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doi: http://dx.doi.org/10.55124/ijccscm.v1i2.238

Sciforce

International Journal of Cloud Computing and Supply Chain Management

Journal homepage: www.sciforce.org

SAP Transportation Management Implementation Using the MOORA Method

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ARTICLE INFO

Article history:
Received: 20250302
Received in revised form: 20250308
Accepted: 20250325
Available online: 20250403

Keywords:
Employee training;
SAP;
IT systems;
early retirement;
employee engagement;
SAP proficiency;
Collaboration;
.

ABSTRACT

Through algorithms, scenario-based planning, and integration with SAP S/4HANA, the solution helps businesses make data-driven decisions while ensuring seamless communication between carriers, suppliers, and customers. Additionally, integration with external systems via Electronic Data Interchange (EDI) and APIs has improved visibility across the supply chain, allowing for proactive exception management and automated notifications. By implementing key enhancements, companies have achieved significant cost reductions, improved shipment visibility, and strengthened overall supply chain management.

Research significance: Implementing SAP Transportation Management (SAP TM) is critical to modernizing logistics operations by improving transportation efficiency, optimizing freight costs, and ensuring regulatory compliance.

The research highlights the need to create actions to initiate shipments, adjust transportation requests, and manage the lifecycle of merchandise, ensuring data integrity, and process automation. These advancements significantly contribute to reducing administrative workload, improving real-time tracking, and reducing transportation costs through optimal route planning and carrier selection.

Methodology: Alternative: Express Logistics, Global Freight, Speedy Transport, Safe Way Carriers, EcoShip Solutions. Evaluation Parameters: Delivery Efficiency, Cost Savings, Transit Time, Delay Rate.

Result: These findings reveal that Global Freight received the highest ranking, and Speedy Transport received the lowest ranking.

Conclusion: The value of the dataset for SAP Transportation Management Implementation, according to the MOORA method, Global Freight achieves the highest ranking.

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Introduction

SAP Cloud Transport Management

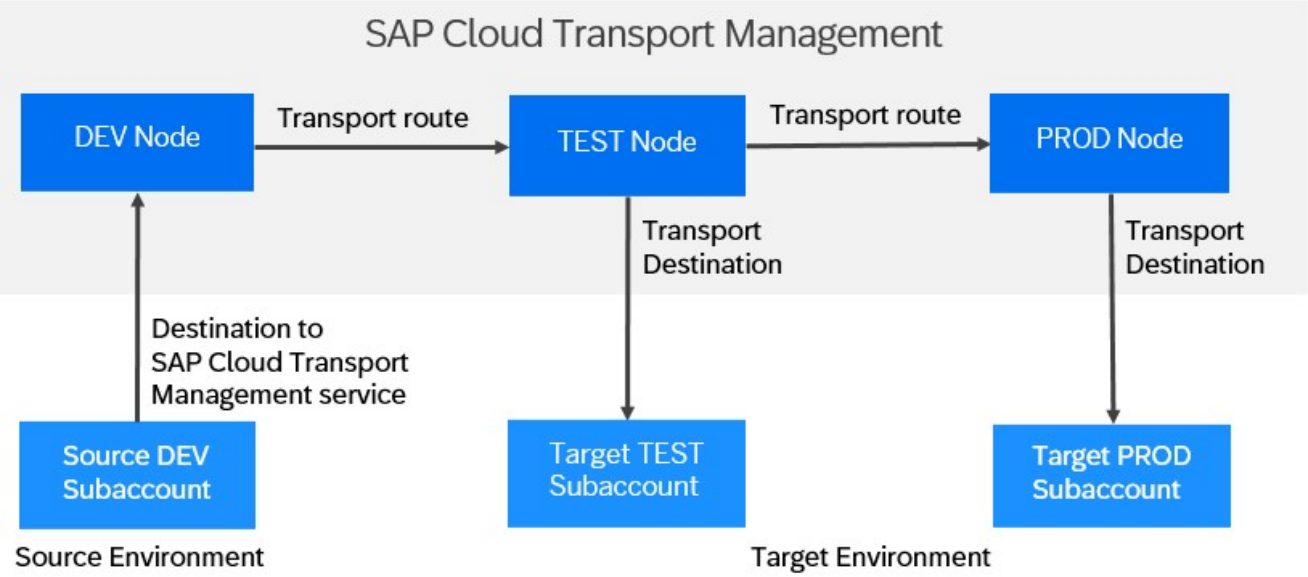
Created actions to initiate exports or adjust transport requests. Designed root nodes, child nodes, and dependent node types to represent various aspects of a business object. Managed the lifecycle of business objects, including creation, validation, processing, and error handling. Ensured data integrity by validating business rules and preventing constraint violations during data changes. Implemented a persistence layer to securely store business object data in ABAP database tables. Handled event triggers for specific actions in the transport cockpit. Freight Cost Optimization: Reduces transportation costs by improving route efficiency, consolidating shipments, and obtaining better carrier rates. Real-time tracking: Improves decision-making by providing instant access to data, reducing delays and unexpected costs. Process automation: Streamlines

tasks like shipment planning and cargo settlement, reducing administrative workload and human error. Reduced lead times: Improves delivery speed by optimizing routes, shipment consolidation, and communicating with logistics partners. Regulatory compliance: Ensures proper documentation and compliance with global shipping regulations. Sustainability support: Features like carbon footprint tracking and route optimization help reduce environmental impact. In the SAP system, the transaction concept ensures that related business activities are stored together.

