ISB CTO

Week 13: Impact of Data Strategy and Analytics

Some companies have undergone substantial transformations in their business processes to amass more data. A prominent illustration of this is Amazon. Amazon has traditionally placed significant emphasis on data in its supply chain operations. However, in recent times, the company has exhibited a heightened commitment to data utilisation. One remarkable instance of Amazon's data-centric approach was the introduction of Amazon Dash in March 2015. These introductions have played a pivotal role in enriching Amazon's data repository and have contributed to data collection, thereby revolutionising and enhancing the entire landscape of supply chain analytics. While such initiatives undoubtedly enhance customer convenience, there are concealed and fundamental motivations behind them. These motivations, often less apparent, underscore the multifaceted aspects of data utilisation and its transformative potential within the supply chain domain.

Application of Retail Analytics Data

Data for Enhanced Supply Chain Efficiency

The integration of data collection and analysis has led to a significant shift in the supply chain paradigm. Traditionally, supply chain analytics primarily relied on point-of-sale data, which encompasses transactional data gathered when customers make purchases, either in physical stores or through e-commerce channels. This data typically manifested in numerical form, serving as the foundation for decision-making in the conventional supply chain landscape. What is undergoing rapid and transformative change is the shift towards not just understanding what customers did, but also delving into the "why" behind their actions and the cognitive processes driving these decisions. This deeper understanding of consumer behaviour opens the doors to not only delivering superior customer experiences but also enhancing the entire value chain's efficiency and responsiveness.

Amazon's Pioneering Efforts

Amazon Dash and Dash Wand are designed to gain insights into consumer preferences. Customers have the option to create buttons on the app, signifying not just their past purchases but their future preferences. This facilitates the anticipation of customer needs and preferences, enabling Amazon to offer more tailored and efficient services.

While Amazon Dash represented a pivotal step, it was eventually discontinued, marking the company's shift towards a broader and more customer-centric approach. The introduction of Alexa shopping has been a significant focus for Amazon. The goal is to enhance customer convenience and also gather comprehensive data to drive both consumer and seller behaviour.

Amazon Key, another groundbreaking initiative offers customers the option to install a camera in their homes, providing access to Amazon for various services, including

secure package delivery, cleaning services, and more. While this raises privacy concerns, it has the potential to revolutionise data collection, analysis and supply chain efficiency.

Amazon Go has introduced a new level of data collection and analysis. The technology tracks customer behaviour, item selection and even gaze patterns. While the volume of video data may seem overwhelming, advances in AI, machine learning, deep learning, and neural networks have made data analysis more accessible.

Amazon Go's success has led to the exploration of similar technologies in high-traffic environments such as airports, railway stations, bus stops and sports stadiums. These developments are expected to change the landscape of data collection, analysis and supply chain efficiency.

Cultural Shift and Collaboration

The shift towards data-driven supply chain management is not merely a technological transition but also a cultural one. Organisations need to adapt their structures, thinking processes, and corporate cultures to fully harness the potential of supply chain analytics.

Supply chain managers should avoid the pitfalls of only optimising specific elements of the supply chain. The Toyota example illustrates the importance of broadening the scope to include Tier 2 suppliers and considering the wider supply chain network, which includes both suppliers and customers.

The future lies in harnessing the power of data, getting deep insights into consumer behaviour and adopting a collaborative, holistic approach to supply chain optimisation. It is a transformation that transcends industry boundaries and holds the potential to revolutionise the entire supply chain landscape.

Managing Supply Chain Drivers

Supply chains are influenced by several key drivers, including transportation, inventory, facilities and information. It is important to note that these drivers are interconnected, and a holistic approach is necessary to optimise supply chain operations.

Transportation

Transportation costs play a significant role in supply chain expenses, making up a substantial portion of a country's GDP. These costs vary from country to country; for example, the United States incurs expenses primarily in driver salaries, while in India, fuel costs dominate. The disparities in costs and challenges require distinct approaches to data utilisation.

Driver shortages, particularly in the United States, have been a major concern. Companies have offered substantial incentives, such as $110,000 salaries for drivers, during the COVID-19 pandemic to bolster their supply chain resilience. The UK even introduced a special visa category to attract more truck drivers. Such variances highlight the need to adapt data usage to specific circumstances.

Various countries, including the United States, India and China, are transitioning to electric vehicles, which also offer enhanced data collection capabilities. This shift represents a pivotal opportunity for improving supply chain efficiency. Additionally, discussions around autonomous or driverless vehicles are gaining prominence in countries like the United States.

