DIGITAL THREAD FOR RETAIL LOGISTICS

LOGISTICS MAKES THE RETAIL BUSINESS

History has shown again and again that decisions on supply chains can make or break a billion-dollar business. When Dell switched to a low inventory model and accepted the hit on small load deliveries, it dethroned the much more established Compact who was loaded down with obsolescence cost every time the PC technology upgraded. Supply chain management also is what allowed Walmart to overtake their behemoth competitor Kmart. Walmart invested heavily in customer satisfaction and cost reduction instead of flashy marketing. Verizon staved off competition on cell phones sales by experimenting with the pull vs push inventory / delivery model. With the right mix of the two distribution modes, Verizon reduced their inventory write off from $2B to $1B. They were so successful in this supply chain innovation, competitors all followed suit soon afterwards.

Besides supply chain strategy being the core part of business competitiveness, the recent COVID triggered disruptions further highlighted the importance of transparency and predictability of the supply chain operations for any whole sellers of goods. Gigantic tankers are docked at key ports for months waiting to offload their load, simply because empty containers are not being returned. In 2021, supply chain disruptions cost the world an average of $184 million. The world learned a painful lesson in the need for resilience in the global supply chain.
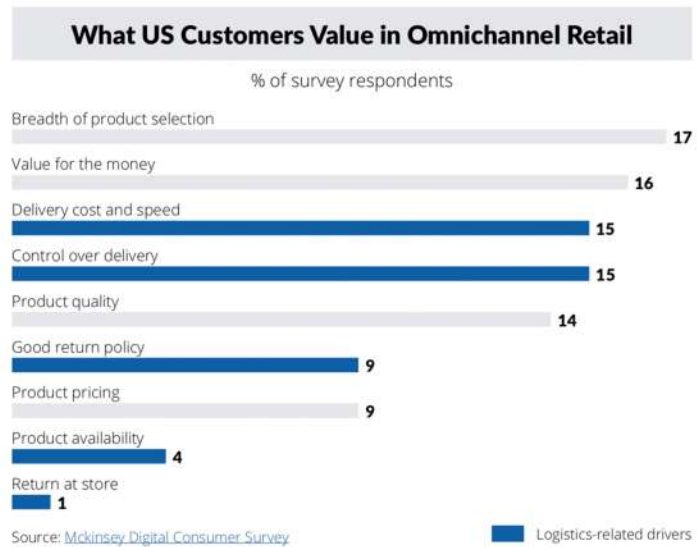

OMNI CHANNEL FULFILLMENT

The pandemic changed shopper behavior in a significant way. Online shopping rose sharply during the lockdown, but the trend continues post-pandemic. Retail eCommerce is expected to reach $503B in 2022. In this new environment, retailers must fulfill orders coming from a multitude of sales channels (Omni channel user experience is another major topic for retailers to explore). Omnichannel fulfillment aims for a unified strategy for inventory management and order processing from all types of sales channels.

Retailers must first streamline their fulfillment process, and further remain keenly aware of consumer expectations in the digital / mobile environment. Consumers are known to back out of shopping baskets as soon as they see a shipping cost added. Yet, they expect the same speed as well as convenience on mode of delivery and return. Furthermore, a study has shown that, across generations, shoppers are looking for brands that offer both digital and physical channels. The comprehensive

list of delivery capabilities includes same-day, buy online but pick up at store, in store order but shipped from warehouse (Verizon model led the way), etc. The simultaneous demand of low cost, accurate and on time delivery requires smart control, insightful forecast, and even automation around warehouse, distribution, inventory, packing and shipping operations on the part of the retail organization. They need an integrated ecosystem, data transparency and intelligent simulations.

A single order of a refrigerator through any eCommerce channel can trigger any number of fulfillment transactions. The vendor can ship out a full trailer or a Less Than TruckLoad (LTL), or put it on a plane today and go final mile delivery the next day, or ship it out FedEx on a pallet. Making decisions like that requires having updated information on item origination, shippers' capacity, historical reliability, geographical and climate support information, and in some cases, the customer's purchase records. Whoever has the best logistics decision support system can make the best choice and run the most efficient operations.

What US Customers Value in Omnichannel Retail

% of survey respondents

Breadth of product selection	17
Value for the money	16
Delivery cost and speed	15
Control over delivery	15
Product quality	14
Good return policy	9
Product pricing	9
Product availability	4
Return at store	1

Source: Mckinsey Digital Consumer Survey — ▮ Logistics-related drivers

DIGITAL TWIN COMING OF AGE

Forward looking retailers invest into the Digital Twin (Dtw) technology to gain visibility into inventory, real-time access to partner data, transparency into the entire supply chain, and guidance into future challenges or issues by means of AI and simulations. Predictive analytics and digital warehouse technology can provide direction at the first sign of disruption.

Digital Twin technology allows us to interact with the virtual counterpart of a physical product or infrastructure, much like the real thing, even inside 3D surroundings.

