The Role of SAP Transportation Management in Reducing Carbon Footprint

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Abstract: *In the contemporary digital age, the pressing issues of climate change and sustainability have gained heightened significance, demanding urgent attention to safeguard Earth's habitability for its 8 billion inhabitants. As per the findings of the Global Logistics Emissions Council (GLEC), freight transportation stands out as a substantial contributor, responsible for 36% of transport emissions and 23% of greenhouse gas (GHG) emissions, ranking third in emission levels behind industry and buildings. Technology emerges as a crucial ally in both gauging and curbing carbon footprints. This paper delves into the advancements in the SAP Transportation Management (TM) realm, specifically focusing on sustainability efforts and carbon footprint reduction. The discussion centers on the end-to-end (E2E) stages of business processes within the SAP TM domain, with particular emphasis on carbon emissions calculation (Scope 1, 2, 3). Additionally, it explores the strategic significance of TM in footprint management through the optimization of transportation processes, provision of real-time visibility, ensuring adherence to regulations, and facilitating environmentally conscious decision-making, ultimately leading to substantial cost savings. By leveraging SAP TM's advanced algorithms and predictive analytics, companies can minimize empty miles, optimize route planning, and consolidate shipments, thereby reducing fuel consumption and emissions. Real-time visibility provided by SAP TM enables proactive monitoring of transportation activities, allowing organizations to promptly identify inefficiencies and implement corrective actions to minimize environmental impact. Furthermore, SAP TM facilitates environmentally conscious decision-making by considering sustainability factors alongside traditional metrics like cost and time. This holistic approach ensures that sustainability objectives are integrated into transportation planning and execution processes, driving towards a greener future while also achieving significant cost savings. The integration of SAP TM with carbon accounting tools further enhances transparency and accountability in tracking emissions, facilitating continuous improvement initiatives. Ultimately, this paper highlights the pivotal role of SAP TM in driving sustainable transportation practices and contributing to a greener future for businesses worldwide."*

Keywords: Transportation Management, SAP TM, Carbon, Sustainability, Footprint, CO2e, Fiori, SAP S/4 HANA

1. Introduction

In today's dynamic and rapidly evolving global business landscape, companies must establish and uphold resilient supply chains to thrive (Sabet et al., 2017). A resilient supply chain possesses the ability to withstand disruptions stemming from natural disasters, economic fluctuations, geopolitical tensions, and other unforeseen occurrences (Alexandar et al., 2022). Achieving this resilience necessitates investments in technology, logistics, and infrastructure that empower swift responses to fluctuations in demand, supply, and transportation (Acero et al., 2022). Additionally, fostering close collaboration with suppliers, customers, and partners is vital to cultivating trust and transparency in relationships (Ramanathan et al., 2021). Through these measures, businesses can effectively mitigate risks, trim costs, and enhance their competitiveness in the marketplace (Sajjad et al., 2020).

SAP Transportation Management (SAP TM) is a software solution designed to enhance the efficiency of transportation processes within organizations (Bayramov, 2023). It furnishes a comprehensive array of tools and features, empowering logistics and transportation experts to streamline operations and cut down expenses (Karmanska, 2021). Engineered to tackle intricate transportation scenarios such as multi-modal transportation, cross-border shipments, and carrier collaboration (Xu, 2020), SAP TM enables organizations to strategize, execute, and oversee transportation tasks in real time, ensuring the punctual and precise delivery of goods (Thangaiah et al., 2022). Furthermore, SAP TM offers advanced analytics and reporting functionalities, empowering organizations to glean insights into their transportation operations, identify areas ripe for enhancement, and make well-informed decisions to optimize their supply chain (SAP, 2023). Ultimately, SAP TM holds the potential to revolutionize transportation management by rendering it more efficient, cost-conscious, and dependable. To facilitate this transformation, seamless integration of the SAP TM solution into both the business and technological frameworks is paramount.