Logistics

Logistic costs incurred by different countries vary due to multiple factors. One key factor is the nature of goods transported. The United States, for instance, primarily transports e-commerce items and food products, whereas other nations may focus on heavier commodities like cement and coal.

Infrastructure

Infrastructure development also impacts supply chain efficiency. The level of investment in infrastructure varies, with countries like China and India investing heavily in recent years. However, infrastructure in some regions, such as India, remains behind, resulting in congestion and inefficiencies at ports. Lack of transparency at ports contributes to supply chain challenges.

Efforts to enhance transparency at ports are essential to reduce costs and improve supply chain efficiency. Innovative solutions are being developed to provide real-time visibility and transparency at ports. These initiatives have the potential to reduce supply chain costs significantly.

The Role of Third-Party Logistics Companies

Third-party logistics companies serve as central points of contact for managing an organisation's logistics. They consolidate and streamline transportation services, providing real-time updates and ensuring efficient supply chain operations. In the United States, approximately 60% of logistics is managed by third-party logistics companies. This is a model that other countries should consider to boost supply chain efficiency and data collection.

India, in particular, has immense untapped potential for supply chain analytics. The low adoption of third-party logistics, combined with infrastructural challenges, offers substantial opportunities for data-driven solutions to revolutionise supply chain management. Enhancing transparency and data utilisation can lead to significant improvements in supply chain efficiency and resilience, not only in India but also on a global scale.

Given that supply chains frequently rely on multiple modes of transportation, establishing streamlined systems like third-party logistics, which harness data, is vital. Efficient information exchange between these modes can provide a unified view for customers, thus revolutionising supply chain analytics and the industry as a whole.

Transportation Network: Design Options

The transportation network is a critical component of supply chain management, involving various optimisation considerations. These include deciding how to transfer items from one point to another, either directly via truck transportation or through intermediate sites. The decision-making process for these logistics routes involves the application of analytics and data-driven optimisation techniques. Cross-docking locations serve as transfer points, rather than storage facilities, for goods. These stations are often strategically utilised to minimise costs, including tax and tariff considerations, and their design is influenced by data analysis.

Selecting delivery routes presents another challenge, with the concept of a "milk run" being particularly relevant. It is crucial to weigh the trade-off between direct delivery and alternative routes, utilising available data to make informed decisions.

Traditionally, organisations focussed primarily on minimising transportation costs. However, leading companies like Amazon and Walmart have adopted a holistic perspective on supply chain costs. This involves considering the interconnected elements that drive supply chain operations, including facilities, transportation, inventory and information.

Optimising Inventory with Data-Driven Models

Inventory costs are a significant consideration, with factors such as cycle stock and safety stock coming into play. Cycle stock represents the inventory maintained to meet demand when operations run smoothly, while safety stock acts as a buffer for unforeseen disruptions, like the COVID-19 pandemic.

To calculate cycle stock, organisations often employ the Economic Order Quantity (EOQ) model. This model prescribes when and how much to reorder, maintaining an average inventory equal to half the order size. Safety stock decisions are informed by data analysis to strike a balance between ensuring supply chain resilience and minimising storage costs.

The role of facilities, though a higher-level decision in the supply chain, can also influence transportation mode choices. By considering facility-related factors, organisations can make more comprehensive supply chain decisions.

Data-Driven Logistics Decisions

Data plays a pivotal role in guiding logistics decisions. For instance, Amazon's shift to using its own delivery fleet was informed by data analysis, which indicated potential cost savings. The transition wasn't without challenges, including creating a proprietary mapping system and resolving logistical issues. Amazon's commitment to data-driven strategies also extends to mapping other countries.

To remain competitive and efficient, organisations must continue to adopt a supply chain view, which encompasses data-driven business design and strategic logistics decisions. This approach allows businesses to adapt and optimise their supply chains in response to evolving data and changing circumstances.

Transportation Network: Aggregation and Consolidation

Transportation Aggregation

When it comes to transportation, the decisions to be made are multifaceted. One key consideration is whether to deliver to each destination individually or to aggregate deliveries. This aggregation can occur in two distinct ways:

- Physical or geographical aggregation, which combines demand from different physical locations into a single delivery
- Temporal aggregation, which consolidates demand over time, typically spanning a week rather than delivering items daily

Both of these aggregation methods involve extensive analytics to determine where and how to aggregate, incorporating data analytics and decision analytics. Regression models, machine learning solutions, mixed integer programs, and nonlinear programming techniques are employed to address these challenges.