For example, when an invoice is generated from a customer order, the system not only stores the entire invoice but also updates the order status accordingly. [1] Gaining knowledge of the SAP framework can help address key issues and improve the situation. Insights gained from SAP results can help identify the root causes of current challenges. In the logistics sector, the adoption of green practices depends on factors such as transport sustainability regulations, eco-driving techniques, and supporting policies, emphasizing the importance of collaboration in improving environmental sustainability. However, freight forwarders and logistics service providers (LSPs) have low awareness and participation in environmental knowledge sharing events and structured training programs focused on multimodal transport. [2] The primary challenge is managing organizations that differ in strategy, work culture, organizational structure, and technology. Supply chain integration involves integrating the interdependencies among supply chain members through various integration mechanisms. A well-integrated supply chain ensures that all members collaborate effectively on processes and operations. To achieve this, they must be adaptable, develop mutual understanding in management and technical aspects, and adapt to different integration approaches. In the XYZ case study, the dynamic SAP-LAP model is used to demonstrate supply chain integration. This flexible framework highlights both management and technical challenges, addressing both the soft and hard aspects of integration in a supply chain environment.[3] There was a lot of cooperation, all members showed friendliness, cooperation, openness and support.

They really appreciated the researcher's interest in understanding the issues of the project. Secondary data sources included libraries, local newspapers, published books, specialized monographs, notes and journals related to the research subjects. In addition, most of the secondary information about SAP International AG Ltd was collected through personal contacts with the consultants and their Australian head office. [4] Sales planning is typically created using historical data, which can be obtained directly from ERP systems, archive systems, or in an aggregated format from data warehouses. Integrating sales planning with the SAP Business Information Warehouse enables organizations to analyze key ERP data based on multidimensional criteria such as product types, regions, and time frames. This analysis helps identify key factors that affect demand forecasts. To ensure accurate data extraction and integration, predefined rules should be established that outline how and when adjustments should be made to the underlying data in response to changes. [5]In customer implementation, a business map is created to outline the processes that need to be monitored, along with the associated business partners and objectives. Since no two projects are the same, the solution must be highly adaptable. While customers often encounter similar processes, SAP SCEM not only provides functionality, but also predefined configurations that ensure visibility into the relevant system processes. Based on this framework, the final system configuration can be established, including seamless integration with third-party applications. [6]The SAP-LAP paradigm integrates learning and action in a mutually reinforcing way, aligning them with performance.

It goes beyond process improvement by connecting the diverse perspectives of the various stakeholders involved in management processes. As a result, SAP-LAP analysis serves as a learning tool and an interpretive framework for exploring complex issues. For organizations that are adopting new and cutting-edge technologies, this framework provides a useful method for analysis and synthesis. To improve supply chain performance, businesses are implementing not only advanced manufacturing and IT solutions, but also innovative management approaches such as supply chain management, and SAP-LAP analysis exemplifies this approach. [7]The SAP-LAP approach effectively explains the current state of reverse logistics, providing top management with valuable insights to begin implementing it within their organizations. In addition, it



Helps identify gaps in the adoption of reverse logistics practices. A key advantage of this method is that the LAP framework recommends necessary improvement actions based on the existing situation, stakeholders, and processes. [8]Employees need additional training in SAP and IT systems. To address this, the contractor should provide skilled trainers to effectively fill the knowledge gap and communicate with the trainees. The company can also reduce this gap by hiring new employees with advanced technical degrees, as they have a strong understanding of IT systems. In addition, SECO can reduce its reliance on older employees through early retirement programs. To improve employee engagement and SAP proficiency, SECO can allow the contractor to conduct basic technical sessions, fostering better collaboration and knowledge sharing.

The SAP system has already been implemented in human resources, financial resources, and transportation; however, there are several phases. SECO should leverage the expertise of these departments, learn from past challenges, and ensure a smooth implementation process. [9]The SAP approach is used in the case study to examine the environmental factors, key stakeholders, and processes that influence the adoption of sustainable practices. Along with the UN's sustainability goals, sustainability pressures act as important drivers, motivating logistics service providers (LSPs) to improve their current sustainability efforts. Key decision makers, including top management, suppliers, and customers, play a key role in redesigning supply chain processes to prioritize environmentally friendly practices. [10]To meet maintenance challenges in an evolving and flexible manufacturing environment, maintenance organizations – now seen as "profit contributors" – must be as adaptable as manufacturing operations. Factors affecting maintenance must be designed to be flexible while maintaining minimal maintenance costs. Assessing the management landscape, identifying problems, and resolving key issues often requires a thorough investigation. A useful approach for this analysis is the Situation-Actor-Process (SAP)-Learning-Action-Performance (LAP) framework, which provides a structured method for assessment and improvement. [11] Since many user organizations are still in the early stages of integrating big data solutions into their smart factory efforts, they may struggle to provide meaningful insights into the problem being studied. As a result, this research was conducted specifically from an IS consulting perspective. In addition, when organizations fail to clearly define their analytics needs, it becomes challenging to select and implement appropriate standards, methods, and tools to filter and manage big data. Without effective big data management, the rapid growth of datasets in smart factories can lead to the accumulation of unnecessary and irrelevant data in data warehouses, which ultimately affects system performance. [12].Implementing SAP is a complex process that requires careful planning and scheduling to ensure a seamless transition. It requires significant changes in technology, business process management, and workflows, which may not always be easily aligned with an organization's current strategy and culture. A well-designed ERP system relies on high-quality data, which necessitates a strong understanding of data quality. According to Redman, poor data quality can hinder strategic implementation, create data ownership conflicts, misalign the organization, and distract management. In addition, it can reduce employee morale and foster distrust within the organization.