SAP TM is a powerful tool designed to enhance the efficiency of transportation processes, enabling businesses to manage their supply chains better. One of the significant advantages of SAP TM is its seamless integration with various other SAP modules across the enterprise. This integration involves close collaboration with SAP Sales & Distribution (SD), Extended Warehouse Management (EWM), Global Trade Solution (GTS), and SAP Procure to Pay (P2P) modules, opening a wide range of possibilities for businesses to optimize their supply chain processes. By leveraging the capabilities of SAP TM, businesses can streamline their transportation processes, reducing costs and improving operational efficiency. Furthermore, integrating SAP TM with other SAP modules can lead to enhanced visibility across the supply chain, enabling better decision-making and reducing the risk of disruptions. In summary, incorporating SAP TM as a pivotal component in the business and technological framework is crucial for businesses aiming to establish and maintain robust supply chains. By optimizing business processes throughout the supply chain, businesses can deliver enhanced efficiencies for end-users, and improve their bottom line.

In this article, I will explore how the SAP TM (Transportation Management) software solution can aid organizations in

attaining a blend of resilience and sustainability amid volatile environments. SAP TM encompasses a comprehensive system that furnishes end-to-end visibility and governance over transportation procedures, spanning planning, execution, monitoring, and analysis. Leveraging SAP TM, organizations can streamline their supply chain operations, realizing cost efficiencies while curbing environmental footprints. The software solution boasts advanced planning and scheduling functionalities, empowering firms to pre-empt disruptions and adapt to shifts in demand, capacity, and route availability. This cultivates organizational agility and responsiveness, crucial attributes for navigating contemporary market volatility.

Additionally, SAP TM promotes sustainable transportation practices by integrating environmental considerations such as carbon emissions, fuel consumption, and route optimization. It enables the calculation of transportation-related carbon footprints and offers insights into areas ripe for enhancement, facilitating organizations in reducing environmental impacts and attaining sustainability objectives. To summarize, SAP TM emerges as a potent instrument for organizations striving to achieve resilience and sustainability amidst tumultuous environments. By furnishing real-time visibility, governance, and optimization of transportation processes, organizations can enhance agility, trim costs, and mitigate environmental footprints.

2. End-to-End TM Cycle

The end-to-end (E2E) transportation management (TM) cycle comprises a multifaceted process encompassing various stages, including planning, execution, monitoring, and optimization of the transportation system. During the planning phase, the system discerns the most efficient and economical approach for transporting goods or services. In the execution phase, it allocates resources such as vehicles and drivers while ensuring all requisite documentation is in order.

Throughout the monitoring phase, the system tracks the real-time movement of goods and services, promptly identifying any emerging issues. Lastly, the optimization stage entails scrutinizing data gathered from each process stage to pinpoint areas ripe for enhancing the transportation system. The end-to-end transportation management cycle stands as a pivotal element of supply chain management, ensuring the timely, cost-effective, and secure delivery of goods and services. An overview of the processes constituting the E2E TM cycle is illustrated in Figure 1.
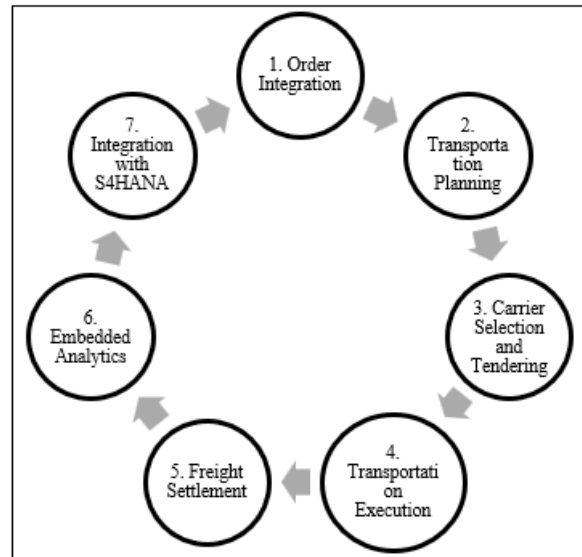
Order Integration: At the inception of the end-to-end cycle, the transportation demand initiates, typically commencing with the amalgamation of sales or purchase orders. In this phase, the SAP TM system synchronizes with SAP Sales and Distribution (SD) and Procure to Pay (P2P) modules to generate freight units for subsequent planning and optimization. This cohesive integration guarantees precise transmission of all data between systems, encompassing order particulars, customer information, and delivery destinations.