They help companies design, visualize, monitor, and maintain assets, optimize services offerings and generate insights from operational data. All eyes are on seeing the adoption of digital twins across the value chain to support more accurate decisions and improve logistic operations. IoT sensors already a standard part of the logistics industry, feed the digital twin with real time data from individual assets and shipments. Events occurring on the physical objects are reflected in the digital model, and insights extracted from the digital model leads to decisions for controlling the physical instance.

LOGISTICS INTELLIGENCE

Many parts of the logistics industry can readily benefit from the adoption of digital twins, with some notable success stories already reported such as sensors added to track shipments, machinery, and material handling equipment. The industry also increasingly embraces open API and cloud computing, which are requisite underlying technologies. Machine learning based on historical and operational data are on the rise. Augmented reality devices are also making appearances for tasks like warehouse picking and truck loading.

With falling prices and increasing maturity of the digital twin technology, the time is ripe for industry leading firms to take a serious look at incorporating its capabilities to sharpen their competitiveness and thrive against the constant threat of Amazon's advance into everything retail.

In the area of containers and packaging, for example, the volatile demands and packaging varieties of eCommerce produces significant waste in volume utilization. Management of reusable containers means not only tracking their movements but also damages and contaminations. Here 3D photography contributes by identifying dents and cracks. A digital model which monitors the level of damages over time can be used to generate an accurate repair or retirement schedule. At the fleet level, it helps management figure out sizing and distribution. When studied statistically, damage reports can even be fed back to container design to improve its lifecycle.

Shipment items in each container can also be modeled with the help of 3D scanning and computer vision. The container and item data together can be used to automate packaging selection and optimize utilization.

For high value products such pharmaceutical and electronics, the packaging includes temperature, shock and vibration sensors which are continuously monitored throughout the transportation journey. A digital twin with sophisticated logic is the best mechanism for retaining the details of the product's treatment and even a real time assessment for its safe delivery. Additional insights can be generated by modeling the effect of external impacts on thermal insulation and shock absorption.

The digital twin can create a 3D model of the entire warehouse or loading dock, with information on size, location and capacity. Modern warehouse management system (WMS) has sensors placed in products, pallets, containers, and warehouse space. It can receive real time updates of item and personnel movement from various automation equipment already commonly found in a warehouse, including stock counting drones, goods to person picking systems, automated retrieval equipment, etc. Simulation models can both optimize operational efficiency of the current facility configuration, but also recommend new layouts or equipment that can further improve the overall performance, such as reduction of energy consumption or average distance walked by human staff.

A digital twin can also feed AR headsets, which enhance personnel productivity by automating new staff training or aiding in identifying product attributes to match picking equipment, avoiding potential damage to items and injury to warehouse staff. This also allows earlier determination of operator strength in a hiring situation.

Component inbound is another area severely impacted with the scattered customer demand pattern. The products are now both customized and increasingly complex. This translates to greater component variants in a lot of one assembly. To maintain on time delivery and avoid cost escalation in this new challenging manufacturing environment, businesses need to make smart choices on supplier location, capacity as well as transport options. Transport pooling across suppliers, for example, could be the solution to frequent deliveries of small quantities. Demand forecast data derived from digital twins will be a key to managing this part of the logistic challenge.

DIGITAL TRANSFORMATION TO ACHIEVE RESILIENCY

Digital twins can be created for every part of the supply chain, across partner domains, and the connection of these twins forms a digital thread (DTh), a comprehensive, cradle-to-grave view of the product or process. The digital thread provides information transparency which can be the key to supply chain resiliency in a global catastrophic event such as the COVID-19 pandemic.

In this scenario, vendors would share their factory reports, production planning, material allocation, staff scheduling, etc. A transportation company would provide visibility into route planning, truck loading and transit information. An eSales agency would open up its demand forecast from the CRM. These relationships form a virtual supply chain ecosystem, offering maximum transparency in times of uncertainty. Simulation models derived from the data would yield alternative scenarios for complete manufacturing goals in times of disruption and inject operational flexibility on a day-to-day basis.

Imagine a nightmarish situation when a manufacturer faces the possibility of a product recall. The worst-case scenario would involve a comprehensive list of millions of deployed units, causing irreparable damage to the brand, as well as steep financial cost in fines. A well-designed digital thread, complete with BOM, models, specifications, sourcing batch id, machinery logs, even staff responsible for processing, can quickly pinpoint the root cause, narrowing down both the collection of affected units as well as a targeted, limited scope fix.

Digital threads create a two-way communication along the design, manufacturing, logistics, sales value chain. The information exchanged amounts to a digital product definition, which speeds up change management, eliminates confusion and ensures a single copy of truth. From a sustainability point of view, sharing of information between partners provides a holistic view of their environment footprint.

CONCLUSION

Digital Twin and Digital Thread are emerging technologies that promise to bring in a new age in logistic excellence. From AR guided box locating, to truck utilization, to last mile logistics, companies who invest in these transformational technologies will be the winners of the hyper customization game in the eCommerce reality. Those who master the underlying technologies, IoT, Cloud computing, machine learning, simulation, and big data are the designated architects who will deliver such a vision.

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