To maximize the benefits of an ERP system, Chung recommends several key steps, including ensuring that the quality and scope of the system closely align with the organization's specific needs.[13] Extensive experience in the implementation of a transportation management system (TMS)

indicates that the benefits of such solutions are not guaranteed. In many cases, TMS adoption has failed to bring about significant changes in a transportation company's business processes or improve overall performance. Research analyzing the gap between business expectations and information system performance has shown that ignoring the human factor – in particular, the user perspective of the system – often leads to unsuccessful outcomes. [14]Depending on the context, it is necessary to first identify the relevant actors. The context may vary for different actors, as a process for one actor may be a situation for another, and vice versa. Within the framework of SAP, interactions drive learning, action, and performance. Gaining insights into SAP helps to monitor or execute actions based on situations, ultimately impacting system performance. This performance, in turn, fosters further learning and informs additional actions aimed at improving the system for improved overall outcomes. [15] The outlined process was divided into three stages: account creation, cost reflection, and finally, receipt of completed documents and final payment. However, this cost reflection method is outdated, as it only provides a general overview of the account balance without detailed analysis. The implementation of the SAP system has significantly changed the cost reflection approach, enabling a structured analysis of transportation costs within the distinct segments of each company's operations. [16] Ramancha et al. published a significant study in the Journal of Artificial Intelligence and Machine Learning applying the ARAS methodology to enhance supply chain efficiency through machine learning models. The paper highlights the importance of intelligent decision-support systems in modern logistics and demonstrates how mathematical modeling combined with AI can improve performance metrics and operational resilience across supply networks. [17] Individual innovation, strong managerial support, organizational self-efficacy, mastery goal orientation, testability, and consultant support all have a significant positive impact on perceived ease of use, which directly affects satisfaction and behavioral intention toward the SAP ERP system. However, the findings suggest that the influence of high managerial support and organizational self-efficacy on perceived ease of use is relatively low. Engineering managers play a key role in adapting to organizational changes within an organization during ERP implementation. This study provides management insights that can help engineering managers improve the success of the ERP implementation process.

The findings are highly relevant to SAP ERP users, consultants, managers, and entrepreneurs. [18]The order fulfillment process begins by transferring a batch of orders from an enterprise resource planning (ERP) system or an online storefront to an order management system. These orders are then sent to a warehouse management system (WMS), which coordinates the packing process by preparing the boxes and containers needed for order fulfillment. At the same time, a transportation management system (TMS) determines the most efficient sourcing and shipping methods, reducing delays caused by fragmented WMS and TMS operations. [19]Developing the SAP–LAP framework designed for risk reduction in global supply chains (GSC), two additional approaches have been proposed: proactive and reactive. However, no organization can implement all strategies at once. Managers must assess both the strengths and limitations of these approaches and determine their suitability for their organization. In addition, they must consider the role and involvement of suppliers, stakeholders, customers, and top management in the decision-making process. [20] Freight Cost Optimization: Implemented improvements to reduce transportation costs by selecting the most efficient freight providers, methods, and routes. Considered rates, service levels, and capacity to determine the most cost-effective solution. Load Optimization: Worked on optimizing the loading of goods into transportation vehicles to maximize space utilization and reduce the number of shipments required. Optimized the loading process by factoring in constraints such as vehicle size weight and volume. Carrier Selection: Automating the carrier selection process based on predefined criteria including cost, service levels, and performance. Optimized the selection process to ensure the best carrier fit for each shipment. Scenario-Based Planning: Facilitated the creation of multiple transportation scenarios for comparison, enabling informed decision-making. Supported both tactical and operational planning to improve efficiency. Integration with SAP S/4HANA: Developed and enhanced custom and standard interfaces to ensure seamless integration between ECC and TM for better transportation management. Real-time decision-making: Delivering real-time insights and recommendations for transportation optimization, helping organizations make quick and accurate decisions.