Transportation Planning: At the heart of SAP TM lies the pivotal phase of planning, where both manual and automated planning activities occur via optimizer algorithms. Essential variables and parameters are inputted into the model for planning purposes. Factors like shipment size, load details, driver availability, truck dimensions, gross weight, and carrier constraints are among the typical variables utilized by the SAP Optimizer to automatically devise freight plans with a single click. Additionally, the optimizer considers other pertinent factors such as route optimization, load distribution, and carrier capacity to formulate the most optimal and economically efficient transportation plan possible.

Carrier Selection and Tendering: Utilizing SAP TM, you can select carriers based on various factors including service excellence, freight rates per distance (miles or km), availability, and historical performance. Moreover, the system empowers users to prioritize carriers according to their preferred criteria, such as cost, lead time, or capacity. Furthermore, SAP has introduced an innovative feature known as "Green Carriers," designed specifically for environmentally conscious providers who optimize routes to minimize their carbon footprint. Whether you opt to widely broadcast tendering requests or directly contact local carriers as needed, the system facilitates this process seamlessly. Additionally, it offers functionalities to monitor the progress of the tendering process, encompassing actions like accepting or rejecting bids and ultimately selecting the most suitable carrier for the task at hand.

Transportation Execution: Following the acceptance of a tender by a carrier and their readiness to transport the goods,

the TM system enables end-users to monitor the shipment in real time. The system furnishes a dashboard that tracks various aspects of the shipment's progress, encompassing its current location, status updates, and any encountered delays or exceptions. Additionally, TM empowers end-users to initiate and oversee key events such as departure, arrival, loading, and unloading, particularly in instances of delays or unexpected exceptions. Carriers may be subject to penalties for delays attributable to negligence.

Freight Settlement: Upon the goods reaching their destination, the carrier submits an invoice to the shipper for their services. The TM system integrates built-in intelligence to cross-check invoices against freight agreements, encompassing terms and conditions as well as rate/distance specifications, thereby facilitating automated payments to carriers. This streamlined invoicing process guarantees precision and swift payment processing. Moreover, the system permits users to generate diverse reports and analytics rooted in invoice data, spanning freight cost analysis and carrier performance metrics.

Embedded Analytics: Within TM, there are inherent analytics and reporting features designed to assess carrier performance, optimize routes, and analyze key performance indicators. These include cost analysis, tendering analysis, business share, allocation, and more. The system also provides a dashboard that displays real-time data on various transportation-related metrics, allowing users to make informed decisions and take corrective actions if needed. SAP TM provides out-of-the-box apps (per the screenshot below) for analytics and informed decision-making.
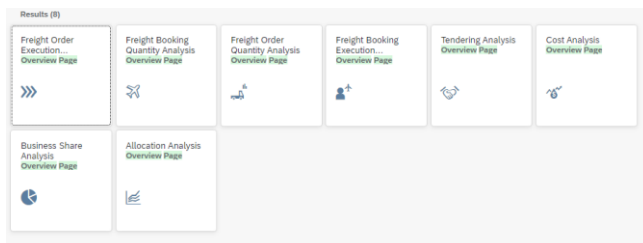
Integration with S4HANA: SAP TM seamlessly integrates with various domains including SAP Extended Warehouse Management (EWM), SAP Global Trade Services (GTS), SAP Sales and Distribution (SD), and Procure to Pay (P2P), facilitating a seamless exchange of information across modules. This cohesive integration guarantees precise transmission of all data between systems, thereby delivering end-to-end visibility and control over the transportation process.

3. Managing Carbon Footprint

In the realm of supply chain management, the carbon footprint stands out as a paramount concern, denoting the volume of carbon dioxide and other greenhouse gases emitted into the atmosphere due to human activities (Wright et al., 2011). Among all sectors contributing to this footprint, the transportation sector emerges as the most significant contributor. This prominence stems from the extensive movement of goods and people over vast distances, necessitating the use of vehicles reliant on fossil fuels. The emissions generated by these vehicles substantially augment the carbon footprint within the supply chain sector. In response to this challenge, logistics enterprises are increasingly prioritizing the adoption of sustainable transportation solutions. These solutions encompass initiatives such as the deployment of electric vehicles and the promotion of public transportation, which hold the potential to notably diminish the carbon footprint within the supply chain sector.

