AUTOMOTIVE MANUFACTURING 360 AND DIGITAL TRANSFORMATION

Car sales used to be a game of brawn. It's largely the perception of power, speed, and reliability, perhaps followed by style and features which defines an automotive brand. However, we are witnessing a rapid shift in market dynamics where car buyers are moving online and expecting the same premium shopping experience that retailers in general offer them.

Brand loyalty is now earned through the same guiding forces of the experience economy. It is about mass customization, omni channel navigation, the thrill of extended reality, and a memorable car buying and owning experience.

THE CAR BUSINESS UNDER THE DIRECT SALES MODEL

From Google search trends, it is estimated that 60 percent of car buyers under the age of 45 are looking to purchase their next car online and prefer contactless sales and services. Latching onto this momentum, Tesla leads the charge in experimenting with direct sales with an under 10 clicks ordering process– elimination price haggling. China's NIO soon follows suit with both leading the way for customer-centric service offering such as one click battery charging, or renting one on a monthly basis.

World class brands everywhere are jumping on the bandwagon. BMW is testing its agency model in South Africa, and Daimer doing the same in Sweden–shooting for complete transparency and control over stock levels, order intakes, and transaction prices. Daimer is expanding the model to Austria and Germany; following the initial COVID era success in Sweden. The Volkswagen group pitched in with its own version of the agency model for the ID3 launch in Germany.

With this new sales model, manufacturers face a number of challenges in the areas of customer experience, new partnership relations, pressure on flexible manufacturing, reconfiguration of supply chain, and the creation of a digital platform for vehicle development with emphasis on simulation and machine learning.

CONSUMER EXPERIENCE

In the era of electric vehicles (EV), consumers are not looking for just a sturdy car, but years of fabulous services in the next few years of ownership. They expect a speedy, smart device which informs, entertains, and connects them while improving in intensity with every upgrade. It is a fashion / lifestyle statement to buy into a new model– an identification with an enthusiast community.

While buyers can now do their car shopping from home on the digital showroom, contact centers can offer an even more immersive experience with extended reality technology simulating the test drive down the pacific highway. This has all the latest entertainment gadgets as well as allowing customers to play with all the option features such as top down, wishbone suspensions, lane drift detection, and the heads up display.

The car brands who know their customers will capture the hearts and minds of the next generation drivers. Taking ownership of customers from traditional dealerships means investing into a comprehensive CRM capable of a 360 degree view of each buyer including buying history, financial records, behavior, opinions, and preferences expressed. This CRM would have to be a system which continues to learn about each customer with every interaction at any touch point.

A complete profile drives advanced analytics which enables personalization of the car model configuration and on-board service offerings. A buyer enamored with the personal touch will in turn reward the brand with loyalty, and be happy to divulge even more insights on taste and preferences in a virtuous cycle.

AGENCY MODEL

Instead of jumping head first into a full direct sales model, most car companies are converting their existing dealerships into intermediary agents with the intention of leveraging their stores, distribution channels, and regional knowledge.

The switch from dealership to an agency model presents disruptive risks as much as opportunities.

It tantamounts to a redesign of the sales journey. A car manufacturer must reassess, redefine, and reconstruct its operational flow as well as realign the legal contract and compliance framework with the customers, warehouses, and logistic vendors. In short, just about the entire supply chain. Manufacturers and agents must engage in perpetual discussions to resolve inventory and pricing issues. The headquarter is now assuming supply chain management, customer complaints, and payment handling directly.

What would really mitigate the challenges in change management is having complete transparency over the entire supply chain logistics with the ability to collect real time operational data, and proactively forecast disruptions and avert breakdowns.

In this regard, digital twins and digital threads are made to order technologies to implement the new supply-chain operation.

A digital twin (DTw) is commonly known as a digital replica of a physical product. However, it is also valuable for simulating a business process such as supply chain operations. In particular, digital twins can represent the storage capacities, material flows, and inventory items down to stock picking machineries in a warehouse. Transportation twins can receive real time updates as to the location, road conditions, vehicle health, etc. of a cargo ship, plane, or truck in transit. Post sale, a vehicle running on the road can be continuously monitored with its twin instance on the corporate cloud– predicting potential component failures.

Digital twins and digital threads are the ideal solutions to the rapid ramp up of a new logistics network, achieving the necessary transparency in the drastically restructured supply chain as car manufacturers adopt the direct sales model, and rely on efficient order and fulfillment information sharing with its agencies.

A digital thread (DTh) on the other hand interconnects all the digital twins in a network throughout a car's product life cycle. At its foundation, a DTh is a two way communication framework which facilitates the exchange of a digital product definition and bridges information silos. This enables the dealer network to preview supply capacity and advertise relevant features for customers. Since the dealers / agents are the ones interacting with customers, they are the best ones to forecast demands to the production line.

IMPLICATION ON MANUFACTURING

Changing consumer demands in favor of premium features and leading edge innovations in concert with expectations of quicker time to market are driving manufacturers to accelerate their design to production cycle. Mass customization forces factories to push the limit of small lot size productions using component rationalization and optimized floor layout and material flow. Companies are dealing with ever increasing complexity by leveraging comprehensive digitization, such as smart factories and digital twins, and other innovations collectively known as industry 4.0

DIGITAL TRANSFORMATION

Central to this new strategy is the use of a digital twin to replicate the physical product. The digital twin can come into being even before the physical version becomes a reality. Right off the designer's CAD system, a digital twin can already capture important design parameters to serve as simulation inputs and to be shared with downstream productions work. As the product creation process proceeds, more and more attributes are added onto its twin. When the physical product finally becomes deployed and ends up in the customer's hands, the digital twin gets frequent updates with operational conditions and is the basis for predictive maintenance efforts– leading to a closed-loop system which improves future product design.