MATERIALS AND METHOD

[1] The simultaneous optimization of two or more conflicting objectives, subject to certain constraints, is called multi-objective optimization. Common examples include increasing vehicle efficiency while reducing fuel consumption, increasing profitability while reducing manufacturing costs, and reducing weight while increasing the strength of an engineering component. Both favorable (where higher values are always chosen) and unfavorable (where higher values are not preferred) objectives are in conflict. One method for multi-objective optimization is the Method of Ratio Analysis (MOORA). [2] Three contractors took the top three spots, and the fourth contractor's positive ranking has not yet been made public. The last spot goes to one contractor. While their exact rankings are unknown, the remaining ten contractors are ranked lower. It is interesting – perhaps surprising – that the best contractors are not the best in terms of pricing. However, the size of the company appears to be a significant factor. As a result, the assumption that no small businesses were initially taken into account turns out to be incorrect. [3] Using an improved

nominal group technique and the Delphi approach, Multi-Objective Optimization by Ratio Analysis (MOORA) satisfies six requirements. Furthermore, to partially satisfy the seventh condition, MOORA uses two different multi-objective optimization approaches. The reason MOORA is considered a particularly robust method is that no other technique fully satisfies all seven conditions. The two components of the non-dimensional measurement-based MOORA technique are a set of non-dimensional ratios and the use of these ratios as distances to a reference point. These two MOORA components are controllable and interdependent. [4] The well-being economy has a more comprehensive approach. In this economy, everyone should be satisfied with things like financial well-being, health, education, security, and the environment. As a result, to assess well-being, several goals must be achieved simultaneously. When these goals are maximized or minimized, they represent general well-being. MOORA. [5] MOORA offers a multi-dimensional approach to decision-making, providing a robust framework for evaluating options with considerable variety and numerous influential factors. MOORA is a multi-objective optimization technique created by Brauers and Zavadskas (2006) that is intended to address difficult decision-making situations. Its primary objective is to choose, from a set of options, the best option by taking into account opposing criteria, assessing both positive and negative aspects simultaneously. [1,2] MOORA is recognized for its advantages over some traditional decision-making methods. It requires fewer mathematical calculations, has a shorter computational time, is more straightforward, and offers greater stability compared to Multi-Criteria Decision-Making (MCDM) methods like AHP, TOPSIS, ELECTRE, VIKOR, and PROMETHEE. [3] The MOORA method facilitates the simultaneous optimization of multiple conflicting goals within defined constraints. It evaluates each potential decision based on these goals, providing a basis for determining the most suitable choice. [4]In practice, MOORA is well-suited for organizing or selecting one or more alternatives from a range of options, especially when dealing with conflicting attributes.

It is known for its simplicity, reliability, and efficiency, requiring minimal mathematical and computational resources. [5] Multi-objective optimization often involves balancing conflicting benchmarks, such as maximizing product profitability while minimizing costs, improving vehicle performance while reducing fuel consumption, or achieving a trade-off between weight reduction and strength enhancement. [6,7] In manufacturing contexts, where decision-makers may have varied interests, MOORA helps quantify and address these conflicting criteria, ranking or selecting the best alternatives from available options. [8,9]Transactional payments do not add value, but rather refer to transfers of value without collateral, such as gifts or favors. Although exchange payments are widespread in everyday life and various types of insurance, the focus is on geographic exchange payments. These are primarily automated through fiscal or para-fiscal channels such as social security. [26] Vagvala, et al. have demonstrated the application of SPSS statistics to optimize SAP manufacturing and quality management processes, offering measurable insights into system performance and data-driven decision-making. [27] An effective maintenance system is important because the performance of machinery depends on proper maintenance and keeping the equipment in good condition over time. In daily life we routinely make decisions and manage time automatically, it is best to rely on mathematical decision-making models for industrial processes.[28] Mishra, et al. explore intelligent systems to enhance supply chain management decision-making processes, offering insights into operational efficiencies.[29] The results provide a basis for comparison, making the selection process simple and satisfying. Therefore, Mult Objective techniques appear to be suitable tools for ranking or selecting one or more alternatives from a set of alternatives, especially when faced with conflicting criteria. [30]

Alternative

Express Logistics: Express logistics focuses on the fast and efficient movement of goods, prioritizing on-time delivery and reliability. It includes fast shipping, optimized routes, and real-time tracking. Widely used in sectors such as e-commerce, healthcare, and perishable goods, express logistics uses advanced technology, automation, and streamlined supply chain processes to ensure fast and seamless deliveries.

Global Freight: Global freight transport involves the international movement of goods across borders using air, sea, rail or road networks. It involves logistics management, customs processing and supply chain integration. Companies rely on global freight transport to efficiently move raw materials and finished goods facilitate seamless trade activities and strengthen economic connections around the world.

Speedy Transport: Rapid transport involves the rapid and efficient movement of goods or passengers through well-planned routes and advanced logistics. It enables rapid deliveries by air, rail, road or sea, often using express services. Sectors such as e-commerce, healthcare and perishable goods rely on rapid transport for urgent shipments and reliable service.

Safe Way Carriers: Safeway Carriers is a logistics and transportation service provider specializing in the safe and efficient movement of goods. It ensures reliable cargo handling through advanced tracking, optimized routes, and security measures. Businesses rely on Safeway Carriers for on-time deliveries, risk-free transportation, and professional supply chain management solutions.