SAP TM offers an array of tools for calculating and managing carbon emissions. Logistics firms can utilize the software to track and monitor carbon emissions in real time, analyze pertinent data, and implement requisite measures to mitigate their carbon footprints.

1) **Carbon Emission Calculation**– This entails assessing greenhouse gas (GHG) emissions, factoring in the mode of transportation (road, rail, air, ocean), distance hauled in miles/kilometers, designated route, and selection of environmentally friendly carriers, among other variables.

2) **Emission Monitoring and Reporting**– This information is employed for compliance reporting to the US Department of Transportation (DOT), integrated into sustainability reports and Sustainability Footprint Management (SFM), thereby empowering businesses to document, monitor, and report emissions throughout the entirety of the supply chain. Additionally, this facilitates the provision of requisite documentation and reporting capabilities to meet governmental mandates regarding sustainable frameworks.

3) **Route Optimization**– The SAP TM optimizer algorithm holds substantial importance in factoring in essential variables like fuel efficiency, vehicle capacity utilization, and workload, thereby selecting the optimal route based on specified constraints and suggesting routes with minimal CO2e emissions.

4) **Carriers Collaboration**– TM chooses carriers with a commitment to the environment, giving priority to those who use sustainable resources like fuel-efficient and hybrid vehicles (electric and gasoline). This choice aims to lower freight costs and minimize CO2e emissions per load.

5) **Continuous Improvement**– As SAP consistently rolls out TM innovation packs and features, typically every quarter for the cloud version, it empowers businesses and leaders to pinpoint opportunities for reducing their carbon footprint. This allows them to establish emission goals for the future, thereby making significant contributions to their overall sustainability objectives.

4. Innovative Footprint Reduction Apps

1) **View Alternate Fuel Usage:** The View Alternative Fuels Usage app serves as a tool for assessing the carbon footprints of vehicles fueled by alternative sources and contrasting them with those using conventional fuels. To compute and compare CO2e emissions from both vehicle types, certain prerequisites such as maintaining Vehicle Class in the Manage Data app are necessary. The