The digital twin, or sometimes referred to as the digital product definition, encompasses CAD files, BOM, approval documents, engineering and assembly drawings, simulation outputs, and any derived artifacts from MES, MRP, ERP, CRM, and any other supporting system of records. The digital thread in term facilitates the communication of the definition between design and manufacturing. In the factory, the product specification serves to configure the shop floor, program machineries, and schedule staff in the feedforward cycle. In the reverse direction, manufacturing simulation can be provided to the designer to make the most optimal design choices to improve manufacturability. Further downstream, production managers need visibility to supplier capabilities, logistic constraints, raw material availability, etc, to do accurate planning.

To enable all these communication channels, all the stakeholders must have access to the needed information in a format they can comprehend and be assured of its accuracy. A design change, whether initiated from the CAD desk or shop floor, must be efficiently validated and approved by all affected parties so that the versions are tightly controlled by a unified distribution with one copy of truth.

Each digital twin schema is designed with one particular purpose in mind such as simulation, operational monitoring, material lightweighting, etc. However, the creation of a digital twin is more likely to benefit from having a digital thread than the other way around. This is because the digital twin is only useful if it is multi-faceted.

For example, in case of a product recall the traceability built into a digital twin allows the investigator to quickly identify the root cause and pick out all the product instances that are affected by the particular faulty component or an off-spec machining step. However, this is only possible if the twin was designed to reference the component version, approval stages, testing results, repair history, sourcing information, and relevant manufacturing steps. An established digital thread is what allows the twin to not only first gather the parameters, but also continue getting updated.

SMART FACTORY

Industry 4.0 (I4.0) has emerged as the leading industrialization concept that exploits many of the latest advancements in software technology, including IoT, big data, cloud computing, and extended reality. Smart Factory became the focal theme for integrating these technologies to improve efficiency, flexibility, and transparency of the manufacturing process. The smart factory is context aware to support operations of the physical items with software simulation.

Smart factory embraces modularity to respond to rapidly changing customer requirements. It leverages the digital thread to achieve high interoperability among network vendors, on the merit of an enterprise wide supported ontology. Operational units in a smart factory make autonomous decisions to adjust to changes of individual orders while remaining compliant to the overall organizational goal. There is increasing reliance on virtualization in terms of monitoring, simulation, and extended reality. Shop floor operators can replace protective goggles with VR headsets to superimpose proper material handling instructions over the actual fabrication system– both for quality control and new hire training.

The overarching theme of the experience economy is selling services instead of products. Factories in the coming age will identify their unique value proposition in a collaborative ecosystem, outsourcing many of its functions and concentrate on innovating its core process, with the internet acting as the medium for service exchanges.

Real time response is an idealized smart factory capability. The system responds to major changes in production planning due to customer demand, machine down time, etc, by means of internal reconfiguration or external cooperation. The new plan is first verified with digital twin based simulation and continues to be monitored in real-time during execution.

ADVANCED ANALYTICS

Car OEM's already have an enviable amount of data: embedded sensors, digital apps, financial transactions, personalization requests, etc. With the direct sales model, they also take ownership of the CRM which integrates customer data across all the touch points from contact centers, dealerships, and inside the car. Such a rich collection yields a customer 360 view of the car buyers with their style preferences, shopping habits, purchasing power, and relevant behavior patterns. AI can convert such data into precise insights to guide marketing campaigns and tailor customized contents.

Machine learning can be applied to logistics data to simulate various manufacturing and fulfillment scenarios to optimize shipment routing or circumvent potential disruptions. These simulations enable the kind of reconfiguration on the fly adjustments discussed above for both supply chain and manufacturing tasks.

Post sales, predictive maintenance of car components is growing in adoption. There is a huge upside in assisting mechanics accurately troubleshoot warning lights, as well as proactively repair parts that would otherwise break down on the road– causing great anxiety to the owner. Such models further yield valuable data as to the mechanisms of failure which the design team can use to improve future products.

Simulation also makes possible the testing of virtual prototypes and allows designer engineers to optimize minute details, perform functional tests, and go through a full gambit of "what if" scenarios before committing to the much more expensive step of making a physical copy. This is all part of thinking in digital twins and migrating towards a smart factory.

CONCLUSION

Automotive manufacturers are facing a new market reality where car buyers are expecting the same digital experience that prevails in every other industry. They are increasingly demanding a personalized treatment and rich feature menu, but expect no compromise on price and delivery.

In this new market condition, car brands must embrace the principles of the experience economy and move aggressively towards a flexible manufacturing model that supports a small lot size production mode.

BigRio brings the technical expertise for implementing I4.0 level digital transformation. We specialize in all the requisite technologies including cloud computing, data integration, petabyte scale data warehousing, application development, IoT, advanced analytics and AI.

Our track record in automotive predictive maintenance was pioneering in its approach. The level of success reached the highest level of recognition at our client company who is a globally renowned car brand.

We aim to deliver digital twin based solutions to more auto companies to help push them into the direct sales model and premium car owning experience. For more information write to us at info@bigr.io