EcoShip Solutions: Eco Ship Solutions specializes in environmentally friendly and sustainable shipping methods. Its goal is to reduce carbon emissions, improve fuel efficiency, and support green logistics through advanced technology. By using energy-efficient ships, alternative fuels, and optimized routes,

Eco Ship Solutions helps businesses achieve cost-effective, efficient, and environmentally responsible transportation.

Evaluation Parameters

Delivery Efficiency: Delivery efficiency is the ability to move goods quickly, accurately, and economically, reducing delays and errors. It involves streamlined logistics, strategic route planning, real-time monitoring, and effective resource utilization. Improved delivery efficiency increases customer satisfaction, reduces operational costs, and improves supply chain efficiency in sectors such as e-commerce and retail.

Cost Savings: Cost savings involve reducing costs through intelligent resource allocation, strategic decision-making, and process improvements. Organizations achieve this by reducing waste, increasing efficiency, and utilizing technology. Implementing effective cost-saving measures increases profits, streamlines operations, and strengthens competitiveness across various industries and economic sectors.

Transit Time: Transit time is the time it takes for goods or passengers to travel between destinations. It is affected by factors such as distance, mode of transport, route performance and potential delays. Improving transit time increases logistics efficiency, reduces costs and increases customer satisfaction in sectors such as shipping, e-commerce and supply chain operations.

Delay Rate: The delay rate measures the occurrence of late deliveries or transportation disruptions within logistics operations. It is affected by variables such as traffic congestion, weather conditions, operational inefficiencies, and supply chain challenges. Reducing the delay rate increases reliability, increases customer satisfaction, and improves overall efficiency in transportation and logistics systems.

ANALYSIS AND DISSECTION

TABLE 1. SAP Transportation Management Implementation

	DATA SET			
Alternative	Delivery Efficiency (Benefit)	Cost Savings (Benefit)	Transit Time (Non-Benefit)	Delay Rate (Non-Benefit)
Express Logistics	85	78	5	8
Global Freight	90	82	4	7
Speedy Transport	80	75	6	9
SafeWay Carriers	88	80	5	6
EcoShip Solutions	83	77	5	7

This dataset provides a comparative assessment of five transportation service providers using SAP Transportation Management, assessed on the basis of four key performance indicators. These indicators are categorized as beneficial criteria (higher values indicate better performance) and unbeneficial criteria (lower values are desirable).Global Freight stands out as the best performing company, achieving high delivery efficiency (90%) and cost savings (82%), while also maintaining fast transit times (4 units). However, its lateness rate (7%) leaves room for improvement. This combination of efficiency, cost-effectiveness, and speed makes it a strong candidate for SAP TM implementation. Safeway Carriers demonstrates consistent performance across all parameters, with the second highest delivery efficiency (88%) and cost savings (80%). It also has a low lateness rate (6%), indicating high reliability. While its transit time (5 units) is average, its overall consistency makes it a reliable choice. Express Logistics and Eco Ship Solutions show comparable performance, with moderate scores on key metrics.

Express Logistics achieves 85% delivery efficiency and 78% cost savings, while Eco Ship Solutions follows closely with 83% efficiency and 77% cost savings. Both have an average transit time of 5 units, although Express Logistics has a slightly higher late rate (8%) compared to Eco Ship's 7%.Fast Transit faces the biggest challenges, recording the lowest delivery efficiency (80%) and cost savings (75%). In addition, it also has the longest transit time (6 units) and the highest late rate (9%), highlighting areas where operational improvements are needed. Strategic adjustments in service delivery and efficiency could improve its SAP TM performance.