snapshot provided below offers end users, who have SAP TM integrated into their landscape, a Generally Available view of sustainability footprints.
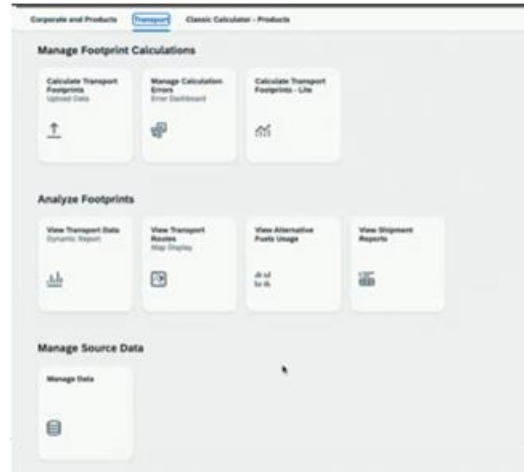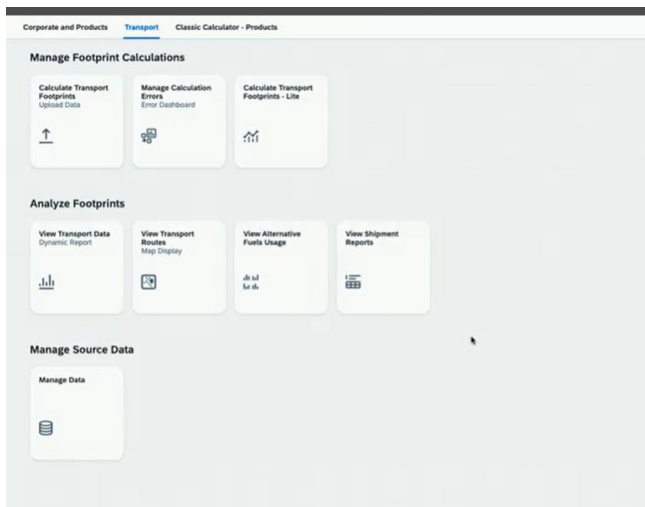
2) **Emissions Tracking and Management:** This application monitors and manages the greenhouse gas emissions produced by transportation activities. It enables users to establish targets for reducing emissions, track their progress, and identify areas for improvement.
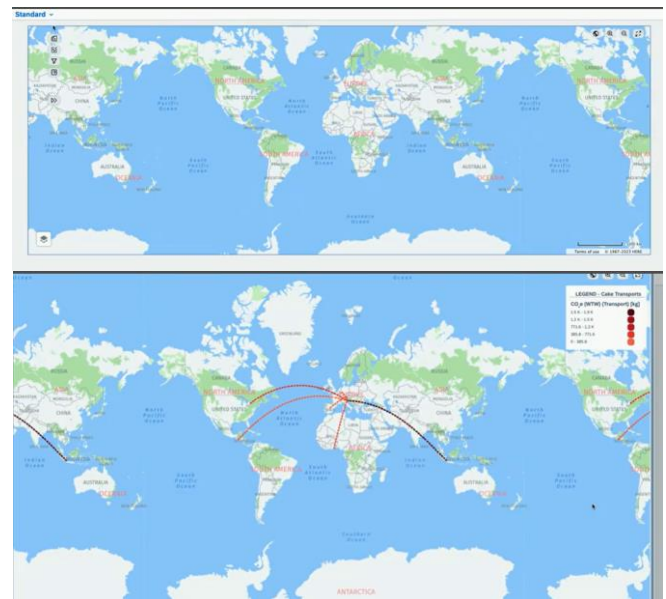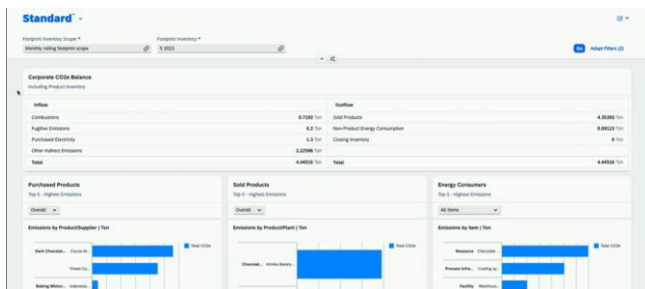
3) **View Shipment Report:** The View Shipment Reports app offers a thorough analysis of the environmental impact of your shipments, presenting information at different levels of detail. This includes basic shipment data as well as detailed insights into the vehicle class associated with each package. Like other reports accessible via analytical Fiori apps, these reports can be downloaded in Excel format for additional analysis.

Screen captures below illustrate the Transport Route app, which helps determine the most carbon-optimal route for shipments on a map.

5. Sustainability Emission Factors

1) <u>**Carbon Dioxide Factor:**</u> Users can calculate the amount of carbon dioxide emissions by specifying a unique carbon dioxide factor alongside a consumption unit for each weight and distance unit.
   Emission quantity = Carbon dioxide factor * distance * total weight

2) <u>**Fuel Consumption Factor:**</u> Users also can ascertain fuel consumption by establishing a specific fuel consumption factor alongside a consumption unit for each weight and distance unit.
   Fuel quantity = Fuel consumption factor * distance * total weight

3) <u>**Fixed weight of means of transport:**</u> Users have the option to set a fixed weight for the mode of transportation, which remains consistent across all sustainability factor calculations for that mode of transportation.

Total weight = Fixed weight for the means of transport + goods weight

6. Conclusion

Minimizing carbon footprint stands as a critical objective for modern organizations, and leveraging SAP TM processes and Fiori apps can assist businesses in evaluating and mitigating emissions. This facilitates leaders with real-time data, enabling informed and strategic decision-making. Furthermore, seamless data integration with the SAP EHS (Environment, Health, and Safety) domain bolsters regulatory compliance, particularly in monitoring waste disposal and shipping hazardous goods, thus averting potential penalties.

Overall, leveraging SAP TM processes and Fiori apps not only helps organizations minimize their carbon footprint but also enhances operational efficiency, reduces costs, and ensures compliance with environmental regulations. This holistic approach to transportation management aligns with sustainable business practices and contributes to a greener and more environmentally friendly future.

In summary, SAP Transportation Management serves as a valuable software solution for logistics firms aiming to optimize transportation processes while advancing sustainability and reducing carbon footprints. With its distinctive sustainable features, SAP TM empowers logistics companies to achieve sustainability objectives and contribute to a greener future.

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