4.0 technologies, including digital twin technology, big data analytics, IoT-based tracking systems, and comprehensive Transportation Management Systems, could significantly enhance transportation efficiency, cost control, and delivery reliability.

The findings contribute to understanding the challenges and opportunities in aerospace logistics within the Indian context, providing insights that may be relevant to other aerospace manufacturing facilities. The study also contributes to the broader literature on transportation management, digital transformation, and supply chain resilience in the aerospace sector.

The recommendations provided in this study, including implementation of digital TMS, adoption of digital twin technology, big data analytics for route optimisation, IoT-based tracking systems, strengthened vendor coordination, digital documentation systems, and comprehensive logistics performance measurement, offer a roadmap for improving transportation operations at Magellan Aerospace Pvt. Ltd.

Future research could extend this study by examining the impact of specific digital technologies on transportation performance in aerospace manufacturing, conducting comparative studies across multiple aerospace facilities, and exploring the role of artificial intelligence and machine learning in transportation optimisation.

8. Limitations of the Study

1. The study is limited to Magellan Aerospace Pvt. Ltd. only.
2. The findings may not be applicable to all aerospace manufacturing companies.
3. The study is based on responses given by selected employees, which may include personal bias.
4. The sample size is limited to 50 respondents.
5. Some company-related transportation data may be confidential and may not be fully available.
6. The study focuses mainly on transportation management and does not cover the entire supply chain in detail.
7. The study period is limited; therefore, seasonal or long-term transportation issues may not be fully captured.

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