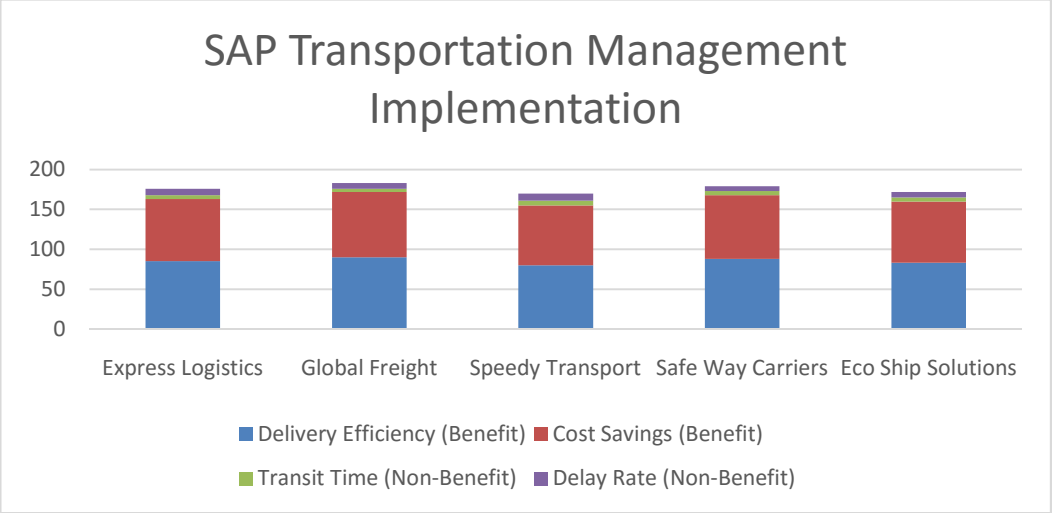


FIGURE 1. SAP Transportation Management Implementation

The stacked bar chart displays the performance metrics of five transportation service providers in their SAP Transportation Management implementation. The visualization effectively compares four key parameters: delivery efficiency and cost savings (both benefits) and transit time and delay rate (both non-benefits).Looking at the overall height of the bars, Global Freight appears to have a very balanced performance profile, with strong showings in both benefit categories (shown in blue and orange) and relatively small non-benefit metrics (shown in gray and yellow). This suggests that it may be the most effective implementer overall. Safeway Carriers follows closely, showing similarly strong performance across all metrics. Speedy Transport displays the shortest overall bar height, indicating potential challenges in their implementation.

Their benefit metrics (blue and orange segments) are significantly smaller than their competitors, while their non-benefit metrics (gray and yellow segments) are proportionally larger, suggesting room for improvement in their operations. Express Logistics and Eco Ship Solutions show similar patterns in their metrics, falling somewhere in the middle of the performance spectrum. Their benefit metrics are moderate, and their non-benefit metrics are kept reasonably low, indicating an efficient but not ideal implementation of the SAP Transportation Management System

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TABLE 2. Normalized Data

	Normalized Data			
	Delivery Efficiency (Benefit)	Cost Savings (Benefit)	Transit Time (Non-Benefit)	Delay Rate (Non-Benefit)
Express Logistics	0.4458	0.4447	0.4437	0.4789
Global Freight	0.4720	0.4675	0.3549	0.4191
Speedy Transport	0.4196	0.4276	0.5324	0.5388
SafeWay Carriers	0.4615	0.4561	0.4437	0.3592
EcoShip Solutions	0.4353	0.4390	0.4437	0.4191

The normalized data table provides a standardized comparison of five transportation service providers, with values scaled between 0 and 1, facilitating direct metric-to-metric evaluation. This normalization process eliminates differences in measurement units and metrics, ensuring a fair evaluation framework. For the benefit criteria of delivery efficiency and cost savings, Global Freight emerges as the top performer, receiving high normalized scores of 0.4720 and 0.4675, respectively. This indicates that Global Freight is more effective in improving these key attributes than its competitors. Safeway

Carriers is in second place in these categories with normalized scores of 0.4615 for delivery efficiency and 0.4561 for cost savings, indicating strong operational efficiency. For non-beneficial metrics such as transit time and delay rate, where lower values are desirable, Safeway Carriers stands out with a low delay rate of 0.3592, reflecting excellent reliability.

However, Global Freight records a better transit time score of 0.3549, indicating efficient delivery speed. Speedy Transport, on the other hand, shows the highest values in non-beneficial metrics (0.5324 for transit time and 0.5388 for delay rate), indicating areas that need improvement. Express Logistics and Eco Ship Solutions maintain average performance across most metrics. Express Logistics consistently scores between 0.44 and 0.47, while Eco Ship Solutions shows a similar trend, with scores typically ranging from 0.43 to 0.44. However, Eco Ship Solutions performs slightly better in the delay ratio (0.4191) compared to Express Logistics (0.4789), indicating higher reliability.

TABLE 3. Weight

	Weight			
Express Logistics	0.25	0.25	0.25	0.25
Global Freight	0.25	0.25	0.25	0.25
Speedy Transport	0.25	0.25	0.25	0.25
SafeWay Carriers	0.25	0.25	0.25	0.25
EcoShip Solutions	0.25	0.25	0.25	0.25

The weighting table presents an equal distribution of importance across the four evaluation criteria for each transportation service provider in the SAP Transportation Management implementation. Each criterion – delivery efficiency (benefit), cost savings (benefit), transit time (non-benefit), and delay rate (non-benefit) – is assigned a uniform weight of 0.25 or 25%, for a total of 1 or 100% for each provider.This balanced weighting approach implies that all performance metrics are considered equally important in the evaluation process. For express logistics, global freight, fast transit, safe route carriers, and environmental shipping solutions, an equal distribution of weights (0.25 across all criteria) implies that no single aspect of performance is prioritized over the others. This creates a level playing field, where success depends on balanced performance across all metrics rather than on excellence in any one area.

The balanced weighting strategy has several implications for the analysis. First, it ensures that improvements or deficiencies in any one metric have an equal impact on the overall evaluation. Second, it promotes a holistic approach to performance evaluation, where providers are required to maintain consistent standards across all aspects of their operations rather than focusing on specific areas.

Third, it simplifies the comparison process by treating all criteria with equal importance, making it easier to identify overall performance patterns and make fair comparisons between providers. This weighting scheme reflects a balanced perspective on transport management, recognizing that successful implementation requires equal attention to efficiency, cost management, speed, and reliability. This suggests that the evaluation framework values comprehensive excellence rather than specialized performance in specific areas, encouraging providers to develop well-rounded operational capabilities rather than excelling in one or two aspects of service delivery.