Aggregation in Food Delivery: An Example

An illustrative example of this process is our collaboration with a food delivery company based in Philadelphia, initiated by Temple University alumni. In this case, we tackled capacity planning and inventory consolidation. By meticulously collecting and analysing demand and delivery data, aggregation strategies were implemented to determine the optimal approach for delivering food. Such challenges are pervasive in the delivery industry worldwide, be it for food or other items. These companies are striving to harness data to consolidate deliveries efficiently, a quest that is supported by a range of sophisticated algorithms. It is the data that underpins this entire endeavour, akin to the value of oil in the supply chain.

The choice between a direct shipment network, which connects each supplier directly with each buyer, and a "milk run" approach exemplifies the distinction. The milk run strategy combines multiple deliveries into a single route, allowing for more efficient transportation. For instance, Supplier A can deliver to Buyers A, B, and C in a single delivery, eliminating the need for three separate deliveries. The term "milk run" originates from the practice of milkmen who would collect milk from various locations and deliver it to different destinations—an instance of physical or geographical aggregation.

Another critical aspect is deciding whether to use distribution centres or send items directly to customers, a choice that should be guided by data. If there is substantial demand in proximity to a distribution centre, items are moved to these centres, allowing customers to pull from them. Amazon's approach during the COVID-19 pandemic serves as a prime example. They acquired numerous small stores that were closing down and repurposed them as distribution centres, situated in close proximity to residential areas. This strategy was informed by data insights indicating a preference for fast delivery. However, such decisions require extensive calculations and analyses to determine how they should be executed optimally.

Optimising Distribution Centre Operations

The role of distribution centres varies; some serve as storage facilities, while others primarily function as sorting centres, a concept known as cross-docking. FedEx is a notable example of a company that employs cross-docking, where items are sorted and routed for onward delivery without storage. Optimising these processes involves considering multiple variables, including the choice of a distribution centre's storage or non-storage function.

Supply Chain Cost Optimisation

It is crucial to note that these decisions should not merely revolve around minimising transportation costs but should extend to the overarching goal of reducing supply chain costs holistically. In achieving this, data-driven insights and mathematical models provide valuable guidance. The mathematical aspects of these calculations are well-supported by advanced tools, but the foundation of these decisions lies in the collection and analysis of relevant data. This data-centric mindset forms the cornerstone of effective supply chain optimisation, ensuring that decisions are made with a focus on overall cost efficiency.

Role of IT in Transportation

Incorporating Information Technology (IT) in the domain of transportation and supply chain management offers an array of possibilities. It can be utilised for optimal route identification, efficient fleet utilisation and data collection via GPS, among various other applications. In practice, aligning transportation strategy with the broader competitive strategy is a critical aspect. This necessitates a comprehensive examination of in-house and outsourced transportation options. Furthermore, harnessing technology to enhance transportation performance and building flexibility into the transportation network are pivotal considerations.

IT for Transportation and Supply Chain Management

- **South American Central Bank's Currency Supply Chain**
  In Mexico, the central bank delivers new currency notes to local banks, which subsequently disburse them to customers. Additionally, they manage the return of unfit notes to the central bank. A rather unconventional approach in Mexico involves the use of "decoy trucks." These decoy trucks travel in tandem with cash-carrying vehicles, but their contents—whether cash or police—remain unknown to potential robbers.
  The optimisation task entailed collecting data to determine the required number of decoy trucks in specific areas. By analysing historical robbery data and factoring in demand data, the optimal routes for each of these vehicles could be devised. An intriguing aspect lay in determining the cash truck's capacity in Mexico, which is based on the total face value of the currency.
  This differs from the methods used in the US and the UK, where physical space and ink deployment are employed to deter theft, respectively.

- **US Coin Supply Chain Optimisation**
  The coin supply chain had to be optimised for the Federal Reserve in the United States. The unique aspect here is the distinctive structure of the coin supply chain compared to currency notes. With structural disparities come the need for a fresh data collection exercise and an entirely new optimisation approach. Data aggregation, supply chain optimisation, and route planning remain key components of this endeavour.

In both cases, a crucial starting point was the comprehensive collection of data. This foundational step allowed the adoption of a supply chain perspective aimed at minimising overall supply chain costs. Identifying the underlying structure of the supply chain and subsequently optimising each component followed suit. By adhering to this view and creating systems accordingly, substantial progress can be achieved in supply chain optimisation and efficiency. Achieving these goals hinges on harnessing new technology for data collection and optimal solution finding. The synthesis of data analytics and decision analytics emerges as pivotal to this process.