TABLE 4. Weighted normalized DM

	Weighted normalized DM			
Express Logistics	0.1114	0.1112	0.1109	0.1197
Global Freight	0.1180	0.1169	0.0887	0.1048
Speedy Transport	0.1049	0.1069	0.1331	0.1347
SafeWay Carriers	0.1154	0.1140	0.1109	0.0898
EcoShip Solutions	0.1088	0.1098	0.1109	0.1048

The weighted normalized decision matrix (DM) provides final evaluation scores for each transportation service provider by integrating the normalized performance data with equally assigned criterion weights. These weighted scores provide a comprehensive assessment of the relative performance of each provider, assuming that all criteria have equal importance.In terms of the benefit criteria (delivery efficiency and cost savings), Global Freight stands out with the highest weighted scores of 0.1180 and 0.1169, respectively. Safeway Carriers follows closely, achieving 0.1154 for delivery efficiency and 0.1140 for cost savings, highlighting its strong operational efficiency and cost-effectiveness.

These results indicate that both providers effectively improve desirable performance characteristics. For non-profit criteria where low scores are desirable (transit time and delay rate), Safeway Carriers excels with a low weighted delay rate of 0.0898, while Global Freight achieves an excellent transit time score of 0.0887, reflecting efficient delivery speeds. In contrast, Speedy Transport records higher weighted scores in these non-profit categories (0.1331 for transit time and 0.1347 for delay rate), indicating areas for improvement. Express Logistics and Eco Ship Solutions show moderate performance across all metrics.

Express Logistics maintains relatively stable weighted scores around 0.11, but a high delay rate of 0.1197 indicates reliability concerns. Meanwhile, Eco Ship Solutions shows stable but exceptional performance across all metrics; with weighted scores ranging from 0.1048 to 0.1109.This weighted normalized matrix effectively highlights the strengths and weaknesses of each provider, ensuring a fair comparison while emphasizing equal importance of each criterion. It serves as a valuable tool for identifying areas of improvement and improving decision-making processes in SAP Transportation Management implementation.

TABLE 5. Assessment value

	Assessment value
Express Logistics	-0.0080
Global Freight	0.0414
Speedy Transport	-0.0560
Safeway Carriers	0.0287
EcoShip Solutions	0.0029

The evaluation value table provides a final combined score for each transportation service provider, providing a clear ranking based on their overall performance in SAP Transportation Management implementation. These scores reflect a comprehensive assessment, including both benefit and non-benefit criteria after normalization and weighting. Global Freight emerges as the top performer with the highest evaluation value of 0.0414, demonstrating excellent overall performance. This positive score highlights its strong performance in the benefit criteria (delivery efficiency and cost savings), while effectively managing non-benefit factors (transit time and delay rate). Safeway Carriers takes second place with a evaluation value of 0.0287, showing a well-balanced performance across all metrics. EcoShip Solutions achieves a marginally positive evaluation value of 0.0029, placing them in the mid-range. This almost zero score indicates stable but significant performance, indicating room for improvement. Express Logistics scores a slightly negative score of -0.0080, meaning its performance is slightly below the benchmark. While not significantly underperforming, there is room for improvement in performance and service quality. Fast Transport ranks very low with a score of -0.0560, reflecting key challenges in overall performance. This negative score indicates that significant improvements are needed across a number of criteria to remain competitive.

TABLE 6. Rank

	Rank
Express Logistics	4
Global Freight	1
Speedy Transport	5

Safeway Carriers	2
Eco Ship Solutions	3

Based on the data table provided, I will explain the company rankings in a clear narrative format. The ranking seems to be for transportation or logistics companies, with Global Freight leading the way at number 1. This company has established itself as the best performing company among the five companies listed. Following at number 2 is Safeway Carriers, which indicates a strong market presence and service delivery that keeps them at the forefront. Eco Ship Solutions is ranked in the middle at number 3, which indicates moderate performance compared to its competitors. Their placement indicates that they maintain competitive services, while having room for improvement to challenge the higher ranks. Express Logistics lags behind at number 4, placing them in the lower tier of this group, although still ahead of the lowest ranked company. Speedy Transport rounds out the list at number 5, which indicates that they may need to address performance issues to improve their position compared to their competitors. The spread between the rankings indicates a clear hierarchy among these transportation providers, with distinct performance differences separating the market leader from the lagging companies.

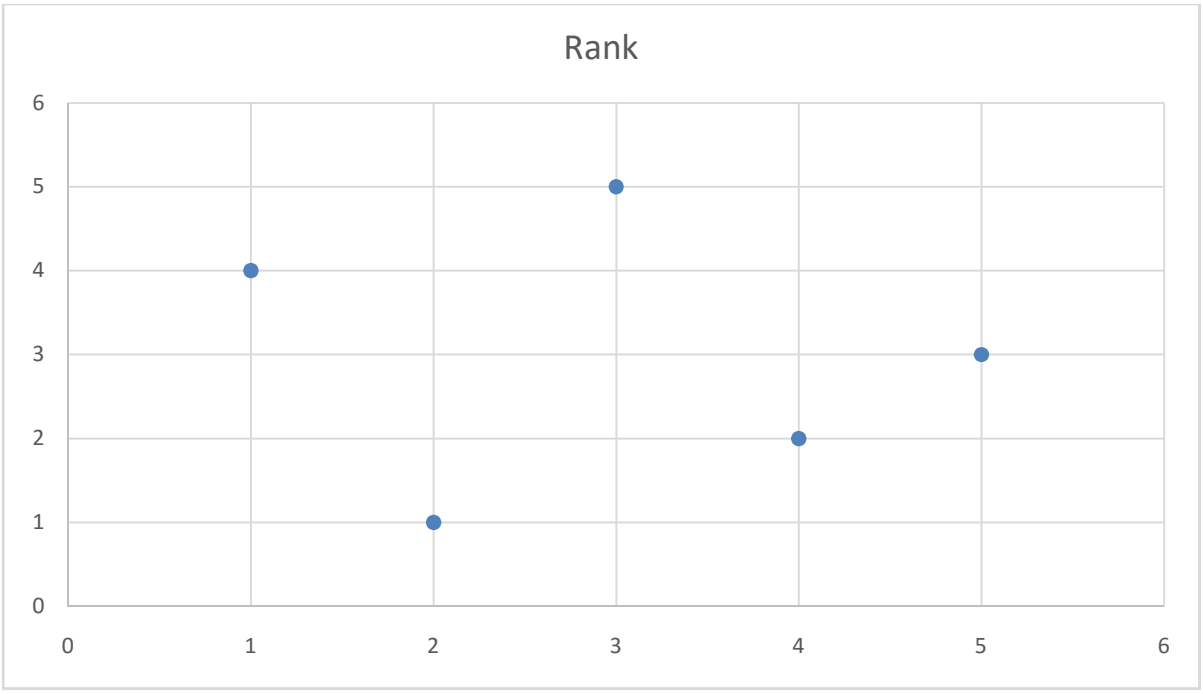

FIGURE 2. Rank

This scatterplot illustrates company rankings on a scale of 1 to 5, where lower numbers indicate better performance. The y-axis represents the ranking positions (0 to 6), while the x-axis appears to distribute the data points at regular intervals (0 to 6).The plotted points follow a nonlinear pattern, which shows variations in company rankings. The first point appears at position 4, which represents the fourth-ranked company. Moving to the right, the second point moves to position 1, which represents the best-performing company in the dataset. The third point rises to position 5, which highlights the lowest-ranked company. The fourth point moves to position 2, which represents the second-best performance, while the final point settles at position 3, which represents a middle-tier company. This visualization clearly depicts the ranking differences between companies, with distinct gaps between each position. Grid lines help to accurately identify rankings, and blue dots effectively highlight each company's position. This structured format allows for quick and intuitive comparisons, making it easy to identify the best, worst, and in-between performers at a glance.

CONCLUSION

Effective use of SAP-powered logistics solutions has led to significant improvements in freight cost management, real-time tracking, process automation, and regulatory compliance. By leveraging SAP technologies, businesses have improved transportation management through strategic freight supplier selection, optimized carrier management, and efficient load planning. The ability to make real-time decisions has streamlined operations, reduced costs while increasing overall supply chain efficiency. SAP's transaction management ensures seamless data consistency by systematically linking related business activities. For example, when an invoice is issued, the system automatically updates the related order status, maintaining accurate records. Furthermore, SAP's analytics capabilities help organizations identify inefficiencies and resolve key operational challenges.

However, logistics service providers (LSPs) often have limited involvement in sustainability-oriented training programs, highlighting the need for improved knowledge sharing efforts. Successful supply chain integration with SAP solutions requires collaboration across diverse organizational structures, cultures, and technology landscapes. Adaptability, mutual understanding, and strategic flexibility are essential for effective integration. The SAP-LAP (Situation-Actor-Process-Learning-Action-Performance) model serves as a structured framework that facilitates coordination between management and technical teams. Case studies indicate that this approach fosters collaboration, improves visibility, and strengthens cross-functional teamwork.SAP implementations also support sustainability efforts through carbon footprint monitoring and optimized route planning. However, challenges remain in employee training, knowledge retention, and alignment with business objectives. Addressing these issues requires structured SAP training, recruiting employees with advanced IT skills, and promoting cross-departmental collaboration. In addition, using SAP Business Information Warehouse for data analytics can refine sales planning and improve demand forecasting, leading to more informed decision-making. The adoption of big data solutions in SAP-powered logistics is in its early stages, with many companies struggling to define their analytics needs.

Without clear objectives, organizations risk inefficiencies due to poor data management. Successful SAP integration depends on meticulous planning, effective change management, and alignment with existing business processes. Poor data quality can hinder ERP implementation, underscoring the importance of strong data management. Ultimately, the SAP-LAP approach bridges learning and action, fostering supply chain performance and environmental responsibility. By overcoming technical, managerial, and strategic barriers, businesses can improve integration, optimize logistics, and ensure compliance with industry regulations. As SAP solutions continue to advance, their role in global logistics and transportation management will expand, driving improved efficiency, sustainability, and overall business success.

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